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NATURE

"To the solid ground
Of nature trusts the Mind that builds for aye."—Wordsworth

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Religion—a Changing Force?

IT will always be a paradox that the gentlest and most lovable character in the whole of the recorded history of mankind should not only be the source of such bitterness and hatred as mark the story of Christianity, but also that He Himself should have been fully aware that the consequences of His teaching would constantly be averse from the spirit of His doctrine. Of all the utterances of Our Lord, that which displays most clearly His insight into the heart of man, and has been most completely fulfilled, is the declaration that he brought into the world not peace, but a sword. Not only did He knowingly set up insurmountable barriers between those who followed Him and their families, friends and fellows in the community, but also when He turned from the Jews to send the seventy disciples on their mission to the world, He informed His religion with an inflexible will to the conversion of the heathen—in other words, of those not of like belief—which in its methods and its results has belied the promise to mankind of peace and goodwill.

Too often in its history, the missioner of Christianity has been of the type of the inquisitor and the conquistador; the fate of its converts a degradation and an extinction no less complete in its results, if less drastic in its methods, than the fate which overtook so many of the Indians of Mexico and Peru. Not indeed that Christianity here stands alone. The first great tragedy of Calvary was a prelude to the beasts of Ephesus, the spectacular slaughters, the crucifixions and the pyres of Rome. If that tragedy was re-enacted time and again in the sectarian quarrels of European civilization through the ages, elsewhere, to name one instance only, the Moslem world enlarged the circle of the Faithful by the persuasion of fire and sword.

A post-War generation, weary of strife, in its desire to build "a brave new world", would have consigned all such antagonisms to the limbo of errors and absurdities of an outworn dispensation. Frank and open discussion of differences, and co-operation, despite these differences, of all of good-will in the promotion of common aims, were to take the place of sectional rivalries and obstructions. Leagues of intellectual co-operation, and international conferences and congresses sprang up on all sides to discuss and deal with every kind of problem which stood in the way of the advancement of mankind—moral, intellectual and social. The events of more recent years have brought a bitter disillusionment to those who thought that Armageddon had passed and the millennium was due to arrive.

The present, however, is no time for pessimism; and least of all does it befit science either to belittle what has been effected by co-operative effort since the War—and the sum total is by no means negligible as the record of the non-political activities of the League of Nations can show—or to despair of the endeavour which is being made to keep open some of the ways to interchange of thought and mutual assistance, at a time when differences of outlook and tradition are being emphasized and barriers of mistrust are being re-erected. There are still matters of universal significance for mankind in which the co-operation of all may be invited, if indeed it be not essential.

Yet, however strong the conviction that a sturdy, and at times dogged, optimism is the only creed for the man of science, as well as a necessary condition of constant progress in the understanding of Nature and the universe, there are whole departments of thought, with their corollaries in human conduct and affairs, from which the principle of universality, which is a condition of world-wide co-operation, seems to be excluded. Co-operation rests, ultimately, on a truth which, in a scientific sense, is universal—in fact, a 'law'. This is the ultimate principle, whether in dealing with the suppression of the drug traffic or with 'sanctions'. But in the field of religious beliefs, on a detached view, truth is relative to the object of belief, and departmental. The code of thought, and its materialization in action, which befits the Buddhist, cannot be reconciled with that of the Christian, however near their approach.

More than passing interest, therefore, will be aroused in many not directly concerned, and irrespective of religious belief, by the announcement that during the early half of the month of July representatives of the more important religions of the world are gathering in London at a World Congress of Faiths for the discussion of "World Fellowship" as a way to the solution of world problems—the problems of war and of social and economic difficulties, which seem inevitably to lead to disaster. Neither the validity nor the possibility of fusion of the religions represented will be under consideration; but each religion is invited to consider how, maintaining its individuality, it can best contribute to the common end.

The organization of the Congress, which opened on July 3, fully maintains the claim that it is both international and inter-religious. The international president is H.H. the Maharaja Gaekwar of Baroda, and the chairman of the British National Council is Sir Francis Younghusband. The chairmen, speakers and openers of debate at sessional meetings have been selected with strict impartiality for their ability to further discussion, without preference of creed. For the attainment of what may be taken to be the more general purpose of the Congress, the dissemination over the widest possible field of a knowledge of the varied lines of approach to the major problems of existence among different peoples and creeds, the greatest importance must be attached to the series of public meetings at which distinguished members of the Christian, Jewish, Buddhist, Hindu and Moslem religions, as well as of independent thought, will expound their respective conceptions of "The Supreme Spiritual Ideal".

To bring together representatives of these different faiths, some of which, it might be thought, would mix as readily as oil and water, for the discussion of such a topic as "world-fellowship" is in itself no mean accomplishment. It does at least lend some colour to the expectation of a not entirely unfavourable answer to the inevitable question, whether any practical outcome is to be anticipated from this attempt to secure co-operation among the more liberal spirits of the various religious beliefs in the solution of world problems.

In view of the past history of religious animosities, the whole project may seem Utopian, the forlorn hope of enthusiasm. Has the time really come when the lion will lie down with the lamb? Have these religious differences been composed, and is the *odium theologicum* a thing of the past? Perhaps we may construe current events as a turn in the tide. In the Education Bill which has now passed through Parliament, for example, we seem to be entering upon the final phase in a settlement of a denominational religious difference which has been an obstacle to progress in popular education for well over a hundred years, and a source of social disintegration for three times that period. The Church of England, it is true, failed to reach a satisfactory conclusion in its overtures to the Orthodox Church; but in other directions, as for example, recently in Finland, it has been more successful. Do these movements and others of a like character point to a weakening of the religious fibre, manifested in a lessening of the spirit of aggression, or do they represent a further stage in progress towards a higher development of religious activity?

To attempt an answer would involve a combination of prophecy and analysis which would be neither profitable nor appropriate here. This much, however, may be said. Religion as a social phenomenon, and not as an individual experience, as the student of religions well knows, is a sublimation of group solidarity. In a supreme self-protective effort it either proselytizes, expels, or exterminates: hence missionary effort and persecution, on the principle that he who is not for is against. This lies at the root of the quarrel of Nazi nationalism, a quasi-religious emotion, and the Confessionals in Germany, just as it inspires the persecution of the Jews. The Old Testament expresses it repeatedly in the reliance of the Hebrews on Jehovah, the god of battles, as the exclusive protector of the Chosen People.

To some extent at the present time this particularist spirit of self-protection has been diverted into the channel of nationalism. More potent, however, is the fact that an ever-increasing number, appealing in the conditions of modern civilization to a widening circle, is not content to rest in the particular, but must pass on to the universal. To such, neither restrictions of national distinction nor differences between creeds can weigh in the balance against the ethical principles explicit or implied in all the higher forms of religion. In this composite but practical creed, analogous to the *jus gentium* of the legists, it may be that they are feeling their way towards a further and higher stage in the development of religious belief, in which the theological differences which antagonize will be forgotten in the pursuit of a common and universal ethical purpose.

Colonial Policy and Scientific Research

MR. ORMSBY-GORE has lost no time on taking up his duties as Secretary of State for the Colonies, in making clear his personal position in relation to a variety of problems with which he is confronted in colonial administration, and more particularly to the need for the active prosecution of research with a view to future development.

An address which he delivered recently, when presiding at the thirty-fifth annual Colonial Service dinner of the Corona Club, was broadcast, and was no doubt consciously directed to reach a wider public than his immediate audience. It will go far to allay some not unjustifiable feelings of uneasiness as to future developments, which for some time have disturbed informed opinion both at home and in the Dependencies. While Mr. Ormsby-Gore deprecated the discussions, in which the possibility of future sessions of territory had been debated, as likely to do more harm than good, he was emphatic in endorsing "the very clear statements" of the Prime Minister and of his predecessor in office, referring specifically among other dependencies to Tanganyika Territory. "Peace," he went on to say, "continuity of policy, social progress, and economic development are the greatest needs of the Colonial Empire."

With this all will agree, although there may be difference of opinion as to the best means by which they are to be attained. It is significant, however, of the confidence inspired by Mr. Ormsby-Gore's appointment, that it has made optimistic even so sturdy a champion of the white settlers' claims in Kenya as Lord Frederick Scott, who, as he told the East African group of the Overseas League on June 18, sees hope for the future in the appointment of "a new Secretary of State for the Colonies, who knew East Africa, and had written . . . the best of all reports on East Africa".

While Mr. Ormsby-Gore is fully alive to the part which has been played, and must continue to be played, by the study of native institutions in their bearing on the further development of the native, there are two matters to which he directed attention as problems of public health confronting the Colonial Governments. Of these the first is the application of the newer scientific knowledge of nutrition. Mental and physical efficiency, as well as resistance to disease, he pointed out, are tremendously affected by nutrition; and he is not satisfied that the problems of nutrition have been adequately studied and the results applied in our tropical dependencies. After a reference to the generous offer of the Rockefeller Foundation to establish a special organisation in Uganda for the study of yellow fever, he spoke of the benefactions received by many Colonies from the Carnegie Corporation of New York, particularly in connexion with education, social services and libraries.

It is especially satisfactory to hear that Mr. Ormsby-Gore intends to devote his personal attention to the application of science to Colonial problems of agricultural development and public health, and to watch with a vigilant eye the work of the education departments throughout the Colonies. In this connexion it may not be inopportune to note that Lord Linlithgow, Viceroy of India, in addressing the opening meeting of the Advisory Committee of Nutrition under the Indian Research Fund Association at Simla on June 18, referred to the relationship of improvement in sanitation, hygiene and nutrition among the rural population to literacy among the women: "In default of female literacy," he said, "it will be found that, whenever supervision is removed, there will be a relapse into age-old customs, and that within a few months nothing will be left of the better living that has been so laboriously inculcated." The experience of India in the past ten years may not be without its lessons for the colonial administrator.

Land-Reclamation in Italy

Land-Reclamation in Italy:
Rural Revival in the Building of a Nation. By Cesare Longobardi. Translated from the Italian by Olivia Rossetti Agresti. Pp. xii+243+29 plates. (London: P. S. King and Son, Ltd., 1936.) 12*s*. 6*d*. net.

ONE of the achievements of which Fascism can unreservedly be proud is the reclamation of great areas of land in Italy that for centuries had added little or nothing to the national wealth, and indeed had frequently, like the Pontine Marshes, been dangerous to human beings owing to the widespread prevalence of malaria. Waste land can be found in all countries, even in our own, densely populated as it is; it escaped enclosure in the old days because it could not be cultivated by the methods then in use. Considerable areas are, however, amenable to modern methods of cultivation, though the cost of reclamation might be too high to permit an economical return on the money expended. For this reason land-reclamation is scarcely proceeding at all in England, though occasionally private individuals embark on the enterprise out of sheer love of the work. In Holland the great Zuyder Zee scheme is being financed by the Government, but it is regarded not as a financial but as a social investment, to provide land on to which the growing population may spread. In the western European countries the problem is complicated by the many private rights which, though long in abeyance, may burst into vitality as soon as there is any suggestion of the land being developed or taken over for public purposes. In countries ruled by a dictator as in Italy and Russia, such questions do not arise, and land-reclamation becomes simply a technical problem which can be carried out regardless of cost.

One of the greatest of the Italian schemes was described by Dr. Roberto Almagia in NATURE of June 15, 1935. There he shows how the great Pontine Marshes have been converted from malarial swamps into good farming land. The present writer visited this region in April 1934 and was greatly impressed with the efficiency of the work and the adequacy of the houses and farm buildings. Hitherto it has been difficult for English experts to obtain information on the many administrative and financial problems involved. These are satisfactorily dealt with by Señor Cesare Longobardi, so that we now have a full account of the procedure and some statement of the cost of the work.

Reclamation has progressed rapidly since the Fascists came into power. In their first years of office, some 5,000,000 man days were given to this work; in 1933–34, their twelfth year of office, this had increased to nearly 18,000,000 man days. Some 4·7 million hectares are already in hand or completed, and marked increases in output of agricultural produce have already been obtained. The production of wheat, which before the War was less than 5,000,000 metric tons per annum, has risen to nearly 7,000,000 tons; net imports of wheat, formerly 1·4 million tons per annum, fell in 1934 to 235,700 tons only.

The Italian reclamation schemes extend also to the land which, though cultivated, is not properly utilized, especially to the well-known latifundia, agricultural properties on which farming is extremely primitive and extensive, where the farms form "a compact mass untraversed by roads, with no water system, infested by malaria, with hardly any permanent inhabitants". The latifundia are associated with what is known as the 'Southern Question', the group of problems arising out of the backward economic and social development of the south of Italy and the islands as compared with other parts of the country.

The general machinery for the reclamation is prescribed by the Mussolini Act which characteristically, as the author states, "does not lose itself in the maze of existing measures It leaves them as they are and goes straight forward". It makes financial provision over a period of fourteen years for work amounting to 7,000,000,000 lire; it directs special attention to works nearing completion; and it opens the way for further developments which experience may suggest. Of the 7,000,000,000 lire, 4,300,000,000 was to be chargeable to the Treasury and the remainder to the land owners. The major part of the finance is provided in the form of 30-year annuities discounted to the parties concerned by several different institutions. The whole of the money has already been taken up, but there still remains much work to be done.

The author states that the Act was received with great enthusiasm by the whole country. The projects submitted would have cost in the aggregate ten or fifteen times the amount available, and therefore rigid selection had to be exercised. The rights of the owners were in principal acknowledged, and, where curtailed, were said to be adequately but not excessively compensated. Preference was given for the execution of the work by consortia of landowners or public bodies, which appear to be something like the public utility societies of Great Britain. This method avoided the danger of supplanting private initiative by State intervention; at the same time it prevented the work from stopping directly the Government had fulfilled its part of the contract and before the landowners had completed theirs. The procedure is dealt with at considerable length. A special section of the Ministry of Agriculture deals with land-reclamation, and receives proposals or itself draws up plans. No project is accepted unless it shows considerable possibility of securing notable improvements in hygiene, demographic, economic and social conditions.

The plan being accepted by the Government, the landowners proceed to execute the works either themselves or through the consortium. They may provide all the money themselves or obtain Government grants or special loans from the agricultural banks. The arrangements seem to be very elastic. A very active body, however, is the National League of Ex-Service Men (Opera Nazionale per i Combattenti), whose name one sees painted up on the buildings in many of these reclaimed areas. The League has special privileges, and can demand the expropriation of landowners even if they are ready to reclaim the land. Whatever is reclaimed by the League is used for small holdings on which ex-Service men or their families are settled. Mussolini attaches great importance to this body as being, in his own words, "mobilised to perform a task with the urgency of which I am more than ever impressed, that of ruralising Italy". When the reclamation is completed, some internal migration and land settlement become necessary; a special commissariat exists to organise this. The migrants are mainly farm workers brought from more densely settled regions; in 1933, for example, some 15,000 farm workers were moved but only 500 industrial workers.

Economic law, however, still seems to operate to some extent in Italy, for we are told that the serious fall in prices of farm products after 1929 made it impossible for the landowners in some years to meet their share of the cost, and consequently Government help had to be given. The portion of the costs chargeable to the landowners is divided between them in proportion to the advantage accruing to each as a result of the work. It is impossible to ascertain this precisely beforehand, hence a provisional apportionment is made and adjusted when reclamation is completed. The credit is held against each landowner by the consortium in the form of 30-year annuities, which rank as a charge on the land immediately after the land tax and the provincial and municipal surtaxes. As the landowners themselves were unable to pay the necessary money, various banks were established for the purpose of enabling them to do so.

Considerable details are given in regard to the larger schemes. The great Pontine Marsh is cut up into holdings of 25–75 acres according to the quality of the land, each furnished with a house, stabling for ten cattle, poultry run, pig sty, well, etc. The Ex-Service Men's League has obtained grants for the settlement of some 100,000 acres. Families are brought by the Commissariat for Internal Migrations; as they have no capital, the farms are taken from the League on a crop-sharing plan, the tenants receiving monthly advances in the shape of supplies and cash allowances from the League, which directs the management of the farm. When the head of the family has acquired the necessary experience and has returned the advances made by the League, an agreement is to be drawn up under which he will purchase the farm and the livestock from the League in fifteen annual instalments covering capital and interest at the official bank rate. The farms are grouped in batches of 130, around one of the three new towns, Littoria, Sabaudia and Pontinia. An expert adviser is available. The cost of the scheme is estimated at 7,000–25,000 lire per hectare; the purchase money therefore amounts to annual payments for fifteen years of sums varying from 200 to 630 lire per hectare, in addition to an annual payment of 70 lire per hectare as cost of upkeep and amortisation of the drainage works. These repayments, however, do not cover the Government contribution, but only that made by the concessionaires. No mention is made as to how the Government share is to be recouped. There is a similar, but somewhat smaller, reclamation scheme in the lower Piave region running towards the Adriatic, and others on the Brisighella in the Lower Apennines, the Sele Plain, the Tirso, etc. The book ends appropriately with some long extracts from Mussolini's speeches on various important occasions in connexion with reclamations.

Señor Longobardi's book gives the best account at present available of Mussolini's remarkable achievements in land-reclamation. They are a challenge to other countries, and in reading about them, and still more in going over them, one is repeatedly asking whether such rapid improvements would be possible under the milder methods of western Europe. E. J. RUSSELL.

Determinism and Man

The Freedom of Man

By Arthur H. Compton. (The Terry Lectures.) Pp. xii + 153. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1935.) 9*s*. net.

SCIENTIFIC writers who have turned to the philosophical interpretation of science are invariably concerned with the relation between man and the physical and biological science he creates. These writers fall, roughly speaking, into three schools.

The first maintains that the methods that man has evolved for the study of the physical universe can be applied, without fundamental modification, to the study of mankind, and of man as an individual; that the determinism of physical science must apply equally to characteristics of the individual, and that from this can be deduced the behaviour of the mass. The universe, including man, is a complex machine. These are mechanists.

The second school sets man and his mind apart from the rest of the universe, asserts that although he is amenable to physical laws, these do not determine the whole of his actions, and that otherwise he is 'free' to act as he wills, in accordance with or against his moral conscience. There is a great variety of such philosophical idealists, ranging from the solipsist who maintains that the universe is created out of the elements of his (the particular solipsist's) consciousness, to those who believe that man, in the exercise of his will, is working out the law of a Superior Intelligence that exists outside man.

The third class asserts that man is a product of material nature, consciousness being a complex quality of the brain; that physical science has been produced by man in his struggle with the material world; that the scientific laws he finds operative to inanimate matter are not necessarily valid as they stand for the more complex problem arising when man, the active agent, is involved, the wider problem of 'man performing the social activity science', for example; but that this, being on a different level of complexity and abstraction, will exhibit laws of a specific nature which have themselves to be the subject of study. This class composes materialists who are not mechanists.

Prof. Compton, in the lectures before us, shows himself to belong to the second school. By a scrupulously careful analysis, frequently hesitating to commit himself, he strives to bring out the relation between his scientific and his religious thinking; in the former, standing fast by strict verifiable evidence, in the latter, supplementing the numerous lacunæ in evidence with general argument based on human and emotional needs. It is clear that there is a vital distinction in criteria between the two modes of thinking, of which Prof. Compton is not too conscious. In this way, he deals with the much discussed question of determinism, with the basis of his belief in a Superhuman Intelligence that guides the destiny of the universe, and with immortality. He concludes that there is a psychic element in the universe standing outside matter and surviving it, an element that, operating along with material indeterminacy, directs the course of human action. It is in fact an assertion of extra-material psychic determinism; and yet, alongside this, he seeks, rather inconsistently it seems, to retain freedom of action for the individual.

The case is well and interestingly argued throughout, but, as with other writings of this nature, the author assumes that in countering the case of the mechanists, he is destroying the materialist point of view. He seems unable to distinguish between the position adopted by the Encyclopædists, the mechanists of the eighteenth century, and that of the modern materialist. Had he done so, he would have recognised that there are in reality several distinct problems of determinism; but if they are to be dealt with as one, then the different levels that fall within its scope must be made clear. There is the sub-atomic level, the mass-particle level, and the human and the social level. To equate concepts at different levels is to miss the essence of scientific abstraction.

Scientific experimentation at the particle level is intrinsically deterministic, and is associated with a particular type of prediction. The language of science, and therefore the language of scientific explanation, formulated at this level, tends naturally to be carried downward and upward in common speech to the sub-atomic and to the social levels. Immediately contradictions seem to emerge. When we talk of human or of sub-atomic determinism, are we talking about something that has a verifiable meaning of the same order as particle-determinism ? What is to be meant by prediction in each of these cases ? When we talk of 'freedom', how is it to be defined, or how are we to recognise it within each of the three categories ? These are questions we must pose and answer before we can be certain that we are using words sensibly or asking sensible questions when we inquire : "Has determinism broken down in the sub-atomic field ? Are we therefore 'free' human agents ?"

The idea that there is a breakdown in detailed prediction does not disturb the materialist, as many imagine, although it has excited the idealists into thinking that they see an escape from the imaginary moral strangulation of a rigid mechanistic determinism. Determinism at the sub-atomic level with its associated 'probability prediction' is a very different story from that at the social level, where the fact that man may frequently predict his own behaviour is a crucial quality of the situation. Prof. Compton, in common with many other outstanding physicists, ought surely to see this, for the nature of the material handled and the appropriate experimental methods are fundamentally different. Conscious living matter has qualities of a totally different order from those either of a particle or a photon. It is an active agent that can think, analyse and experiment. In the problem of 'man performing the social activity science', for example, man ranks as one of the determining forces in the situation. If we are to answer the question : "Is human action predictable ?" we have first to form the appropriate abstractions and devise an experimental technique, in order to create a basis for prediction at that level for this human process, to elucidate the laws exhibited. If man's actions are sometimes accompanied by a subjective sense of free-will, as they undoubtedly are, we have to discover the laws of free-will behaviour. All social predictions (and there are many of the small scale in the commercial and industrial world) are based on such laws. Their distinctive quality is that human beings as active agents form these laws and formulate them. As conscious beings, however, they can become aware of the laws they can make and therefore they can plan their future. That is the link between science and human progress.

When viewed from this angle, 'freedom of man', the subject of these lectures, is not something already existing or to be argued into existence. It is something to be achieved. To rank it with determinism at other levels is to miss its essentially distinctive character.

H. LEVY.

Structure of Metals and Alloys

The Structure of Metals and Alloys
By Dr. William Hume-Rothery. (Monograph and Report Series No. 1.) Pp. 120 + 4 plates. (London : Institute of Metals, 1936.) 3*s*. 6*d*. net.

OF all the recent developments in metallography, the most outstanding has been that which has resulted from the invasion of the physicist and the physical chemist, both of whom have, in the past few years, applied their own methods of investigation more and more to the metals and their alloys. As a result, although most of the ideas reached by the use of the older methods have withstood this attack, other conceptions have had to be modified, and in one or two cases, drastically.

The most recent adventure of the Institute of Metals in publishing a series of monographs, each of which is to deal authoritatively with some special aspect of metallurgical interest, could not, therefore, have commenced with a more suitable one than that under consideration, nor could a more proper author have been selected than Dr. Hume-Rothery, whose own contributions to this particular field of study are well-known. The position of metallography at the common boundaries of so many sciences renders it almost impossible for its workers to maintain contact with all the developments which have a potential bearing upon their own lines of work, and the Institute of Metals and Dr. Hume-Rothery have performed a service to the science of metals which cannot be acknowledged in terms too high.

Assuming merely that knowledge of modern physics and physical chemistry which may now reasonably be expected from the metallographer, the author has, in a manner as simple as the nature of his subject permits, described present-day conceptions of the electronic structure of the atom, the crystalline structure of the elements and their atomic radii, the solid solutions which form the end phases of the equilibrium diagrams and the phases which occur in between. The concluding section of the book is concerned with the imperfections of crystals, a matter of supreme importance to the metallurgist, whose materials are all aggregates of crystals, which in normal circumstance are very far from perfect. It cannot be too strongly stressed, however, that the work is essentially scholarly, and although necessarily written with the needs of the metallographer chiefly in mind, contains matter of the most direct importance to the physicist, the physical chemist and the crystallographer. For many readers the general account given will probably be adequate, but for those who desire to study the subject matter of this monograph still further, the long lists of references to original work will be of first-rate value.

It is inevitable that almost every metallographer will find certain aspects of the work with which complete acquiescence is impossible—to the present writer, for example, there appears to be an inadequate appreciation of the solidity of the structure built up on the basis of what may perhaps be termed classical methods—but there can be no doubt that the author has performed the task assigned to him in a most praiseworthy fashion. Both to him and to the Institute of Metals most sincere congratulations must be offered for the publication, at a price within the reach of all, and at a time when it is perhaps most needed, of a really authoritative account of pioneer work which may well initiate an entirely new era in fundamental, theoretical metallography.

F. C. T.

Alpine Studies

The Structure of the Alps

By Prof. Léon W. Collet. Second edition. Pp. xvi + 304 + 12 plates. (London: Edward Arnold and Co, 1935.) 20*s*. net.

In a review of the first edition of Prof. Collet's fascinating account of the building of the Alps (NATURE, 121, 412; 1928), the appeal of his work to mountaineers and holiday-seekers, as well as geologists, was emphasised. That the book should have gone out of print and a revised edition be required is a tribute to its value and interest; also to the rapid progress of Alpine studies. Indeed, as the author states in his preface to this second edition, "a brilliant international gathering of geologists has been engaged in following the Alpine structure in the Western, as well as in the Eastern, Mediterranean regions, and new ideas of the structure of the Alpine Range have been presented". Prof. Collet has therefore added a new Part 6, consisting of six short chapters dealing with the Apennines, the mountain-arcs of Corsica, Sardinia and Elba, the Alpine Chain of southern Spain and the Balearic Islands. As many of these areas are becoming increasingly popular as tourist resorts (and for residence), Prof. Collet's descriptions of the rock-structures and their effects on the scenery will be highly appreciated.

The increase in length of the book thus necessitated has been to some extent offset by a reduction of detail in some of the chapters, such as that on the Jura Mountains. In this regard, the author's policy will doubtless be welcomed by the non-technical reader, especially as opportunity has been taken to clarify parts of the text of other chapters, to add new diagrams, and to rewrite the chapters on Mont Blanc and the Aiguilles Ranges (to the knowledge of which Prof. Collet has himself made noteworthy contributions).

Some of the minor blemishes of the first edition have been removed. Students are no longer told (without supporting evidence) that the higher Pre-Alps represent a small part of Africa resting on Europe. Indeed, the new edition of the book conveys the impression of being less extremist in the matter of belief in the long-distance travel of overthrust sheets (*nappes*) of the earth's crust. An approach to the more moderate views of the Austrian geologists is shown by the attribution of the East Alpine sheets to Kober's *Zwischengebirge* (or *Zwischenmassiv*). It is perhaps unfortunate that the author introduces the inelegant term "Betwixt Mountains" for these masses; for, although it is a literal translation of one of Kober's expressions, the areas involved are not always mountainous (as witness, the country within the Carpathian arcs). A better English equivalent, "median mass", has been in use for some years. It is a pity also that the termination *-ides* has been retained in such words as Metamorphides, Dinarides (*G. Dinariden*). Astronomers do not write "Leonides", or cause confusion by trying to pronounce the word!

But, whether or not we agree about these matters of detail, or about the views of the extremists of the Nappe theory school, Prof. Collet's volume is unquestionably of great value.

P. G. H. B.

Phenomena in High-Frequency Systems

By August Hund. (International Series in Physics.) Pp. xv + 642. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 36*s*.

THIS well-packed book of specialised information does not appreciably overlap the author's previous "High-frequency Measurements", and is intended to give a comprehensive and up-to-date discussion of the rapidly varying phenomena which the electrical communication engineer controls for useful ends, possibly often without understanding entirely the basic physical principles.

The thermionics of gaseous and vacuous valves introduces the subject matter, after a prefatory acknowledgment of the pioneer observers and developers of electromagnetic theory and electronics; generators of high-frequency power, modulators, demodulators, rectifiers and amplifiers receive detail treatment, and electro-striction is made an important division of the main subject; the serious aspects of electromagnetic theory then find a place, with applications to the more practical phenomena associated with propagation through ionized space and the technique adopted in directing radiated energy.

There are useful appendixes, but the last chapter on filters seems incomplete and redundant in view of the more comprehensive treatises now being issued. The author has a critical sense of the work of others, and his 'display' diagrams are specially helpful for the elucidation of the operation of complex valves and antennæ systems; the reviewer has still to find an explanation of what happens at the corners when a long wire is folded up to form a directive antenna.

L. E. C. H.

Die Allotropie der chemischen Elemente und die Ergebnisse der Röntgenographie

Von M. C. Neuburger. (Sammlung chemischer und chemisch-technischer Vorträge, herausgegeben von Prof. Dr.-R. Pummerer, Neue Folge, Heft 30.) Pp. 106. (Stuttgart: Ferdinand Enke, 1936.) 9.30 gold marks.

THE author gives an account of all the elements which have been supposed to exist in allotropic modifications and, by taking account of the latest methods of investigation, particularly X-rays, he decides which of them actually exhibit allotropy. The crystal forms of the allotropes are specified quantitatively, with very complete references to literature and diagrams.

Although the text is commendably brief and clear, it fails in one or two cases to supply information which the reader would like to have, such for example as to whether explosive antimony is an allotropic form or not. The author, in fact, is concerned almost entirely with the results of X-ray analysis, and where this is not applicable he tends to remain silent. In its field, the book is of very considerable value and serves as a reliable guide through a large mass of data, much of it contradictory. It states clearly in which cases allotropy has been established and where it has not, and in the doubtful cases it presents the evidence in an unprejudiced way.

Soils:

their Origin, Constitution and Classification; an Introduction to Pedology. By Prof. G. W. Robinson. Second edition. Pp. xvii + 442 + 5 plates. (London: Thomas Murby and Co., 1936.) 20*s*. net.

PROF. ROBINSON'S novel treatment of soil science evidently 'met a long-felt want', for a new edition has been required in less than four years. The rapidly developing subject of pedology has many more intimate links with other branches of science than had the older agricultural chemical treatment of soils. At the same time, it bears more closely on those general questions of land classification and utilisation which are becoming increasingly urgent. Surveys and planning must be preceded by careful study of the objects to be classified and their relationships to environmental and historical factors. Prof. Robinson's book shows how far the modern science of soils has been able to go in the interpretation of the formation and behaviour of soils. The geographical and genetic aspects are kept in the foreground throughout, while the more purely technical and agricultural ones are treated very briefly indeed. The book can be strongly recommended to workers in many branches of natural and applied science.

In the new edition the bibliography has been increased and the illustrations greatly improved. Quite recent work on the clay complex, base exchange and soil moisture are fully discussed, space having been gained by omitting the appendix on methods of analysis, which were well handled in Mr. C. H. Wright's recent book.

Official Year Book of the Commonwealth of Australia

No. 28, 1935. Prepared by E. T. McPhee. Pp. xxxi + 971. (Commonwealth Bureau of Census and Statistics, Canberra.) (Canberra: Commonwealth Government Printer, 1936.) 5*s*.

THE new issue of this valuable year book is planned on the usual lines, and even if the call for economy still curtails the size of the volume and curbs the desire of the editor in the presentation of available data, the scope is so comprehensive that little of real importance can have been omitted.

After a summary of the history of the Commonwealth, with the Act of Constitution in full, there follows a chapter on the climate and meteorology provided with statistics, graphs and a rainfall map. Among the many chapters of administrative and financial statistical detail, there is especially full treatment of vital statistics as disclosed in the census of 1933. It appears that the birth-rate in Australia has fallen to the relatively low figure of 16·4 per 1,000 from 27·1 in 1901. If this is low, the death-rate of 9·3 per 1,000 is one of the lowest in the world, so that the natural increase is still higher than in European States excluding Russia, the Netherlands, Spain and Italy. Increase by immigration, which was so high as 32,000 in 1927, fell to about 1,000 in 1934 after four years of actual loss by emigration. The volume has full particulars of agricultural production and mineral output. New Guinea is included in the survey. There is a useful bibliography.

Canadian Water Power Developments during 1935

By Dr. Brysson Cunningham

THE series of reports[1] recently issued by the Dominion Water Power and Hydrometric Bureau indicate that, during the year 1935, there was steady progress in the development of water power in Canada, resulting in a substantial addition to the aggregate power installation, which on December 31 last reached a total of 7,909,115 horse power, as compared with 7,547,035 horse power at the close of the preceding year. The accompanying table shows the distribution of power among the provinces of the Dominion. It is pointed out that while the increase in generating capacity is noteworthy, there is even greater significance in the continued growth of the demand for power, as reflected in the monthly records compiled by the Dominion Bureau of Statistics, which indicate a steady increase, month by month, over the figures for the previous year, amounting in general to more than 11 per cent. This increase, it is stated, is not confined to any one part of the Dominion but extends from the Atlantic to the Pacific.

Available and Developed Water Power in Canada, January 1, 1936.

Province	Available 24-hour power at 80 per cent efficiency		Turbine installation (h.p.)
	At ordinary min. flow (h.p.)	At ordinary six months flow (h p.)	
British Columbia	1,981,000	5,103,500	718,497
Alberta	390,000	1,049,500	71,597
Saskatchewan	542,000	1,082,000	42,035
Manitoba	3,309,000	5,344,500	392,825
Ontario	5,330,000	6,940,000	2,560,155
Quebec	8,459,000	13,064,000	3,853,320
New Brunswick	68,600	169,100	133,681
Nova Scotia	20,800	128,300	116,367
Prince Edward Island	3,000	5,300	2,439
Yukon and North-west Territory	294,000	731,000	18,199
Total	20,347,400	33,617,200	7,909,115

Among the chief installations inaugurated in 1935 were three additional units of 66,000 horse power each at the Canyon station of the Ontario Government on the Abitibi River, bringing the station up to its full capacity, as designed, of 330,000 horse power, and the addition of two 50,000 horse power units at Beauharnois, on the St. Lawrence River, by the Beauharnois Light, Heat and Power Company, bringing the number of units at that station up to eight, with an aggregate capacity of 400,000 horse power. This latter installation, which has been already described in NATURE[2], comprises very important control works on the St. Lawrence River, with the diversion of an authorised quantity of 53,072 cu. ft. per second from the river flow. These control works have now been completed. The MacLaren-Quebec Power Company has added a fourth 30,000 horse power unit to the High Falls installation on the Lièvre River, bringing it up to its total ultimate capacity of 120,000 horse power.

It is, accordingly, evident that the activities of the various companies and authorities engaged in hydro-electric exploitation continue unabated, but there is still ample scope for further development, since it is reliably estimated that Canada has an aggregate available water power totalling 20,347,400 horse power under conditions of ordinary minimum flow, and 33,617,200 horse power ordinarily available for six months of the year. Even these figures are probably understatements, for on the basis of the actual water-wheel installation throughout the Dominion, there is a realised excess of 30 per cent over the calculated quantities, so that it may confidently be stated that the actually recorded resources of the Dominion admit of a turbine installation of some 44,700,000 horse power, of which only about 18 per cent has so far materialised. Yet, even this relatively small percentage places Canada with its 722 horse power per 1,000 inhabitants in an outstanding position amongst the water power using countries of the world. The provinces of Ontario and Quebec jointly possess more than 81 per cent of the total developed power, representing, in Quebec, a proportion of 1,258 horse power per 1,000 inhabitants, and in Ontario, 712 horse power per thousand.

It is interesting to note the uses to which the power is put. Almost 88 per cent of the total hydraulic development is utilised in central electric stations, and represents more than 95 per cent of the main generating equipment of the industry which, in turn, generates more than 98 per cent of the total electricity produced for sale in Canada and for export. Although not specially remarkable in size or power, the view in Fig. 1 is interesting as an example of a recent development at Sault Ste. Marie, on the St. Mary River, Ontario. The installation is of 28,050 horse power and belongs to the Great Lakes Power Company. Another channel of absorption is the pulp and paper industry, Canada's predominant manufacturing activity, which has hydraulic installations of 605,346 horse power and a motor installation for operation by hydro-electricity aggregating more than 1,029,000 horse power, or a combined mechanical installation of more than 1,634,000 horse power. In addition, the industry purchases large quantities of electricity from the central electric stations for use in electric boilers. Fig. 2 shows a development of 56,250 horse power at Smoky Falls on the Mattagami River, belonging to the Spruce Falls Power and Paper Company Ltd.

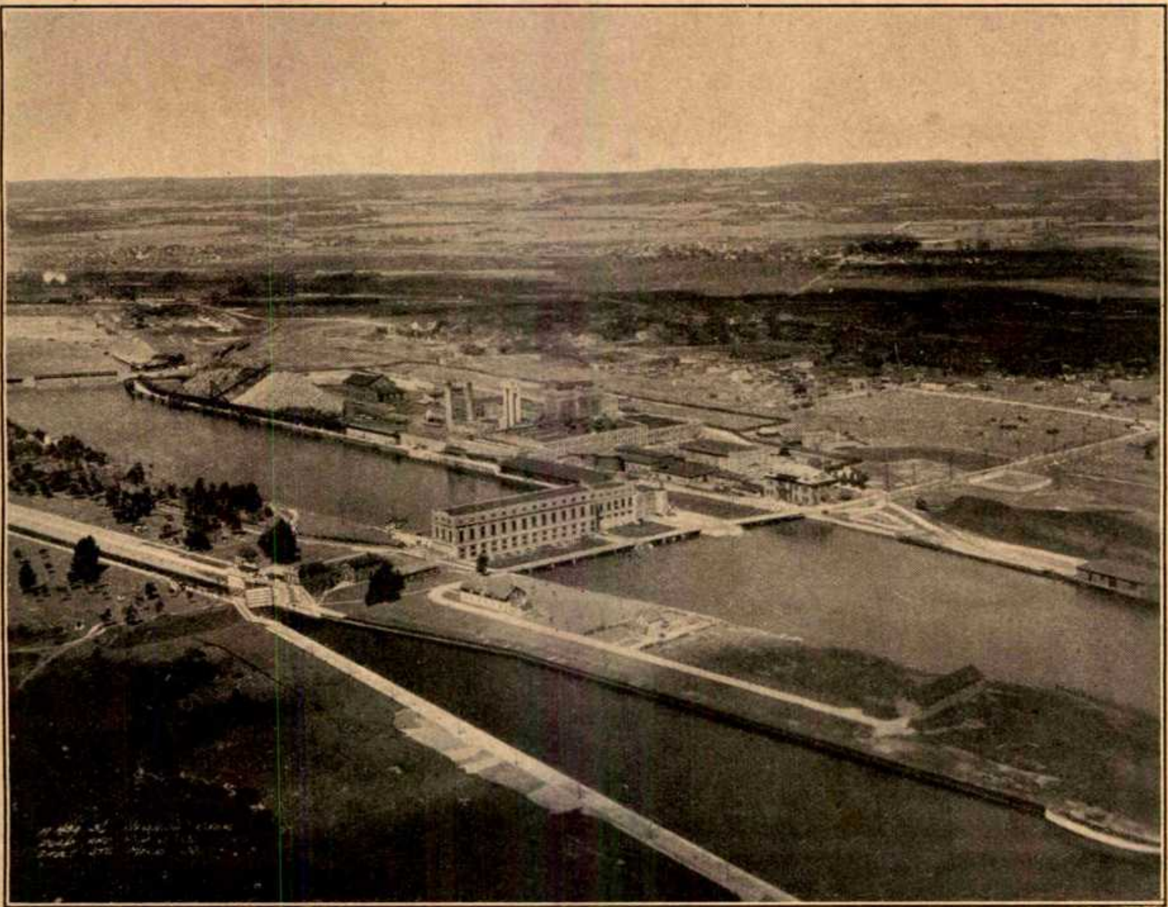

FIG. 1. Sault Ste. Marie development, St. Mary River, Ontario. 28,050 horse power. Great Lakes Power Co., Ltd. By courtesy of the Canadian Official News Bureau, London.

Water power is also a valuable aid to the mineral industries, and indeed its importance in this respect can scarcely be overstated. The convenient location of ample supplies of hydraulic power economically adjacent to mineral fields and centres of mining activities, and the consequent low price generation of power have been dominant factors in the successful development of the mining industry in Canada. A particularly notable feature is the large volume of lower grade ore which can be, and is, profitably mined as a result of the low cost of power. In the latest Annual Report issued by the Dominion Bureau of Statistics on the mineral production of Canada, it can be seen that the Dominion produces, normally, about 90 per cent of the world's supply of nickel, 60 per cent of its asbestos, nearly 35 per cent of its cobalt, 12 per cent of its gold and lead, 10 per cent of its silver, 15 per cent of its zinc and 13 per cent of its copper, besides being one of the major producers of the platinum metals and of aluminium, radium and uranium. Moreover, there is a wide field among the rocks of the great Laurentian Plateau or Pre-Cambrian Shield for the further exploitation of mineral deposits, remarkable alike as regards variety and extent, and this area contains nearly 60 per cent of Canada's available water power, an endowment which is highly favourable to economic development. The Report of the Water Power Bureau affirms that "so far as information is available, there is no present or prospective mineral area, with the exception of some of the coal fields of the middle plains, where hydraulic energy cannot be made available as demand arises".

One of the most enterprising administrative organisations of the Dominion is the Quebec Streams Commission, which continues to maintain efficiently the desired regulation of flow on all the controlled rivers by means of its extensive system of storage reservoirs in various parts of the province. The Commission now controls seventeen reservoirs, some of them of very considerable size. During the year under review, important legislation was passed by the Quebec Provincial Government extending the powers and activities of the Commission to the actual development and utilization of water power sites, the operation of hydro-electric installations and the production and transmission of hydro-electric energy, as also its purchase from other central electric stations and its re-sale to municipalities and other consumers. A new Commission, the Quebec Electricity Commission, has been created with wide powers in regard to the regulation of operations, and the levying of rates and other matters connected with the production and distribution of electrical energy in the Province.

With these evidences of the energetic exploitation of its resources of water power, so realistically described in French as *la houille blanche* (white coal), it can be seen that Canada is more than counterbalancing its deficiency in natural fuel. At a moderate estimate of equivalence, the present hydro-electric installations, on the record of their output for 1935, are shown capable of effecting a saving in coal of 19 million tons per annum, and since owing to the lack of geological coal deposits, the highly industrialised Provinces of Ontario and Quebec are under the necessity of importing supplies, it is obvious that the substitutionary power is of the highest importance to their commercial welfare.

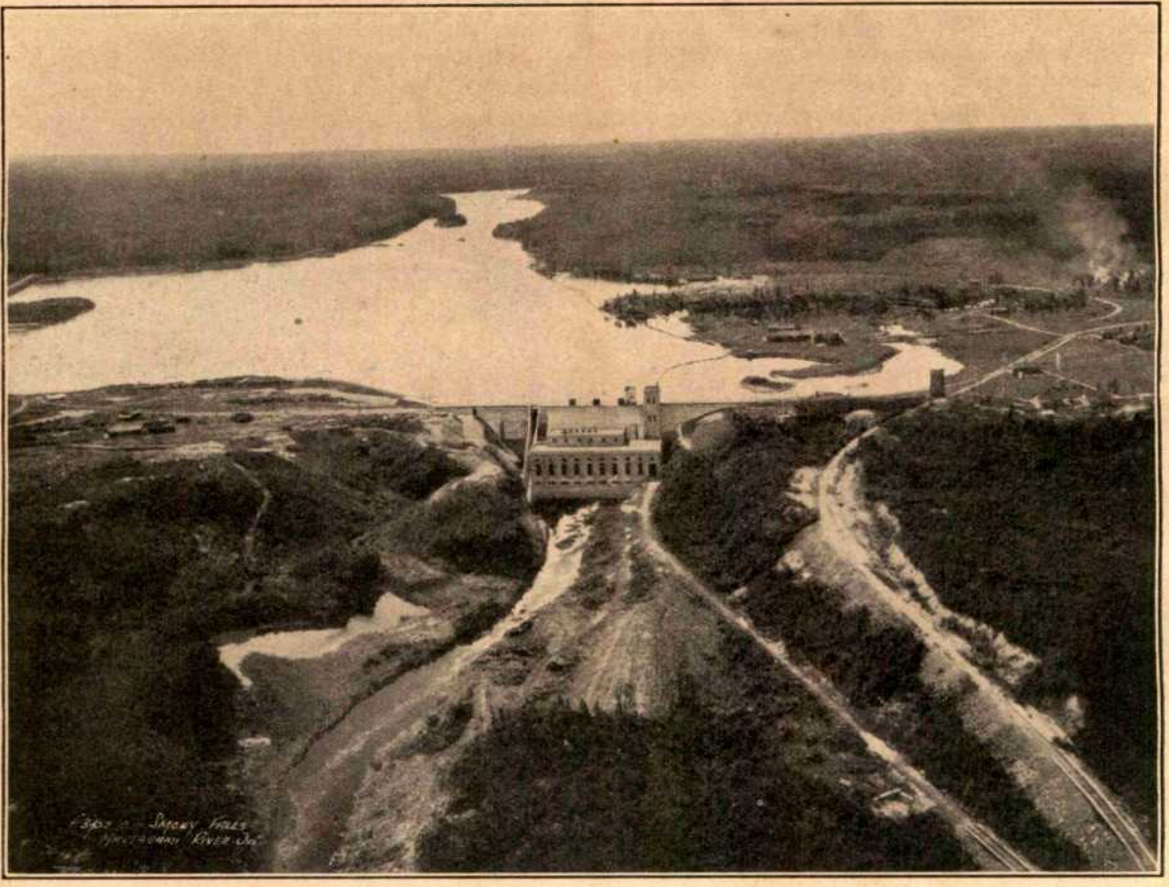

FIG. 2. Smoky Falls development, Mattagami River, Ontario. 56,250 horse power. Spruce Falls Power and Paper Co., Ltd. By courtesy of the Canadian Official News Bureau, London.

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[1] Hydro-electric Progress in Canada in 1935. Paper No. 1871. Water Power Resources of Canada, and Hydro-electric Progress in 1935: A Review of the Year's Activities. By the Hon. T. A. Crerar, Minister of the Interior. Paper No. 1879. (Ottawa: Dominion Water Power and Hydrometric Bureau, 1936.)

[2] NATURE, **131**, 788 (1933).

Indeterminism and Free Will

By Prof. E. Schrödinger

IT has become the orthodox view of physicists to-day, that the momentary state of a physical system does not determine its movement or development or behaviour, to follow; Nature is supposed to be such that a knowledge of state, sufficiently accurate for sharp prediction of the future, is not only unobtainable but also unthinkable. All that can be predicted refers to a large number of identical experiments, and consists in a definite statistics among all the possible developments to follow. The relative margin of indeterminacy (the 'spread' of the statistics) is large for a small system, for example, for an atom; but for large systems the margin is usually, though not necessarily, small, which makes it possible to account for the *apparent* determinacy of inanimate Nature.

Many eminent scientific workers, especially physicists, have tried to play with the idea that the *apparent indeterminacy* of animate Nature, that is, of living matter, might be connected with the theoretical indeterminacy of modern physics. What makes this play so fascinating and thrilling is evidently the hope (whether outspoken or concealed) of extracting from the *new* physical dogma a *model of free-will*, which the *old one* would refuse to yield. I consider this hope an illusion, for the following general reasons.

When observed objectively in other creatures, free-will actions do not call for a special 'indeterminist' explanation any more than other events. When two persons (or the same person on different occasions) react differently under apparently the same conditions, we feel compelled to account for it, whether the reaction is a passive or an active one; by a real, though unknown, difference of conditions, including, of course, character and temporary disposition on the part of the reacting persons. A poet unrolling before us the objective picture of free-will actions is just as concerned about proper causation (here called motivation) as the classical physicist was for inanimate Nature.

On the other hand, when regarded as a fact of self-observation, free-will has quite a different standing from scientific experience. The two are, as it were, in different planes, which do not intersect. Self-observed free-will I would analyse into *two* facts. First, indeed, a prediction, but *not* based on previous experience, certainly not in the way in which scientific prediction is. If I am the actor, I just *know* what is going to happen, and that, apart from pathological cases, with the greatest amount of certainty which is ever met with in life. The *second* fact is a moral one: I feel responsible for what happens.

Now, it is true that this *absolute* prescience is a matter only of the very last moment before or when the action sets in, which it rather accompanies than precedes. Before that there is frequently doubt and even entire ignorance ('hesitation'). This antecedent period, together with the remarkable feeling of responsibility, entails the idea of *choice* between different possibilities for which a clue is sought in the modern views of physics. If that were right, it would mean *either* one of two things. First, that the laws of Nature are after all at "my" mercy. For if my smoking or not smoking a cigarette before breakfast (a very wicked thing!) were a matter of Heisenberg's uncertainty principle, the latter would stipulate between the two events a definite statistics, say 30 : 70; which I could invalidate by firmness. *Or*, secondly, if that is denied, why on earth do I feel responsible for what I do, since the frequency of my sinning is determined by Heisenberg's principle? The new physics does not shift St. Augustin's paradox by a hair's breadth.

In my opinion the whole analogy is fallacious, because the plurality of possible events, in the case of an action under free-will, is a self-deception. Think of cases such as the following: you are sitting at a formal dinner, with important persons, terribly boring. *Could* you, all at once, jump on the table and trample down the glasses and dishes, just for fun? Perhaps you could: maybe you feel like it: at any rate you *cannot*. Then, which of the virtually possible events are to be called possible under the auspices of free-will? I would say, just the one that actually follows.

Against this view cases might be quoted where the decision is really difficult, serious, painful, bewildering, when we are down on our knees before the Almighty to forgo it. But in this He is inexorable! We *must* decide. One thing *must* happen, *will* happen, life goes on. There is no ψ-function in life. I have always considered this having-to-decide as a strikingly close subjective correlate to the classical, the deterministic model of Nature. It ought to be emphasized that modern physics does not compel us to abandon this correlation. The material units which determine the processes of life seem to be large enough for—possibly and even probably—safeguarding the essential course of these processes against any perceptible direct and immediate manifestation of the Heisenberg uncertainty.

The preceding remarks have been elicited by the first page of a highly interesting sketch by Prof. F. G. Donnan, "Integral Analysis and the Phenomena of Life" (Acta Biotheoretica, Series A, vol. 2, Pars 1, 1936; Leyden: E. J. Brill), though not by way of contradiction. Prof. Donnan is not concerned with the question of free-will. His idea is that an organism is to be regarded as a 'historical' system, whose reactions at a given moment are not determined alone by its surroundings and by its momentary state, but also by what has happened to that organism during a certain previous period. This is a highly attractive view, and the mathematical treatment proposed by Prof. Donnan a very suggestive one—even if one should hesitate to agree with the view (which he considers essential) that some of the historical traces are *not* engraved in the momentary state otherwise than by modifying its reactivity.

The Institute of Experimental Psychology at Oxford

THE University of Oxford has recently enacted a statute establishing an Institute of Experimental Psychology, at which active work will be begun in the autumn. Dr. William Brown, Wilde reader in mental philosophy in the University, has been appointed its first director, with Dr. William Stephenson as his assistant. The management of the Institute is in the hands of a committee consisting of the Vice-Chancellor, a representative appointed by each of the boards of the Faculties of Medicine, Literæ Humaniores, Biological Sciences and Social Studies, together with the director.

Thus Oxford has at length officially fallen into step with the movement that has been going on for more than fifty years, the aim of which has been to free psychology from the exclusive tutelage of philosophy, and establish it as an independent, empirical and experimental science. Such freedom, however, does not imply separation, nor can the independence be more than a relative one.

In taking its place among the other natural sciences, the data of all of which provide grist for the philosophical mill, psychology will still look to philosophy, as they do, for the solution of some of the ultimate problems; though it will pursue its own proximate quests by its own empirical line of approach and the use of its own appropriate methods. Grouped together with the other sciences, again, and particularly with the biological and social sciences, there will be much overlapping and interlacing, which can only result in great mutual advantage to them all. Both these points have most wisely been taken into consideration in the constitution of the committee of management of the new Institute.

The foundation of this laboratory at Oxford is in a sense a historic event. For centuries, the University has been the home of philosophy, of which psychology has always been an integral and essential part. In the Middle Ages, Roger Bacon and Duns Scotus, no mean psychologists, stand out amongst its scholars. In the seventeenth century, the 'father' of modern psychology, John Locke, author of the famous "Essay Concerning Human Understanding", was a student of Christ Church. When the Wilde readership was founded in 1898, a distinguished psychologist, G. F. Stout, was appointed to hold it; and he was succeeded by a no less distinguished teacher of the science than William McDougall.

An age-long tradition was there; the conversion of rational into empirical psychology had already begun. But as yet there was no established laboratory in which systematic research could be prosecuted. One is tempted to ask why Oxford should have lagged behind when Cambridge, London, Manchester, Edinburgh forged ahead, in company with most other European and American universities, following the lead of Wundt at Leipzig. Was it opposition from the ancient vested interests of philosophy? Was it the belief that scientific psychology was a mere appendage of physiology? Did the terms of the Wilde readership, excluding experimental psychology explicitly from its purview, stand in the way? Of recent years, at any rate, it was none of these things. Before the Great War, McDougall was able for a time to direct a laboratory, housed in rooms belonging to the Department of Physiology, and having access to apparatus in use there. Solid work had already begun; and, but for the upheaval of the War years and their aftermath, it might have become permanent. But the accommodation was then urgently needed for other purposes, and funds were unavailable; so the project had to be abandoned.

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During Brown's fifteen years' tenure of the Wilde readership, several attempts were again made in this direction; but, though encouraged by much friendly sympathy on the part of the authorities, the same lack of funds and rooms in which to house a laboratory made it impracticable. Last year, however, a generous offer of £10,000 was made through the Wilde reader for this purpose; and it was gladly accepted by the University. The curators of the University Chest will provide the necessary accommodation; and a further sum of £500, together with a grant of £150 a year for five years from the Rockefeller benefaction for research in the social sciences, is to go to the Institute.

Centenary of Darwin's Visit to the Galapagos Islands

Issue of Commemorative Stamps by Ecuador

DISTINGUISHED men of science have, before now, been commemorated on postage stamps by countries sufficiently civilized to value their achievements, but it does not appear that any particular event in the history of science has hitherto been celebrated in this way. It has been left to the Republic of Ecuador to mark, by the issue of a special series of stamps, the centenary of a critical point in the development of the evolution theory. It was on September 16, 1835, that Darwin first landed on Chatham Island in the Galapagos group, where, as he wrote in his "Journal of Researches", "we seem to be brought somewhat near to that great fact—that mystery of mysteries—the first appearance of new beings on this earth". The influence of what he saw there on the later development of his thought is now a commonplace of biological teaching, although some modern writers on evolution might be well advised to read again his own account of his observations and the conclusions to which he was led.

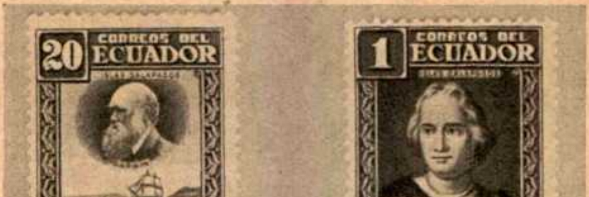

FIG. 1. Stamps issued by the Ecuadorean Government in commemoration of the centenary of Darwin's visit to the Galapagos Islands in the *Beagle* in 1835.

The six stamps which are here reproduced bear designs associated with the islands or with Darwin's visit, the introduction of a portrait of Christopher Columbus being apparently suggested by the Ecuadorean name for the group, "Archipelago of Colon". The portrait of Darwin is taken from a well-known photograph now hanging in Down House; it represents him in his old age, and is probably that by which he is best remembered, although at the time of his visit to the Galapagos Islands he was, of course, a young man of twenty-six years. A view, presumably representing some place in the islands, has a group of coconut palms in the foreground. If this is correct, it indicates a change in the flora since Darwin's time, for he notes in his "Journal", "I saw nowhere any member of the palm family". Two of the designs represent reptiles characteristic of the islands, one of the land iguanas and one of the giant tortoises from which the group takes its name. How many zoologists, one wonders, associate "Galapagos" with the familiar but etymologically obscure word "carapace"?

It is important to remember that one of the things that struck Darwin on visiting the islands was the abundance of individuals, especially of some of the larger reptiles. This density of population has now become a thing of the past, and the accounts of recent travellers make it clear that unless adequate protection can be given, the disappearance of this unique fauna is only a matter of time. It is therefore a subject for congratulation that the Ecuadorean Government has taken an enlightened view of its responsibilities. It has declared the greater part of the archipelago a Nature reserve, in which no hunting or collecting is allowed except by special permission for scientific purposes. Further, a list has been drawn up of the species more immediately threatened, and the killing or capture of these is prohibited, except that the inhabitants may kill some of them for food.

Many scientific bodies on both sides of the Atlantic have expressed their approval of the steps taken, and have offered to co-operate in rendering them effective. A committee of the British Association, under the chairmanship of Sir Edward Poulton, is at present considering what can be done to organise this international co-operation with the Ecuadorean Government.

W. T. CALMAN.

Obituary

Prof. A. A. Bowman

BY the death on June 12 of Prof. A. A. Bowman at his home in Glasgow, British philosophy has lost one of its most effective and attractive personalities.

Prof. Bowman was fifty-three years of age. Except for the period of the War, he had spent his life in the study and teaching of philosophy, first in Glasgow, then in the United States, finally again in Glasgow. He took his degree in classics and philosophy: and after a post-graduate year in Germany, he served his apprenticeship to teaching in Glasgow. In 1910 he was elected professor of logic at Princeton, New Jersey, becoming later administrative chairman of the Department of Philosophy. In 1926, at more than a little material sacrifice, he accepted a call to return to his old University. For one year he held the chair of logic: and from 1927 until his death the chair of moral philosophy. At no time in the long history of that illustrious chair has its holder exercised a stronger personal influence upon his students, upon the University as a whole, and upon Glasgow and the west of Scotland, than Bowman exercised during his short tenure.

Bowman was profoundly a man of peace, and ardent in service of its better organization. The War, however, especially the last months of it, was one of the decisive experiences of his life. He was in the United States. But from the beginning of the War he was restless. In 1915 Princeton gave him leave of absence. The British authorities in the United States, thinking him (quite rightly) medically unfit for active service, refused to recruit him. He came home at his own expense, found some complaisant medical officer to pass him for home service, then, being in the army, badgered his superiors until finally they let him go to France. After a few months campaigning, he was captured in the Lys break-through of April 1918 and sent to a prison camp. That, which seemed to be the end of his service, proved in fact to be his opportunity. Conditions in the camp were deplorable. Bowman's fluency in German made him the natural centre and unofficial leader of the camp. With tremendous resolution, he threw himself into the task first of improving those conditions through negotiation with the German authorities, and then of raising and maintaining the morale of his fellow prisoners. His main instrument for that purpose was a system of tutorial classes which had to be carried through without books or material or facilities of any kind; indeed, with almost no other resource than his own erudition and the persuasiveness of his teaching. He gave lectures and instruction in literature, in philosophy, in contemporary history (especially German and Russian), and in the history of art; and on groups of men quite unfamiliar with these themes, he made a profound impression. He taught them really to save their souls; and he was inspired in the task. That experience sharpened and developed his powers of leadership and of public speech. He had always been a good teacher; the prison camp made him one of the most brilliant and powerful expositors of his time.

Both in the United States and in Scotland Bowman had immense influence. Of slight and even frail physique, he had superb spiritual energy and insight, unshakeable courage, and, as has been noted, quite unusual powers of expression. Scholarship was natural to him: and although his flair was for speculation at once bold and thorough, it was always backed by solid learning. All his life he was an ardent student of classical and of modern literature. He had read widely in social theory and history. He was a good critic of painting. Especially in later years, his studies in the philosophy of religion had drawn him into the field of cultural anthropology, in which he had a vast and intimate knowledge of a great variety of primitive civilizations. All this equipment he brought into fullest play in the ordinary business of his crowded class-room. His students, indeed any audience which he addressed, fell instantly under his spell. For his learning, his humour and his eloquence were no more than the instruments of a man of richest personal quality—of deep insight, of rare imaginative power, and of profound moral and social convictions. In philosophy, he held by the Idealist tradition in which he had been nurtured. He gave it a metaphysical form of his own which his early teachers would have found strange. But he never moved from their conception as to the nature and importance of the issues with which philosophy is concerned. In his hands philosophy was a way not only of thought but also of life. He had worked out his system in the grand style, compact, articulate, thorough and comprehensive, and he presented it with uncommon power.

Bowman's great work was done in the class-room and on the public platform. The tale of his publications is small: a volume of sonnets—the fruits of his prison camp experience—two or three pamphlets and a few articles in learned journals. Happily there is a bigger book almost ready for the press; and it may be hoped that in the large mass of manuscript material which he has left, enough will be found in readily publishable form to give to others than his own students, some idea of the reflections of one of the most original, interesting and courageous minds of our time. H. J. W. HETHERINGTON.

Prof. Margaret Benson

PROF. MARGARET BENSON, whose death on Saturday, June 20, is mourned by a wide circle of friends, is known best to botanists as one of the leading palæophytologists of the last generation. Much of her early work on fossils, which began about 1904, has long been incorporated into the text-books; but it is only a year since she published her last paper on the subject. Her best work was done at a time when the technique of fossil cutting was in its infancy, and for years she cut her own sections at a small lapidary bench in a shed in the grounds of the Royal Holloway College, with a cutting machine worked by a gas engine. She left her valuable collection of fossil slides to the College.

Prof. Benson's industry and single-mindedness were quite exceptional, and were combined with a very real flair for knowing what a fossil might yield and how a structure might be interpreted. She was trained in research at Newnham College, Cambridge, and University College, London, and her early work there on the embryology of Amentiferæ, for which the D.Sc. of the University of London was conferred on her in 1894, is now a classic. In October 1893 she was appointed head of the newly founded Department of Botany at the Royal Holloway College. The Department flourished under her, and in 1912 the University conferred on her the title of University professor of botany, which chair she held at the College until her resignation in 1922.

Prof. Benson was a great traveller and collector; and the botanical garden, museum, herbarium and well-stocked laboratories of her College to-day bear witness to her indefatigable enthusiasm and wise foresight. In the Michaelmas term of 1897 she was granted leave of absence in order to visit the professors of botany of Brussels, Heidelberg, Tübingen, Basle, Strasbourg and Paris in their respective laboratories during term. This tour she made with the view of securing the best information for the equipment of a botanical laboratory. In later years she made two journeys to the antipodes, and on both occasions brought back quantities of valuable specimens. Her botanical work is of enduring value, and she inspired many generations of students with a love of the subject. E. M. B.

Prof. A. A. Noyes

THE death of Arthur Amos Noyes, director of the Gates Chemical Laboratory at the California Institute of Technology, which occurred at Pasadena on June 3 as the result of an attack of pneumonia at the age of sixty-nine years, has deprived physical chemistry of another of its pioneers of the Ostwald school. Noyes may be regarded, indeed, as the American prototype of Sir James Walker, who died last year. Just as Walker was Ostwald's first British student at Leipzig, Noyes was the first American. Of them, Ostwald remarks in his autobiography: "Both are not only distinguished as investigators and teachers, but belong also as men to the best examples of this diversified race".

For nearly twenty years the research laboratory of physical chemistry of the Massachusetts Institute of Technology, which Noyes directed and to which he personally contributed half the expenses of maintenance, was the centre of this branch of science in the United States, and many of the leading American physical chemists may be counted among his students. His own contributions to the ionic theory of electrolytes and to the principles of qualitative analysis were of primary importance in the modern development of these two fields.

Modesty and thoroughness were the chief characteristics both of Noyes' work and of his character. He sought no honours: he leaves many friends.

JAMES KENDALL.

WE regret to announce the following deaths:

Mr. Arthur D. Carey, known for his explorations in Central Asia, for which he was awarded the Founder's Medal of the Royal Geographical Society in 1889, on June 11, aged ninety-one years.

Prof. Ira E. Cutler, emeritus professor of zoology in the University of Denver, on May 25, aged seventy-three years.

Prof. W. E. Dalby, F.R.S., emeritus professor of engineering in the City and Guilds College, Imperial College of Science and Technology, University of London, on June 26, aged seventy-two years.

Prof. Ivan Hönl, professor of bacteriology in the University of Prague, known for his work in combating the scourge of tuberculosis in Central Europe, on June 7, aged seventy years.

Mr. Frank Merricks, past-president of the Institution of Mining and Metallurgy, and a member of the Geological Survey Board in 1920–26, on June 8, aged seventy years.

Sir Charles Nathan, C.B.E., member of the Executive Council of the Australian Commonwealth Council for Scientific and Industrial Research in 1927–28, on June 5, aged seventy-six years.

News and Views

Retirement of Prof. W. A. Bone, F.R.S.

AT the end of the present session, Prof. W. A. Bone vacates, under the age limit, the chair of chemical technology at the Imperial College of Science, which he has held for the past twenty-five years. A graduate of Owens College, Manchester, he studied under Prof. H. B. Dixon and later, when lecturer there in chemistry and metallurgy, he carried out those classical investigations into the slow and explosive combustion of hydrocarbons which have done so much to elucidate the mechanism of their oxidation, and enabled him to formulate the hydroxylation theory. In 1905, he became the first Livesey professor of coal gas and fuel industries in the University of Leeds, and there laid the broad foundations of the new branch of science, fuel technology; there also, in collaboration with McCourt, he invented and developed surface combustion. At South Kensington, Prof. Bone was faced in 1912 with the task of building up a new Department of Chemical Technology, and under his inspiring leadership a research school of world-wide reputation has been created. His field has covered high-pressure explosions and gas reactions, flame spectra, the study by high-speed photography of flame movements in gaseous explosions, the chemical constitution of coal and gas reactions in the blast furnace. At a dinner on June 17, given in honour both of Prof. Bone and Mr. W. C. Hancock who is also retiring from the lecturing staff of the Department, a distinguished gathering including many old colleagues and students assembled, and suitable presentations were made. Fortunately Prof. Bone's retirement does not mean the ending of his scientific activities, for the College authorities, strongly supported by industry and other outside bodies, are providing a new research laboratory in which he will be enabled to pursue those investigations on which he is still actively engaged.

Société de l'Industrie Minérale: Foreign Members

AT a general meeting of the Société de l'Industrie Minérale, St. Etienne, held on May 24, it was decided that the Society should, for the first time, elect honorary members, the terms of the modified statute being that "the title of Honorary Member can be given by the General Meeting to persons of foreign nationality who have promoted the mineral industry or the society by their works". The first elections under the new statute are: Sir Robert Hadfield; Dr. C. E. Guillaume, director of the International Bureau of Weights and Measures; Prof. L. Denoël, professor of mining in the University of Liège; and Prof. P. Fourmarier, professor of geology in the University of Liège. The Société de l'Industrie Minérale, which was founded in 1855, is one of the leading associations of French engineers, and has a roll of nearly two thousand members.

Meyer Medal for Plant Introduction

THE Meyer Medal of the American Genetic Association, for distinguished service in plant introduction, was presented on June 13 to Mr. P. H. Dorsett, who for more than forty-five years has been associated with the scientific work of the U.S. Department of Agriculture. Mr. Dorsett was instrumental in bringing together the largest collection of soy bean varieties that has ever been made. Two expeditions to China were undertaken to make this collection. On the first trip Mr. Dorsett and his son, the late James Dorsett, collected more than two thousand samples from Nanking and its vicinity. On the second expedition, Mr. Dorsett and Dr. William J. Morse, soy bean expert of the U.S. Department of Agriculture, collected more than six thousand samples which were sent to the United States for test. A total of some two thousand distinct varieties of soy beans was obtained from these samples. These are being tested to determine their value to the American farmer. Some of them are already being widely used. The soy bean is a relatively new plant immigrant in the United States, but in 1935 five and a half million acres were planted with it, and forty million bushels of the dry beans were harvested. Mr. Dorsett also took part in three expeditions to obtain new varieties of plants to Brazil (1913–14) and to the West Indies in 1927–30. He was instrumental in bringing into the U.S. valuable citrus varieties and many rare ornamental plants. The Meyer Medal is awarded at intervals by the Council of the American Genetic Association for distinguished services in plant introduction. It is named in honour of the late Frank Meyer, pioneer plant explorer of the U.S. Department of Agriculture, and had its origin in a fund left by Meyer to his fellow workers in plant introduction, who decided to use it for this purpose. Meyer spent the last nine years of his life in plant explorations in China. Among previous recipients is Mr. H. N. Ridley, who was responsible for the introduction of Para rubber into the East Indies.

Newton Manuscripts

AN interesting sale of manuscripts is advertised by Messrs. Sotheby and Co., 34 and 35 New Bond Street, on July 13 and the following day. Readers of NATURE may remember the "Portsmouth Papers", strictly a "Catalogue of the Portsmouth Collection of Books and Papers written by or belonging to Sir Isaac Newton", published by the Cambridge University Press in 1888. The then Earl of Portsmouth presented the scientific part of these papers to the University, and an influential syndicate of the University issued a catalogue of the whole, and took a copy of the more important letters that it did not keep, and returned these to Lord Portsmouth. The Portsmouth family, which has a connexion with

Newton, has put the manuscripts, or such as they have now, in the hands of all serious workers, from Horsley to L. T. More. Viscount Lymington, the heir of the Earl of Portsmouth, has now instructed Messrs. Sotheby to sell them. It might thus seem that there was little except personal matters to find. Many of the letters have been published, accurately or inaccurately, whole or in part, in various well-known sources. But the list includes, for example, such items as "three thick folio volumes", which we did not know of, relating to the Mint and containing documents in Newton's hand. It makes one leave in suspense the Cambridge report, that "Newton's manuscripts on Alchemy are of very little interest in themselves", probable as this may seem in itself, and though the syndicate contained one notable chemist. Also Messrs. Sotheby have added some celebrated portraits to their list. The sale should be well attended; for though most of the contents that are valuable are available, many would like a copy of Newton's beautiful handwriting and that of his contemporaries, apart from those that contemplate a more extensive purchase.

National Inland Water Survey

THE first Annual Report of the Committee appointed in January, 1935, jointly by the Minister of Health and the Secretary of State for Scotland, "to advise on the Inland Water Survey for Great Britain, on the progress of the measures undertaken and on further measures required and, in particular, to make an annual report on the subject", has been awaited with keen anticipation in many quarters, and especially by those engaged in the use and exploitation of the water supplies of Great Britain. It was scarcely to be expected, however, that during the first year of its existence, the Committee would be able to achieve any remarkable results. Its first duty was, naturally, to review the existing conditions and to ascertain the extent to which processes and methods in vogue could be adapted to some uniform and standardized system of procedure. The purpose of the survey, as set out in the Report now issued (London: H.M. Stationery Office. 3*d*. net.), "is to correlate the information at present obtained from all sources, to extend and increase the sources of information, and to make the information readily available for the use of the interests concerned". This has involved exploratory investigations in various directions and the issue of inquiries, which took the form of a detailed questionnaire (reproduced in an appendix to the Report) to which replies have been received from about 3,000 bodies and persons. The replies show that there is a good deal of information available, but that it is varied in type and date, is insufficient and lacks co-ordination and distribution—an endorsement of the conclusions arrived at by the British Association Committee in its report to the Leicester meeting, 1933.

THE present Committee has, accordingly, directed its attention to the means by which an improved system of gauging and recording could be attained. At the same time, it has been conscious of the desirability on economical grounds of adopting as gauging stations a number of structures not originally designed for the purpose, and of obtaining measurements from weirs of a type perhaps not best suited to the end in view. It is of opinion, as advocated in NATURE (Nov. 5, 1932; and again, Aug. 4, 1934), when the matter was first under public consideration, that the Catchment Boards of England and Wales, established under the Land Drainage Act, 1930, are the appropriate bodies to instal gauging stations on rivers and to make and record the measurements of the flow of the rivers which they control. The co-operation of the Catchment Boards has therefore been sought with results which are described as encouraging, and, as there is a large area in England and Wales not yet under the jurisdiction of any catchment board, the Committee has concentrated attention for the time being on areas for which Catchment Boards have been appointed. As regards underground water, the aid of the Geological Survey has been enlisted with the approval of the Committee of the Privy Council for Scientific and Industrial Research. In estimating the value of the existing gauging stations for measuring overground water, an examination has been made of three selected rivers—the Nene, the Thames and the Clyde—and a section of the Report deals with each of them in detail. After setting out its proposals for the publication of data, the Committee concludes the Report with an expression of satisfaction at what it has been able to accomplish in the first year of its existence.

Britain's Largest Hydro-Electric Development

AN aggregate of 102,000 kilowatt of plant is installed in five power stations in Kirkcudbrightshire and Wigtownshire in the south-west of Scotland. When the Water-Power Sources Committee presented its report in 1924, this portion of Scotland was defined as a place where there were possibilities of water-power development, but it was not surveyed as no commercial outlet for the power could then be visualized. The formation of the Grid, by providing the necessary power outlet, showed how a commercial application was possible, and the present hydro-electric scheme was developed as an important factor in the Central Scotland Grid scheme. In the *Electrical Times* for June 25 there is a detailed account of this scheme, called the Galloway Water Power Scheme, which generates the greatest amount of hydro-electric power of any station in Great Britain. In any power scheme the peak units are by far the most expensive. With steam generation, for example, a large amount of plant capacity has to be provided to cover the period of maximum demand. Daily peaks also occurring at regular intervals are expensive owing to the stand-by coal required. In these circumstances, we can see that hydro-electric plant, which can pick up and drop load at very short notice either in normal operation or in emergency, is a very valuable asset. The Galloway undertaking is unique amongst power stations, as it was planned and carried out as a peak load station instead of supplying the usual basic load. It has already proved valuable during the sharp rise and fall of the Glasgow industrial load at the midday dinner hour and other similar occasions. It is satisfactory to learn that after the results of the first twelve months' operation of the first half of the scheme, which includes the two power stations of Tongland and Glenlee, having plant aggregating 57,000 kilowatt, the financial future of the undertaking seems assured.

"Concerning Human Progress"

DR. H. S. HARRISON was characteristically stimulating in his presidential address to the Royal Anthropological Institute on June 30, when he spoke "Concerning Human Progress". Unquestionably his choice of a topic was apt to the needs of contemporary thought, which may well look to the anthropologist for guidance on such questions as the direction and mechanism of human development. Dr. Harrison's conclusions, however, gave his hearers little cause for complacency. He showed no little courage in electing neither to attempt a strict definition of progress, nor to lay down canons of discrimination between upward and downward, in the direction of change. In the event, however, when once he had pointed out that the idea of progress is a modern growth, which did not affect human development until the latter part of the nineteenth century, this deliberate omission enabled him, speaking more especially as a technologist, to demonstrate the essential opportunism of cultural development in the past, which has moved continually forward, backward and sideways, without knowledge of what the direction might be, and not infrequently has led to a dead end. Social progress, he went on to point out, has had no better guidance; but as codes of conduct and actual behaviour are the objective revelations of the mind of man, individually or collectively, and both the material and immaterial products of the human mind have trespassed far beyond the biological necessities, the question arises whether the mind of man has been moulded in response. Dr. Harrison, quite rightly, stressed the apparent paradox that, so far as the evidence goes, there is little, if any, difference to be discerned in physical character and brain power between the earliest example of *Homo sapiens* and the man of to-day. If we look for the directional factor which might have brought about a change in the heart and mind of man, of those forces which have been put forward as active in organic evolution, use-inheritance alone appears to fulfil the requirement, but is ruled out of court, owing to its general repudiation by the biologist. Hence, Dr. Harrison concluded on a note of pessimism, "the mind of man . . . has little sense of direction, and if it may be said to have an ultimate aim, that aim is too obscure for formulation."

The Osborne Reynolds Ridge

THE recent letters in NATURE from Prof. W. Schmidt and Prof. H. Stansfield, describing their observations of a capillary wave on the surface of water, are a reminder that important published observations may be forgotten for many years. Prof. Stansfield now finds that this phenomenon was described by Osborne Reynolds in 1881. Reynolds produced the wave by dropping oil on water, and also observed it in the open air, perhaps when he was fishing, as he says it looks like a line of gut floating on a river, where the water eddies up to the surface in deep pools. About forty years later, there was fresh activity in the study of moving films. In September, 1921, the late Mr. E. Edser quoted Reynolds's paper at a meeting of the Faraday Society, and described experiments showing that the moving film of oil sets in motion a thin layer of water beneath it. Five years before, in Toronto, Prof. J. Satterly had noticed a 'ripple' which moves up a glass tube in advance of the liquid meniscus, when the tube is being filled from below; this and other effects similar to the Reynolds ridge were under investigation there. Five years later, Burdon of Adelaide published a photograph of oil spreading on the surface of water, clearly showing the Reynolds ridge in advance of the visible oil film; and in the same year, 1926, Edser included this photograph and a discussion of the ridge in Appendix IV of his "General Physics for Students". When the rising generation of physicists see the Reynolds ridge, they should recognize it at once as an old friend.

Syria and Crete: Further Discoveries

SIR LEONARD WOOLLEY'S further report on his excavations in Syria is a striking justification of the prescience which sought in the area at the mouth of the Orontes evidence for the early relation of the civilizations of Crete and western Asia. The evidence which has been brought to light since the dispatch of his first report (see NATURE of June 13, p. 979) carries the story of the Ægean connexions of Syria from *c.* 900 B.C., the point at which the settlement at Tell Sheikh Yusuf begins, back to the Middle Minoan age of Crete, somewhere between 1700 and 1580 B.C. At Tell Atchana, a mound near the bank of the Orontes, half-way across the Amk plain in the rear of the Amanus mountains, Sir Leonard reports in *The Times* of June 25, trial excavations in a single trench, which lasted for no more than a fortnight, produced evidence of the existence in the heart of Syria of a city settlement, which was predominantly Cretan in character, and was deserted entirely not later than the twelfth century B.C. At an earlier stage of its history this city had been ravaged by fire and sword, as was shown by the evidence of the large buildings, of which the fire-scarred remains were uncovered. Here the floors were littered with fragments of pottery, among which Syrian wares were mingled with sherds showing characteristic Minoan *motifs*, as well as with specimens of the art of, at present, unknown provenance previously reported. The evidence indicates that the destruction of the building took place before the Late Minoan age began. The find of a Minoan bronze sword is balanced by a Mesopotamian bronze axe and chisels and cylinder seals. The link between Crete and the site on the Amk plain has yet to be demonstrated; but a clue is afforded by the ridge-top acropolis site at the head of the delta, where surface finds on one hand match the pottery of various periods at Tell Sheikh Yusuf, and on the other include fragments of Mycenæan and Cypriote bronze age wares corresponding with the later levels of Tell Atchana.

Recent Acquisitions at the Natural History Museum

MRS. CONSTANCE THORBURN has presented to the Department of Zoology of the Museum seventeen water-colour drawings of British mammals executed by her husband the late Archibald Thorburn. Purchases for the Department include a collection of small mammals, mostly rodents, including some rare and little-known species from the Cameroons; and a small collection of European birds obtained on their northward migration in April and May by Mr. C. G. Bird, at Rio d'Oro, on the north-east coast of Africa. Dr. C. T. Trechmann has generously presented to the Department of Geology a large and valuable collection (including more than 200 type and figured specimens) of Mollusca collected by him from the West Indies. The Mineral Department has received as a gift from Mr. Arthur Earland sea-bottom deposits collected from the Weddell Sea in the Antarctic by the "Discovery" expedition, together with the crystals of gypsum, calcium oxalate, and the new mineral earlandite which had been picked by him from the samples collected. Among the purchases is a series of minerals from Brazil, including a beautiful, table-cut, strongly dichroic aquamarine, spodumene of three kinds and quartz in many different forms and habits. A series of well-shaped crystals of lapis-lazuli and three iridescent limonites from Queensland also have been bought.

Mathematics in Bombay

A VERY interesting experiment in the teaching of mathematics is being carried out in the University of Bombay. Prof. John Maclean, of Wilson College, has had the commendable courage to break away from the beaten track of academic mathematics by devising a special course for his students, dealing mainly with the uses of elementary mathematical methods in the description of quantitative phenomena. The course forms the subject matter of a recent book by Prof. Maclean entitled "Descriptive Mathematics", which was noticed in NATURE of March 7, p. 382. In the Bombay Intermediate Arts and Science examination in March, alternative papers were set; one being of the traditional academic type, whilst the other, entitled "Statistics and Nomograms", was designed to test the efficacy of the new course. Out of a total of 1,400 students, about twenty took this paper. Its questions cover a wide field, and range from Newton's interpolation formula, probability and frequency distributions to transcendental equations and the construction of various types of nomograms. It will be interesting to study the results of this experiment for, judged by the examination paper in conjunction with Prof. Maclean's book, the new course is certainly designed not only to stimulate interest, but also to render a rigorous presentation of the basic ideas in mathematics much more vivid and powerful than that provided by the stereotyped courses.

Scientific Research in Australia

THE ninth annual report of the Council for Scientific and Industrial Research, Commonwealth of Australia (Canberra: Government Printer, 1936. 4*s*. 8*d*.), covers the year ended June 30, 1935, and gives brief accounts of the work of the various divisions in which the work is organised. Weed problems are receiving a considerable share of attention, particularly on the entomological side, through the introduction and distribution of insects which attack the plants in other countries. Investigations are being initiated into contagious bovine mastitis, a serious disease prevalent in dairy herds throughout the world, and an attempt is being made to establish at a dairy farm near Melbourne a normal herd free from the disease. The rabbit pest and the testing of seeds continue to receive attention, and in addition to its investigations on weed pests, the Division of Economic Entomology has been investigating means of preventing the attack of sheep by blowflies. The Division of Animal Health has discovered new and more effective methods of administering anthelmintics for the control of internal parasites of sheep, while the Division of Animal Nutrition has studied the 'coast disease' of sheep, drought feeding and the processes of wool growth. Soil problems, timber preservation and seasoning, the preservation and transport of fruit and chilled beef have been investigated by other Divisions. Even the brief accounts of these investigations contained in the present report indicate that the work of the Council is making noteworthy contributions to the welfare of the basic industries and occupations of Australia.

Geological Survey of Australia

WHEN the Commonwealth of Australia was established, the administration of mining affairs, including geological work, was left with the six independent States. The consequence is that Australia is to-day the only dominion without a national geological survey, a situation which is viewed with grave dissatisfaction by its scientific workers. Every effort hitherto made to remedy the position has failed owing to official opposition from some, but not all, of the State Departments of Mines. A conference between Commonwealth and State officers, held in Melbourne last month, was but little more successful than any of its predecessors. Political, rather than scientific, considerations appear to dominate the issue, and this further failure to agree upon the establishment of a national body, either by the Commonwealth alone or by the States acting jointly, is greatly to be regretted.

Economic Products of the British Empire

VOL. 34, No. 1 of the *Bulletin of the Imperial Institute* has been published by the Institute itself, but the general format remains practically unaltered. This number contains an important report by the

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Imperial Institute Advisory Committee on Hides and Skins on a series of hides prepared experimentally in Southern Rhodesia with the view of improving the material turned out by the natives. It is shown that a simple method of drying the hides which was recommended by the Committee gives excellent results, as it did in the case of earlier experiments in East Africa, and is a great improvement over the ordinary native methods of sun-drying. An article by Mr. M. H. French, of the Tanganyika Veterinary Service, records the work which has been done in that Territory to improve the quality of the clarified butter (ghee) produced there. This product, although little known in Great Britain, is of great importance in tropical regions, since when properly prepared and stored it will keep almost indefinitely under conditions in which ordinary butter turns rancid in a few days. An article by Dr. E. O. Teale, mineral adviser to the Government of Tanganyika Territory, describes recent developments in gold mining in this country. Another article gives a brief outline of the mineral resources of Johore, one of the little-known Unfederated States of Malaya. Alluvial tin ore is being mined in three different areas. In another area iron ore is being mined, and unworked deposits are known to occur in three further regions. Gold and china clay are being produced in small amounts, wolfram has been found in one locality, and prospecting for coal is being carried on in two places.

National Bureau of Standards

A REPRINT from the annual report of the U.S. Secretary of Commerce, 1935, describes briefly the more important of the developments of the Bureau of Standards during the last twelve months. Scientific workers and engineers are making increasing use of its facilities. The testing of supplies and materials has increased by 15 per cent over the previous year. This is partly due to the building activities of various Government agencies. Having received an exceptionally pure sample of the metal gallium, its freezing point was determined and found to be $29 \cdot 780° \pm 0 \cdot 005°$ C. The melting point of this element is so low that the crystals melt to a liquid on a hot summer day. An investigation has been completed on the efficiency of a large number of rust-preventing materials with particular reference to their use in preventing corrosion in aviation engines during storage. Certain types of materials have been found to be extremely effective for this purpose and for use as general rust preventatives. Laboratory tests of numerous types of oil filters show that some of these devices are most efficient in removing impurities formed in the oil during service. Two formulæ were developed for ink powders which make a writing ink superior to the present federal specification. Work has shown that the superior properties of the English clays are apparently due to the presence in them of certain natural fluxes which are not found in American clays. These fluxes have been identified and studies are now being made of American clays modified by the addition of fluxes. A code for the safety glass used in automobiles has been formulated. It was developed by the co-operation of manufacturers and users of glass and motor-cars. It specifies tests for wire glass, heat-treated glass and laminated glass which ensure satisfactory safety glass.

Scientific Horticulture

THE fourth year-book of the Horticultural Education Association ("Scientific Horticulture", from the Editor, Mr. R. T. Pearl, South Eastern Agric. Coll., Wye, Kent, 3*s*. 6*d*. net) presents many helpful contributions. Several papers describe the special considerations of gardening in various parts of England, or discuss the horticultural needs of a particular industry, such as cider-making; and the number of articles which achieve the difficult blend of science with practice shows a gratifying increase over previous year-books. There are also articles which summarize the findings of research stations. Dr. W. F. Bewley writes on "Twenty-one years' Glasshouse Research at Cheshunt", whilst Mr. R. B. Dawson portrays the origin and work of the Board of Greenkeeping Research. Prof. R. J. D. Graham has collected the results of the late Laurence Baxter Stewart on vegetative propagation, and his tables, showing the times and seasons when difficult cuttings may be rooted, will be of very real value to gardeners. Plant pathology has two papers: "The *Phytophthora* Disease of Strawberry" by Mrs. N. L. Alcock and Mr. D. V. Howells, and "The Virus Diseases of Glasshouse and Garden Plants" by Dr. K. M. Smith. Very useful reviews of the present position of research into vernalisation and into photoperiod are given by Dr. O. N. Purvis and Prof. F. G. Gregory respectively. Messrs. W. J. C. Lawrence and J. Newell describe "Seedling Growth in Partially Sterilised Soil", and Drs. Kidd and West issue a warning about the gas storage of apples. They show that the harmful concentration of carbon dioxide in the atmosphere of the store varies with temperature and also with the oxygen content. The president of the Association, Mr. H. L. Jones, chose the subject "Horticultural Education in North Wales" as the title of his address. The contributions are rarely reports of new work, but serve, in an admirable manner, to make available the more abstruse, and often isolated, findings of research in pure science.

Sands, Clays and Minerals

THE April number (Vol. 11, No. 4) of *Sands, Clays and Minerals*, published by Mr. A. L. Curtis, Westmoor Laboratory, Chatteris, once again brings home to readers the fundamental purpose of this magazine. The editorial reiterates that at any rate a partial solution to the problem of unemployment lies in opening up the vast unexploited mineral resources of the British Empire. Numerous industries depend on minerals as raw materials, and increased production leads to increased activity in these industries, with a corresponding fall in unemployment. Certain minerals now being obtained from foreign sources might be produced wholly or in part within the British Empire. Obstacles to optimum development of such resources are not irremovable, though at the present time they loom large. Possibly if the responsibility for economic development were taken from bureaucratic bodies and sharply dissociated from political circles, a more rapid advance could be achieved. It is the practical men, technologists and experts who are best equipped to regulate development of mineral wealth now lying dormant within the boundaries of the Empire. Indirectly such men are already furthering this object, both in an advisory capacity and by their contributions to magazines such as this. Several articles follow in illustration of the importance of mineral wealth. Mr. W. G. Boden writes of Canadian radium, showing how important it has become in the fight against cancer. Mr. L. Sanderson describes the rare metal niobium found in association with columbite and which is destined to play an important part in steel stabilisation and welded construction for service in the embrittling zone of temperatures. In addition there are descriptions of the mineral wealth of East Africa, Southern Rhodesia and the Gold Coast. Publicity of this character obviously furthers the case for utilization of British resources to meet British demands.

Distribution of Insecticide by Shot-Gun

IN a report from Science Service (Washington, D.C.) dated April 25 a patent is announced, and briefly described, embodying the application of insecticides by means of shells discharged from a kind of gun. The idea is an American invention, which claims that shot-gun shells can be loaded with compressed wads of insecticide instead of lead shot. When such a shell is fired, the force of the explosion ejects a wad like a bullet, and when it has travelled a certain distance, it breaks down into a cloud of ultra-fine dust. The distance at which the dissolution of the wad will occur depends upon its make-up—its compactness and moisture content. This distance, it is claimed, can be calculated so that the dust cloud can be discharged on a desired tree or crop. The advantages of the method, as claimed by the inventor, are safety of the operator from the effects of a toxic dust; elimination of cumbersome and explosive spray or dusting equipment; practically no labour; and effective distribution of an insecticide in otherwise inaccessible places.

Biochemical Research at the Franklin Institute

WE have received the third volume (1934–35) of "Reports of the Biochemical Research Foundation of the Franklin Institute". In a foreword, the director, Dr. Ellice McDonald, points out that this issue marks the withdrawal of the Cancer Research Laboratories of the Graduate School of Medicine from the University of Pennsylvania and their inception as the Biochemical Research Foundation of the Franklin Institute. The ostensible reason for this withdrawal is the refusal of the University to allow patenting of medical or biochemical discoveries for the continued furtherance of research activities, though not for personal profit. The Institute has decided that the past research done on the cancer problem should be made an avenue of approach to the more general area of other diseases. The objects of the new Foundation are the study of the processes of disease from a chemical point of view, the study of new organic chemical compounds for their therapeutic value and the study of longevity and the diseases of age, with the hope of prolonging the span of life. The present volume contains reprints of some thirty papers published by the staff of the Institute and the Cancer Research Laboratories and their colleagues, dealing in general with various aspects of both normal and abnormal tissue metabolism.

Business Mental Activity and Management

MR. W. R. DUNLOP, of 57 Gordon Square, London, W.C.1, who for a number of years has been interested in the study of business mental activity from the point of view of management and administration, and with particular reference to the logic and probability of decisions, desires to get into touch with a logician with a taste for probability arguments and a psychologist interested in the underlying psychological factors. It is desired, if possible, to arrange a private meeting for joint discussion at which an experienced business manager with introspective ability would also be present. The object would be to get a combined opinion on Mr. Dunlop's method and to make proposals for further studies and investigation. Mr. Dunlop would be greatly obliged if any reader would assist him in getting into touch with specialists willing and competent to collaborate in the direction indicated.

Thomas Gray Memorial Trust

THE Royal Society of Arts, through the Thomas Gray Memorial Trust, the objects of which are "the advancement of the Science of Navigation and the Scientific and Educational interests of the British Mercantile Marine", is offering the following prizes for competition in 1936: a prize of £100 to any person who may bring to their notice an invention, publication, diagram, etc., which is considered to be an advancement in the science or practice of navigation, proposed or invented by himself in the period January 1, 1931–December 31, 1936; a prize of £100 for an essay on the following subject: "What are your views as to the effectiveness or otherwise of Part II. of the Merchant Shipping (Safety and Load Line Conventions) Act, 1932, with special reference to vessels engaged in the carriage of oil and timber cargoes, and with particular regard to actual sea experience?" Further information can be obtained from the Secretary, Royal Society of Arts, John Street, Adelphi, W.C.2.

International Association for Quaternary Studies

THE Association internationale pour l'Étude du Quaternaire européen, which met last at Leningrad in 1932, will hold its third session at Vienna on September 1–5. Prof. A. Penck is honorary president, Prof. G. Götzinger is president and Dr. O. Ampferer is president of the Organizing Committee. On this occasion, however, in accordance with a resolution passed at Leningrad, the scope of the Congress is to be the Quaternary in general and not the Quaternary of Europe only. Communications have already been promised on questions previously arranged for discussion in relation to the Quaternary of Austria and the Alpine glaciations covering stratigraphy, chronology, morphology, climate, prehistory and speleology. MM. Menghin, Kyrle, Beninger and Liebus will devote attention to the palæolithic period. Arrangements have been made for two excursions while the Congress is in session. Of these, one will visit the loess regions of the Danube Valley (Gottweig, Krems) and the other those in the neighbourhood of Vienna (Laaerbeg). At the close there will be a one-day excursion to the Drachenhöhle of Mixnits, while on September 7–8 an excursion will visit the loess of Weinviertel. Finally, a long excursion has been arranged for September 9–25, to visit the Austrian Alps and adjacent terrain. An illustrated guide-book is in course of preparation. Membership is a condition of attendance at the Congress, the annual subscription being 10 schillings (Austrian) or two dollars. In addition to the privilege of attendance at the Congress, members receive copies of reports which cover the progress of quaternary studies from 1908 until 1935. There are at present 180 members of the Congress drawn from twenty-five nations. Communications relating to the Congress or to membership should be addressed to Drs. Götzinger and Ampferer, Geologische Bundesanstalt, Rasumofskygasse, Wien III, or to the General Secretary, Herr H. Gams, Botanische Institut, Innsbruck-Hötting.

Announcements

It is announced that the Right Hon. Viscount Hailsham, the Lord Chancellor, has accepted the chairmanship of the British Empire Cancer Campaign.

At the meeting of the Paris Academy of Sciences on May 25, Paul Portier was elected a member of the Section of Medicine and Surgery, in succession to the late Charles Richet.

Dr. H. J. Plenderleith, of the British Museum Research Laboratory, has been appointed professor of chemistry at the Royal Academy in succession to Dr. A. P. Laurie, whose term of office has expired. The professor of chemistry gives six lectures at the Royal Academy, in October and November. They are primarily intended for the Royal Academy students, but are open free to students of other art schools and Royal Academy exhibitors of the year who may wish to attend.

The Council of the Royal Meteorological Society has awarded the Howard Prize for 1936 to Cadet John Burton Davies, of H.M.S. *Worcester*. The subject of the competition was an essay on "The Causes of Fog over the Open Sea and in Coastal Waters".

We much regret that the name of Prof. A. C. Seward, who is retiring from the chair of botany in the University of Cambridge which he has held since 1906, was inadvertently omitted from the list in Nature of June 27, p. 1063, of those on whom the honour of knighthood has been conferred.

On the occasion of the Congress of Psychiatry held at Rome on April 3, a bust of the neurologist and psychologist, Prof. Sancte de Santis, was unveiled by Prof. Ponzo.

Dr. Marshall C. Balfour, representative in Greece of the International Health Board of the Rockefeller Foundation, has been awarded the silver medal for distinguished services by the Greek Academy of Sciences, Arts and Letters in recognition of his researches on malaria control in the Peloponnese and Macedonia.

The eleventh International Congress of Psychology will be held at Madrid on September 6–12 under the patronage of the Spanish Republic and the presidency of Prof. E. Mira of Barcelona. The official languages will be Spanish, English, French, German and Italian. Further information can be obtained from the general secretary, Dr. José German, Instituto Nacional de Psicotecnica, Alberto Aguilera 25, Madrid.

Applications are invited for the following appointments, on or before the dates mentioned:

A lecturer in anatomy in the University of Birmingham—The Secretary (July 7).

A scientific officer (physics or engineering) in a Government establishment in the south of England—The Secretary, Royal Engineer Board, Regent's Park Barracks, Albany Street, London, N.W.1 (July 7).

A technical assistant (male) in the Air Defence Experimental Establishment, Biggin Hill, Kent—The Superintendent (July 7).

A lecturer in production engineering in the County Technical College, Wednesbury—The Director of Education, County Education Offices, Stafford (July 9).

An assistant lecturer in civil engineering in the City and Guilds College, Imperial College of Science and Technology, Prince Consort Road, South Kensington, S.W.7—The Secretary (July 10).

Chemists (male) at the War Department Chemist, Woolwich Arsenal—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (July 10).

A lecturer in mechanical engineering in the Heanor Mining and Technical School—The Director of Education, County Education Office, St. Mary's Gate, Derby (July 11).

Two assistants (Grade I), one assistant (Grade II) and two junior assistants in the Directorate of Explosives Research; and an assistant (Grade II) in the Directorate of Metallurgical Research in the Research Department, Royal Arsenal, Woolwich—The Chief Superintendent (July 11).

A lecturer in mathematics in the University of Aberdeen—The Secretary (July 17).

A lecturer in physiology in the University of Birmingham—The Secretary (July 17).

A demonstrator in human physiology in the University of Manchester—The Registrar (July 18).

A professor of social anthropology in the University of Oxford—The Registrar.

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Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 39.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Correlation between Scattering and Recoil in the Compton Effect

As is well known, the experiments of Bothe and Geiger[1] and of Compton and Simon[2] on the correlation between scattering of individual X-ray quanta and electron recoil gave results in complete agreement with the theoretical explanation of the Compton effect, based on the conservation of energy and momentum in each scattering process. The entirely negative results of the recent attempt by Shankland[3] to find such a correlation in the scattering of γ-rays from radium was therefore most unexpected, and it seems desirable to repeat the experiments under conditions as well defined as possible and especially using the much more homogeneous γ-rays from thorium[4].

For this purpose, experiments have been carried out, using a source of 10 mgm. of RaTh filtered by 0·5 cm. lead. The γ-rays next passed through a hole of cross-section 1 — × 1·5 cm. in a lead block 30 cm. thick. The scattering angle was 30° both for the electrons and the quanta, the scatterer was a sheet of paraffin wax of 0·05 cm. thickness. A single counter was used for the detection of the scattered quanta and one for the electrons; the two counters were identical except that the electron counter had an aluminium window with thickness 0·04 mm. and diameter 2 cm. The distance from the counter to the scatterer was about 8 cm.

In a single experiment the coincidences were counted together with the kicks in each of the counters. To determine the number of chance coincidences a lead sheet of thickness 2 mm. was placed in front of the β-counter; the reduction in the number of single kicks caused by the presence of the lead plate was counterbalanced by placing a weak source of RaD close to the electron counter. The number of kicks in the γ-counter was not changed by this procedure. The coincidences found with the lead plate in position give the number of chance coincidences in the first experiment. The following results were obtained in two different series of experiments:

	Kicks per minute				Coincidences per hour		
	Without scatterer		With scatterer		Total (without lead plate)	Chance (with lead plate)	Difference
	β	γ	β	γ			
I	120	28	195	29	6·5 ± 0 6	2·3 ± 0·3	4·2
II	120	120	195	121	11·7 ± 0 9	8·6 ± 0·7	3·1

In the second experiment the number of chance coincidences was increased by exposing the γ-counter to a weak source of RaD. The experiments show that coincidences exist between the β- and the γ-counter in a number which is well beyond the experimental error.

The number of kicks in the γ-counter due to the presence of the scatterer was 1·0 per minute. This was found by replacing the scatterer by a block of paraffin wax of known weight, the proportionality between the weight of the scatterer and the number of kicks being tested by separate measurements. If for each scattered quantum recorded by the γ-counter the corresponding electron was recorded by the β-counter, the number of coincidences would thus be 1·0 per minute. This is, however, reduced considerably by a number of circumstances, such as lack of homogeneity of the primary radiation, scattering within the scatterer, etc., which are difficult to take into account accurately. A rough estimate gives for the expected number of coincidences about 8 per hour, in substantial agreement with the value actually found.

These experiments would, therefore, seem to confirm the usual theory of the Compton effect in every respect.

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[1] *Z. Phys.*, 32, 639 (1925).

[2] *Phys. Rev.*, 26, 289 (1925).

[3] *Phys. Rev.*, 49, 8 (1936).

[4] Since the experiments recorded above were finished, an account of similar experiments leading to the same results has been published by Bothe and Maier-Leibnitz (*Göttingen Nachr.*, 10, 127; 1936)

Conservation Laws in Quantum Theory

IN connexion with the new experiments on the correlation between scattering and recoil in the Compton effect by Bothe and Maier-Leibnitz, as well as those by Dr. Jacobsen recorded above, both contradicting the conclusions regarding the absence of such a correlation arrived at by Shankland, I should like to make the following brief comments upon the renewed discussion[1] on a possible failure of the laws of conservation of energy and momentum in atomic phenomena, to which Shankland's experiments have given rise.

When in an early attempt[2] at a generalisation of the classical radiation theory suited to meet the puzzling dilemma of the wave and corpuscular character of radiation, doubts were expressed regarding the validity of the conservation laws for individual quantum processes, the situation was quite different from what it is to-day. Not only have subsequent experimental discoveries made us familiar with similar paradoxes regarding the behaviour of electrons and other material particles, but above all has the establishment of rational methods of quantum mechanics and electrodynamics proved the compatibility of the existence of the quantum of action with the strict validity of the conservation laws in all such phenomena as electron diffraction and Compton effect. Moreover, the examination, initiated by Heisenberg, of the complementary limitations in quantum theory of measurements of mechanical quantities as well as of electromagnetic field components[3] has completely removed every paradox in this respect. The essence of the argument may be said to be that any attempt at an unambiguous space-time co-ordination in quantum phenomena implies a renunciation of the strict application of the conservation laws, due to the essentially uncontrollable exchange of energy and momentum between the object under investigation and the rigid bodies and clocks which define the space-time frame; conversely, any well-defined application of the conservation laws in quantum phenomena implies an essential renunciation as regards space-time co-ordination[4].

As the fundamental relations between the wave and particle aspects of light and matter can be expressed in full conformity with the relativity principle, the still unsolved difficulties of quantum electrodynamics, emphasised by Dirac in connexion with this discussion, can scarcely be attributed to any incompatibility between the foundations of quantum theory and relativity theory. The root of these difficulties may rather be looked for in the atomistic nature of electricity, which is as foreign to classical physical theories as the quantum of action itself. The rational incorporation of these different aspects of atomic problems in a comprehensive theory will probably claim entirely new points of view, taking the essentially atomistic structure of all measuring agencies into consideration; but at the moment there would seem to be no reason to expect that this would involve any real departure from the conservation laws of energy and momentum.

Finally, it may be remarked that the grounds for serious doubts[5] as regards the strict validity of the conservation laws in the problem of the emission of β-rays from atomic nuclei are now largely removed by the suggestive agreement between the rapidly increasing experimental evidence regarding β-ray phenomena and the consequences of the neutrino hypothesis of Pauli so remarkably developed in Fermi's theory.

N. BOHR.

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June 6.

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[1] P. Dirac, NATURE, 137, 298 (1936). E. J. Williams, NATURE, 137, 614 (1936). R. Peierls, NATURE, 137, 904 (1936).

[2] N. Bohr, H. A. Kramers and J. C. Slater, *Phil. Mag.*, 47, 785 (1924).

[3] N. Bohr and L. Rosenfeld, *Kgl. Danske Vidensk. Selsk. math.-fys. Medd.*, 12, 8.

[4] N. Bohr, *Phys. Rev.*, 48, 696 (1935).

[5] N. Bohr, Faraday Lecture, *J. Chem. Soc.*, 349 (1932).

$[SO_3]_x$

MESSRS. Gerding, Nijveld and Muller[1] infer from the Raman spectrum of sulphur trioxide that it is a mixture of polymorphs. It is interesting to have such information, but to chemists who have known the compound this has always been a necessary assumption.

I remember Frankland introducing me to sulphuric anhydride early in 1867, at the Royal Institution, where we were doing gas analysis with the Frankland and Ward apparatus. He distilled it out of Nordhausen acid, using a bulb blown on the spot from an odd bit of tube, heating the small still on a warm tile of a Hofmann combustion furnace. To-day I can see him doing this: it was the way he had of showing one how to use one's fingers. Somehow I fell in love with the silken beauty of the oxide. As a German student, it was my first research *Schatz*: I cultivated its more acquaintance by the kilo, to the surprise of my fellow students and even of Kolbe.

I am carried back to 1868, when I tested its action on a large number of chlorides. Typical is the effect it has on carbon tetrachloride, forming carbonyl chloride and pyrosulphuryl chloride, $S_2O_5Cl_2$, it would seem directly, as SO_2Cl_2 and SO_3 do not combine. On the other hand, the anhydride combines readily with HCl and EtCl forming simple chlorides—compounds which behave, however, as though they were the trioxide: they are not active apparently through their chlorine, as indeed is the case with acid chlorides generally. Pyrosulphonyl chloride is both a sulphonating and a chlorinating agent; sulphonyl chloride chlorinates.

The peculiarities of the 'trioxide' are not sufficiently recognized. It has high residual affinity. It is the perfect sulphonating agent, used alone but preferably diluted with sand. SO_2HCl is a convenient form in which to administer it—not nearly so powerful; the anhydride may even be used in solution in SO_2HCl with effect. I always feel proud of having introduced this chloride into use; it has played a big part in the manufacture of saccharin.

No text-book does justice to the protean character of the sulphuric acids: their properties have been Ostwaldized into oblivion. $\frac{1}{2}H_2SO_4$ is not the equivalent of the acid: it is 90 per cent a monosulphonic acid—the lactic acid of the sulphur series—not dihydric sulphate. The well-defined stable acid of the series is anhydrosulphuric acid—*oxodisulphonic acid*. The first product of the interaction of vitrolic acid and, say, salt or sodium nitrate is not the acid sulphate of the text-books but $H_3Na(SO_4)_2$—a fact which makes the use of nitre in nitrations uneconomic. When chemists some day recover the full use of symbols and pay attention to facts, these and not a few other matters will receive the attention too long denied to them. Sulphonation is the most important of all the processes in the dyestuff industry—and we owe it to Faraday.

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[1] NATURE, 137, 1033 (June 20, 1936).

Kinetics of Gas Reactions: an Attempt to Connect Thermal Decomposition and Oxidation Processes

THE thermal decomposition of formaldehyde[1] and of acetaldehyde[2] can be represented by $x-t$ graphs which indicate a period of rapid decomposition, followed by one of slow decomposition. The experimental results of Spence[3] for the rates of oxidation of formaldehyde appear to be represented by similar graphs, indicating a similarity in the processes. Seddon and I have pointed out[4] that, in the case of acetaldehyde, the total rate of thermal decomposition appeared to be independent of all conditions except temperature and initial concentration, the nature of the final products, whether methane and carbon monoxide on one hand, or propylene, carbon dioxide and water on the other, being materially dependent on certain other conditions.

Now in the case of the oxidation of formaldehyde, it appears that the final stage in the process follows two alternative courses, which may be represented by,

$$(CH_2O_2)\begin{array}{l}\nearrow CO_2 + H_2\\ \qquad\text{or}\\ \searrow CO + H_2O.\end{array}$$

Spence refers to the penultimate stage as involving the formation of "activated formic acid", but it is perhaps wise to avoid the nomenclature of organic chemistry, and speak of a "short-lived intermediate" of composition (CH_2O_2).

One may imagine that the system passes through a series of states defined by symbols X, X_1 . . . X_x . . . $X_{(n-2)}$, $X_{(n-1)}$, X_n. To account for the similarity between oxidation and thermal decomposition processes, it seems to be necessary to assume that there is some change which is dominant and common to both, and I suggest that this is to be found in the transition represented by,

$$X_{(n-2)} \rightarrow X_{(n-1)}.$$

This is the change involved in the formation of the short-lived intermediates. The probability of reversal of this process is, as Seddon and I suggest, small, and the energy drop considerable. The energy is utilized in a process represented by,

$$X \rightarrow X_1,$$

that is, in increasing the probability of the formation of new primary centres.

The suggestion is somewhat similar to one of those put forward by Semenoff. Qualitatively, it would involve the initial acceleration of the process, which would afterwards slow down. In a considerable number of processes, involving relatively small energy changes, which have been investigated in this laboratory by means of detailed analyses, the form of the $x-t$ graphs is very similar, showing a very sudden transition from rapid to slow reaction generally at or before 50 per cent change. This seems to happen in the case of the oxidation of formaldehyde and in the thermal decomposition of acetaldehyde.

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[1] Fletcher, *Proc. Roy. Soc.*, A, 146, 357.
[2] Travers and others, *Proc. Roy. Soc.*, A, 146, 250, and in the press.
[3] *J. Chem. Soc.*, 649 (1936).
[4] NATURE, 137, 906 (1936).

Vitamin P: Flavonols as Vitamins

VARIOUS chemical and clinical observations have led to the assumption that ascorbic acid is accompanied in the cell by a substance of similar importance and related activity. In absence of both substances, the symptoms of lack of ascorbic acid (scurvy) prevail and conceal symptoms of the deficiency of the second substance. In the lack of suitable experimental animals or conditions, progress was dependent on spontaneous pathological conditions, caused or influenced by this second factor.

In collaboration with L. Armentano and A. Bensáth, we have found that in certain pathological conditions, characterised by an increased permeability or fragility of the capillary wall, ascorbic acid is ineffective, while the condition can readily be cured by the administration of extracts of Hungarian red pepper ('vitapric') or lemon juice. The extracts were effective in cases of decreased resistance of the capillary wall toward whole blood (vascular type of hæmorrhagic purpura) as well as in cases in which the capillary wall showed an increased permeability towards plasma protein only (various septic conditions). The extracts were fractionated. The active substance was found in the end in a fraction consisting of practically pure flavon or flavonol glycoside. 40 mgm. of this fraction given daily intravenously to man restored in a fortnight regularly the normal capillary resistance. Spontaneous bleeding ceased, the capillary walls lost their fragility towards pressure differences and no more plasma protein left the vascular system on increased venous pressure.

These results suggest that this great group of vegetable dyes, the flavons or flavonols, also play an important role in animal life, and that the dyes are of vitamin nature. The group is not to be confused with the yellow dye, discovered by one of us and termed 'flaves' (like cytoflave), which dye forms the prosthetic group of Warburg's yellow enzyme and has later been renamed by R. Kuhn 'flavins'. We propose to give the name 'vitamin P' to the substance responsible for the action on vascular permeability.

This research is sponsored by the Josiah Macy Jr. Foundation, New York.

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May 27.

Role of Adenylic Acid in Vitamin B_1 Deficiency

THE work of Peters[1] and his collaborators has shown that abnormal amounts of lactic and pyruvic acid accumulate in the brain of the polyneuritic pigeon. Further evidence of the Oxford school has demonstrated that the brain tissue of such polyneuritic pigeons exhibits a lowered oxygen consumption in the presence of either pyruvic or lactic acid. The addition of vitamin B_1 *in vitro* to such tissue restores the oxygen uptake to a large extent. Other workers[2] have also pointed out the presence of excessive amounts of lactic acid in the tissues of the vitamin B_1 deficient animal. This emphasis on the 'lactic acid' theory of the vitamin B_1 syndrome led Drury, Harris and Maudsley[3] to suggest that the bradycardia found by them in vitamin B_1 deficient rats was due to the excessive accumulation of lactic acid in the heart. No direct evidence was brought forward to support this theory, although the results of Birch and Harris[4] showed that the severity of the bradycardia went parallel with the lactic acid level in the blood.

The attention which has been devoted to this theory has obscured the similarity between the effect of adenine nucleotides on the normal heart and the effect of vitamin B_1 deficiency on this organ. In the rat, the bradycardia produced by certain adenine compounds apparently resembles in all respects that produced by avitaminosis B_1. For example, with moderate avitaminosis or with small doses of adenylic acid, the heart exhibits a simple slowing. In severe avitaminosis when the heart rate is below 350 beats per minute the auricular wave disappears[3]. This disappearance of the auricular wave also occurs when a large enough dose of adenylic acid is injected.

These facts have led us to study the action of adenine nucleotides on the heart of both the normal and vitamin B_1 deficient animal.

It was found possible to increase further the bradycardia already present, due to vitamin B_1 deficiency, by the injection of small amounts of adenosine, or either of the adenylic acids from muscle or yeast. Using normal animals, a much smaller effect was obtained with the same dosage of these substances. The results using muscle adenylic acid are shown in Fig. 1.

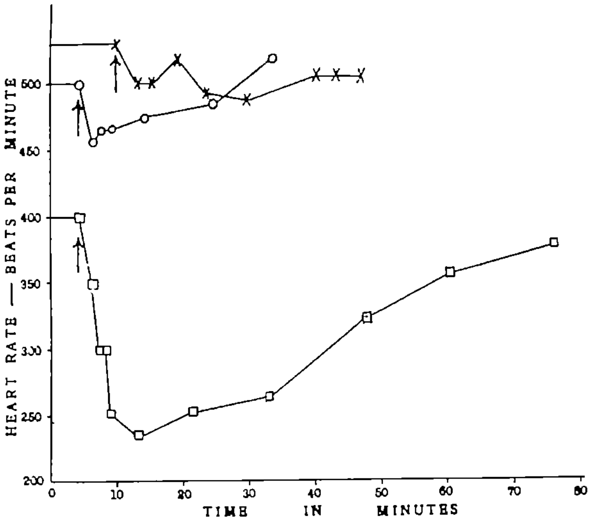

FIG. 1. Effect of muscle adenylic acid on heart rate. 3 mgm. of the acid were injected at points marked by the arrows. □, Vitamin B_1 deficient animal; ×, same animal 18 hours after administration of vitamin B_1; ⊙, animal on 'stock diet'.

These experiments demonstrate that the vitamin B_1 deficient animal is more sensitive to the action of these compounds. This increased sensitivity disappears completely 18 hours after the administration of vitamin B_1, the heart rate having by this time returned to its normal value.

These results suggest that the B_1 deficient animal is unable to render these compounds innocuous at the same rate as does the normal animal.

The two known mechanisms whereby the adenylic acids are converted into substances having little or no effect on cardiac muscle are (1) deamination to ammonia and inosinic acid; (2) phosphorylation to adenosine di- or tri-phosphate.

We have as yet studied only the first of these mechanisms, and have established the fact that the deaminase activity of vitamin B_1 deficient cardiac tissue is on the average more than 20 per cent lower than similar tissues from control animals on a full 'stock diet'. Moreover, tissue obtained from cured animals 18 hours after administration of the vitamin shows a deaminase activity equal to that of normal animals.

Ammonia Produced in 40 minutes per gram of Heart Tissue

	Normal		B_1 deficient
	1,010 γ		778 γ
	998 ,,		710 ,,
	1,041 ,,		752 ,,
	987 ,,		807 ,,
	918 ,,		955 ,,
	875 ,,		695 ,,
	995 ,,		725 ..
	1,072 ,,		845 ,,
Average	982 ,,	Average	783 ,,

We have not yet succeeded in obtaining this restoration of deaminase activity by the direct addition of vitamin B_1 to deficient tissue *in vitro*. This fact, as well as the delayed recovery in the heart rate after administration of vitamin B_1, may indicate that in the rat the vitamin must first be synthesised into another compound before its biological action is manifest.

It seems possible that this failure of the deaminase mechanism may result in an increased accumulation of adenylic acid in the tissue, which is the cause of the bradycardia. Likewise, many of the effects obtained with vitamin B_1 deficient tissues (for example, increased lactic acid and decreased oxygen consumption) may be due to the inhibition by adenylic acid of the oxidative mechanisms which are responsible for the removal of these metabolytes.

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[1] Kinnersley and Peters, *Biochem. J.*, 23, 1126 (1929). Meiklejohn, Passmore and Peters, *Proc. Roy. Soc.*, B, 111, 291 (1932).

[2] Hayasaka, *Tôhoku J. Exp. Med.*, 14, 72, 85, 283, 487 (1930).

[3] Drury, Harris and Maudsley, *J. Biol. Chem.*, 73, 335 (1930).

[4] Birch and Harris, *Biochem. J.*, 28, 602 (1934).

Equivalent Particle-Observers

MILNE[1] and Page[2] have attempted to build up relativistic theories without employing the concepts of *rigid body* or *absolute clock*. Now we can certainly abandon one of these concepts. The possibility of getting rid of the rigid body (assuming an absolute clock) was pointed out by me some time ago[3], while (assuming rigid bodies) we can avoid the absolute undefined clock by employing a light ray oscillating between mirrors at the end of a rigid rod. But to proceed with *neither* concept, as Milne and Page appear to do, is not possible.

Basic in the theories of Milne and Page is the concept of *equivalent particle-observers*. A *particle-observer* is simply a particle equipped with a clock, not an absolute clock, of course, but just any clock that assigns a monotonically increasing sequence of numbers to the events that occur at the particle. According to Milne (*loc. cit.*, p. 30) two particle-observers are *equivalent* if their clocks can be so regulated that, on exchange of light signals between them, there exist certain relations between times of departure and reception of the signals. Page (*loc. cit.*, p. 256) states that in similar circumstances the *clocks* are equivalent, "or that the two particle-observers are equivalent".

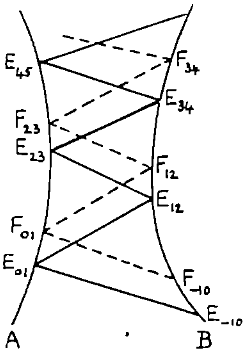

FIG. 1.

This idea of equivalence, at least so far as just two particle-observers are concerned, seems quite a hollow one, because (as will be shown below) *any two particle-observers are equivalent*. Further, the statement that two particles have a *constant relative velocity* is devoid of any absolute physical meaning in terms of the definitions employed (provided that we think only of two particles), because it is always possible by proper choice of 'equivalent' clocks to make this velocity zero.

Consider the world-lines of two particle-observers A, B (Fig. 1). Starting with any event E_{01} in the history of A, we may construct a 'ladder' by means of a light ray passing to and fro between A and B, the 'corners' of the ladder being the events . . . E_{-10},

E_{01}, E_{12}, E_{23}, . . . as shown. Let us choose any positive number k and assign to the events of A between E_{01} and E_{23} a time parameter t, arbitrary except for the conditions that it shall increase monotonically from $t=0$ at E_{01} to $t=2k$ at E_{23}. Let F_{01} be any event in the interval (E_{01}, E_{23}) and let its time be t. Let us construct the ladder having F_{01} for a corner and let us assign to the events at the corners of this ladder (both on A and on B) values of t such that

$$t(F_{n,n+1})=t(F_{n-1,n})+k, \quad (n=\ldots-1,\,0,\,1,\,2,\ldots).$$

Letting F_{01} range over (E_{01}, E_{23}), we assign by this process a value of t to every event in the histories of both particles, the assignment of t over (E_{01}, E_{23}) remaining arbitrary except for the terminal values (0, $2k$).

The time-systems assigned as above satisfy the conditions of equivalence of Milne and Page. Thus any two particles are equivalent. Incidentally, on account of the arbitrary choice of t in (E_{01}, E_{23}) it is obvious that the following statement of Page is not true (*loc. cit.*, p. 257): "The readings of the clocks of P and P' are fixed to within an arbitrary additive constant by the condition that they be equivalent." Furthermore, the 'distance' of Milne and Page between the two particles is constant for equivalent clocks defined as above. Their 'relative velocity' is zero.

It would seem that both Milne and Page have permitted their partially arbitrary clocks to assume an absolute significance. It must be understood, however, that the above remarks apply only to a system of two particles. With more particles the question of equivalence may take on more physical reality.

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[1] E. A. Milne, "Relativity, Gravitation and World-Structure" (Oxford, 1935).
[2] L. Page, *Phys. Rev.*, 49, 254–268 (1936).
[3] J. L. Synge, NATURE, 108, 275 (1921).

Time Effects in Supra-conductors

IN continuation of previous investigations on the magnetic hysteresis phenomena in supraconductors, we have recently reported on experiments concerning the time effect[1]. We observed that after a sudden change of one of the variables of state (magnetic induction or temperature), a final value of the induction in a long supra-conducting cylinder was only attained after a considerable time (up to 20 minutes). The effect was strongest in single crystals and very pure polycrystalline specimens.

As a possible explanation, we tentatively suggested that the redistribution of supraconductive and normal material was perhaps delayed by the slow dying-out of induced currents in the boundary surface between the two states. Such an explanation necessitates, of course, the existence of macroscopic supra-conductive and normal regions in the specimen. It has been recently worked out by R. Peierls[2] and F. London[3] independently (we are much indebted to both authors for giving us an opportunity to acquaint ourselves with the theories before publication, and for the permission to quote their results), that the existence of such macroscopic regions is unlikely in a sphere, whereas the assumption of such a region seems to us necessary in a body of a more complicated form, for example, a short cylinder.

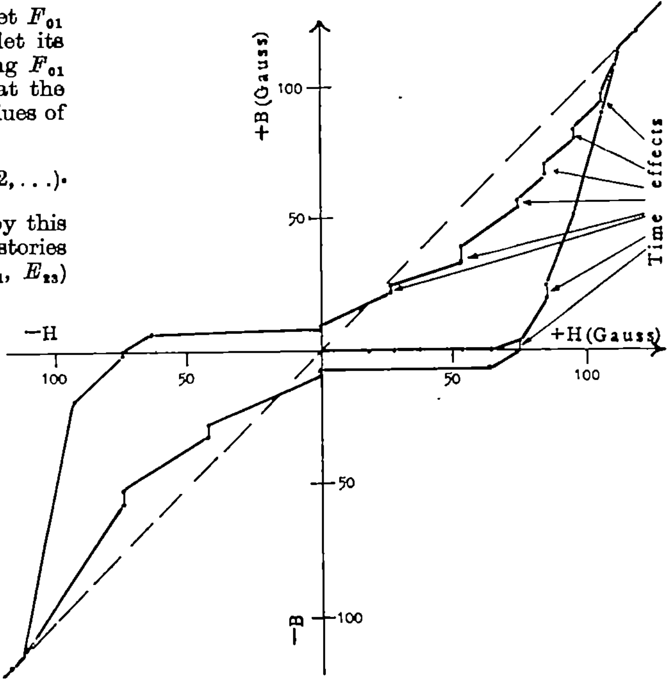

FIG. 1. *B/H* curve of short cylinder of polycrystalline tin, temperature constant, 2·842° K.

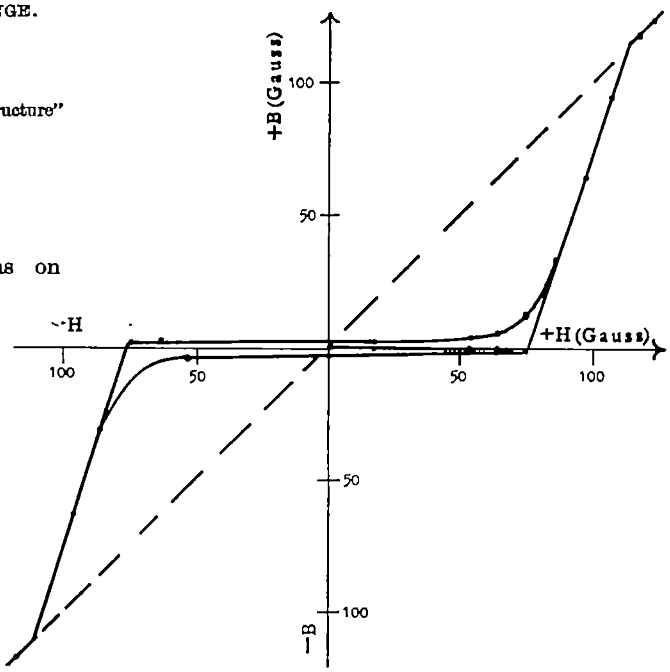

FIG. 2. *B/H* curve of sphere made from cylinder of Fig. 1, temperature constant, 2·85° K.

We have therefore determined the relation of the induction (B) to the external field (H) in a short cylinder of very pure polycrystalline tin. The result is given in Fig. 1, and it can be seen that when the external field is altered, it takes in many cases an appreciable time before a final value of the induction is reached.

After this experiment, the cylinder was worked down carefully to the shape of a sphere. The change of induction observed now (Fig. 2) is nearly reversible, and no time effects were observed.

In both experiments, the first determination of the induction was carried out about 10–15 seconds after the field had been changed. In the second experiment, no variation of induction was observed after this time, whereas a variation was observed even after 3–4 minutes in the first case.

The results show clearly that in the same sample time effects may or may not occur, and that their occurrence depends on the geometrical form of the specimen. Considering the facts stated above, the experiments seem to confirm our assumption that the time effects indicate a slow expansion or contraction of macroscopic supra-conductive regions.

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[1] K. Mendelssohn and R. B. Pontius, *Physica*, 3, 327 (1936).
[2] R. Peierls, *Proc. Roy. Soc.*, A, in print.
[3] F. London, *Physica*, in print.

Determination of Physico-Chemical Constants

THE high sensitivity of W. Swietosławski's ebulliometric test of the purity of liquid substances[1] permits the correlation of data for any physico-chemical property with Δt, the difference between the boiling point and condensation temperature of the substance under investigation, in order to calculate the constants for the pure substance or azeotropic mixture.

The difference mentioned, Δt, when measured in an ebulliometer of standardised dimensions, is a criterion of purity of liquid substances, and for a pure substance it equals zero. Having made measurements of Δt and of a given constant for a series of preparations of the same compound having different degrees of purity, as for example a few successive fractions of distillate from an efficient column, one may plot Δt, the difference between the boiling point and temperature of condensation of each of the preparations, against the data obtained for the given constant. Direct extrapolation of the curve to the point where Δt equals zero gives the constant corresponding to the pure substance or azeotropic mixture.

The determination of the boiling point of iso-amyl alcohol by W. Swietosławski's comparative method[2] may serve as one example of such a correlation. In Table 1 there are listed: number of the fraction, the difference Δt, the degree of purity on W. Swietosławski's scale[1], and the normal boiling point of each of the samples investigated.

Table 1.

No.	Δt	d.p.	b.p.
1	0 032	III	131·067
2	0 019	IV	131·450
3	0 005	V	131·779
4	0·002	V	131·802

The boiling point of pure iso-amyl alcohol obtained by extrapolation of these data is 131·806° C.

The precise determination of density by means of the twin pycnometer method[3] furnishes another example of measurements which may be correlated with Δt to obtain the densities of pure liquids. In Table 2 the densities of two fractions of n-propyl acetate are given, together with the corresponding values of Δt and degree of purity. The density of pure n-propyl acetate obtained by extrapolation to $\Delta t = 0$ is $0{\cdot}88299_3$ gm./cm.^{3} at 25° C.

Table 2.

Δt	d.p.	d(gm./cm.^{3} at 25° C)
0·011	IV	0 882832
0 004	V	0·882939

It is worth noting that as the degree of purity of the substance investigated becomes higher, the change in the property measured becomes more nearly linear with Δt, thus permitting a reliable extrapolation to $\Delta t = 0$. Details will be published elsewhere.

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[1] W. Swietosławski, *J. Phys. Chem.*, 38, 1169 (1935); IX Con. Inter. Quimica, Madrid, 1934, 13; *Roczniki Chem.*, 13, 176, 227 (1933); *Z. phys. Chem.*, A, 160, 257 (1932).
[2] *J. chim phys.*, 27, 496 (1930).
[3] E. R. Smith and M. Wojciechowski, *Bull. intern. acad. Polonaise*, A, 1936.

Metabolism of Cartilage

IT has been found by means of Warburg's manometric method that the metabolism of cartilage is entirely anærobic; it splits glucose to form lactic acid at a rate of about 0·2 c.mm. carbon dioxide (produced from bicarbonate solution) per mgm. dry weight per hour, that is, about a tenth the rate of nearly related connective tissues forming the synovial villi, and a fiftieth the rate of the choroid plexus[1]. By means of cell counts and corrections for specific gravity and drying, it has been shown that this glycolysis is essentially of the same order per cell as in most other adult tissues. This glycolysis is the

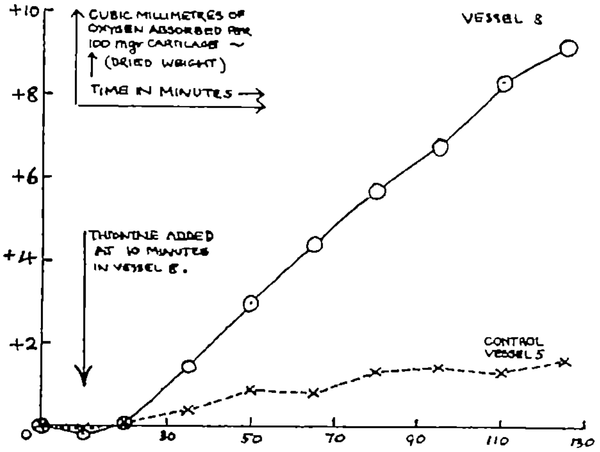

FIG. 1. Diagram showing oxygen uptake of cartilage with addition of dyestuff.

same whether measured under ærobic or anærobic conditions. Rabbit cartilage was kept for a fortnight under aseptic anærobic conditions in bicarbonate Ringer solution with glucose, and its glycolysis measured throughout. At the end of the experiment it had only fallen to 0·09 from an initial $Q_{CO_2}^{N_2}$ (c.mm. carbon dioxide per mgm. dry weight per hour in nitrogen) of 0·34.

There is no oxygen uptake that can be measured certainly by this method; if it exists, the Q_{O_2} (c.mm. oxygen consumed per mgm. dry weight per hour) must be at most 0·01, and probably below 0·005. With methylene blue, however, an immediate large increase in oxygen uptake occurs, paralleled only by the similar behaviour described by Harrop and Barron[2] of non-nucleated mammalian red corpuscles. The Q_{O_2} rises from an average of −0·003 (nine experiments) before, to an average, using the same slices, after addition of dye, of −0·065—a twenty-fold increase.

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[1] Krebs, *Tab. Biol. Period.*, 3, 209 (1933)
[2] Harrop and Barron, *J. Exp. Med.*, 48, 207 (1928)

Oxide Layer on a Polished Copper Surface

THE application of electron diffraction to the problem of the structure of polished metal surfaces has greatly extended the knowledge gained from microscopical methods. In general, in the course of polishing, the rings of the electron diffraction pattern become blurred until they run into two broad haloes. As these changes may be explained by assuming that the metal crystals become smaller and smaller as the polishing progresses, the above-mentioned results are strongly in favour of Beilby's supposition that the topmost layer of highly polished metal is amorphous[1].

There is, however, considerable difficulty in accounting for the fact that the haloes have been found to be practically the same for all metals. They correspond to the spacings 2·25 A., and 1·28 A. ± 5 per cent respectively. This apparent uniformity could scarcely be expected. If we assume the polish layer to be composed of very small crystals, the radius of the haloes should depend on the lattice constants, while if the layer be completely amorphous it would be the atomic volume which should govern their size.

As the majority of the metals investigated are known to be easily oxidisable, it was decided to examine how far these difficulties might be due to the formation of an oxide film on the surface in the course of polishing. After having obtained results concordant with those of other authors for copper polished in the usual way with wet rouge, in air, I polished a specimen under the surface of benzene. This gave haloes of quite different size corresponding to spacings of 1·91 A. and 1·16 A. As polishing under pentane yielded the same result, it seemed likely that the pattern commonly attributed to polished copper is actually due to the oxide. To make sure, the specimen which had been polished under benzene was left in the air and the changes in the pattern were traced by taking pictures every few hours. It was possible to follow the gradual decay of the original haloes and gradual appearance of the pattern corresponding to the spacings 2·24 A. and 1·28 A. The last pattern, which is the one obtained after polishing in air, is thus clearly due to an oxide.

Whereas in the pattern obtained in the absence of air the inner halo may be interpreted as the effect of degeneration of the (111) and (200) rings of copper, and the outer one of the (220), (311) and (222) rings, the haloes obtained in air occur exactly in places where one may expect maxima of intensity after blurring of the corresponding rings of cuprous oxide, the cube side of copper being 3·61 A. and of Cu_2O 4·25 A.

Many of the properties of a polished copper surface have recently been found to differ from those of a polycrystalline one[1]. As usually no special precautions against oxidation are observed during polishing, an interesting question arises as to how far these differences are to be attributed to the change of the physical state of the surface, and how far to change of chemical composition.

The investigation is being extended to other metals, as it is known that many metals which have themselves different crystalline structures, such as iron and nickel, have face-centred cubic oxides with a cube-side differing from that of Cu_2O by only a few per cent. This fact may be partly responsible for the apparent uniformity of size of the haloes.

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[1] For references see G. I. Finch and A. G. Quarrell, NATURE, 137, 516 (1936).

Electrolytes and a General Phenomenon in Tissue Cells

THE starting point of the present experiments was the assumption that the practically undiffusible particles of protoplasm are charged by the *per se* diffusible electrolytes with the formation of a double layer, and are maintained thereby in a dispersed state. If this be the case, then there must exist a certain equilibrium between the electrolytes, which build up the double layer on the particles of the protoplasm, and the electrolytes in the surrounding medium.

It must also be considered that this might concern thermodynamically a Donnan equilibrium—since the latter exists independently of the way in which the diffusible ions are adsorbed on the non-diffusible particles. In this case, if the salt ion contents of the outside liquid are diminished to nearly zero, then all the salt ions, as is well known, travel to the outside liquid.

If the above reasoning is valid, then it must be expected that if one makes the medium outside the tissue cells nearly free from electrolytes, the salt ions will travel to the outside liquid. Consequently a discharge, and a coagulation of the non-diffusible and discharged particles of protoplasm, would be expected.

It has been possible in the case of tissue cells cultivated in liquid media to make the liquid outside the cells nearly free from electrolytes and to produce thereby a discharge (most active Brownian movement in the protoplasm as a sign of a minimum of viscosity; obviously advancing aggregation of the particles of the protoplasm). The following results have been obtained:

(1) If tissue cells are brought from their liquid culture medium, after several washings, into a medium free from electrolytes, then within a few seconds the following phenomena, consisting of three main effects, take place: (*a*) an assumption of globular form by the cells; (*b*) the appearance of a vivid Brownian movement of the granules and vacuoles in the cytoplasm, as a sign of a maximal reduction of the viscosity in consequence of a discharge with simultaneous increasing absorption of water; (*c*) a process of slow coagulation in the cytoplasm, which manifests itself in the appearance of new particles in vivid Brownian movement, which continuously increase in size. The gradual multiplication and increase of the particles is best seen with dark field illumination, but the vivid Brownian movement is also well seen with direct illumination.

(2) In some of the cells which have become globular, there occurs a bursting of the cell, with extrusion of liquid contents containing particles in Brownian movement (analogous to hypotonic hæmolysis with extrusion of hæmoglobin). Sometimes the torn parts adhere together again after diminution of the interior pressure.

(3) The presence of non-electrolytes in the medium ($n/36-n/12$ dextrose: $n/5-n/1$ urea) does not hinder the appearance of the phenomena described, but naturally reduces the activity of the Brownian movement in the cytoplasm.

(4) The phenomena described are reversible. The reversal can be produced after several minutes by means of Ringer solution, $n/10$ sodium chloride, or $n/10$ sodium bromide. The cells regain their former shape extremely quickly, with immediate stoppage of the Brownian movement in the cytoplasm. The cells then show normal vital staining.

(5) The phenomena can only be produced with living and not with dead cells. Failure is a sure sign of cell death.

The results of these experiments prove the justness of the above assumptions. Furthermore, they show that hypotonic hæmolysis is only a special case of a general phenomenon in tissue cells. They reveal, furthermore, a fundamental property of tissue cells in which the salt ions of the tissue liquid participate decisively in the maintenance of the particle charge of the protoplasm.

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A Syndrome produced by Diverse Nocuous Agents

EXPERIMENTS on rats show that if the organism is severely damaged by acute non-specific nocuous agents such as exposure to cold, surgical injury, production of spinal shock (transcision of the cord), excessive muscular exercise, or intoxications with sublethal doses of diverse drugs (adrenaline, atropine, morphine, formaldehyde, etc.), a typical syndrome appears, the symptoms of which are independent of the nature of the damaging agent or the pharmacological type of the drug employed, and represent rather a response to damage as such.

This syndrome develops in three stages: during the first stage, 6–48 hours after the initial injury, one observes rapid decrease in size of the thymus, spleen, lymph glands and liver; disappearance of fat tissue; œdema formation, especially in the thymus and loose retroperitoneal connective tissue; accumulation of pleural and peritoneal transudate; loss of muscular tone; fall of body temperature; formation of acute erosions in the digestive tract, particularly in the stomach, small intestine and appendix; loss of cortical lipoids and chromaffin substance from the adrenals; and sometimes hyperæmia of the skin, exophthalmos, increased lachrymation and salivation. In particularly severe cases, focal necrosis of the liver and dense clouding of the crystalline lens are observed.

In the second stage, beginning 48 hours after the injury, the adrenals are greatly enlarged but regain their lipoid granules, while the medullary chromaffin cells show vacuolization; the œdema begins to disappear; numerous basophiles appear in the pituitary; the thyroid shows a tendency towards hyperplasia (more marked in the guinea pig); general body growth ceases and the gonads become atrophic; in lactating animals, milk secretion stops. It would seem that the anterior pituitary ceases production of growth and gonadotropic hormones and prolactin in favour of increased elaboration of thyrotropic and adrenotropic principles, which may be regarded as more urgently needed in such emergencies.

If the treatment be continued with relatively small doses of the drug or relatively slight injuries, the animals will build up such resistance that in the later part of the second stage the appearance and function of their organs returns practically to normal; but with further continued treatment, after a period of one to three months (depending on the severity of the damaging agent), the animals lose their resistance and succumb with symptoms similar to those seen in the first stage, this phase of exhaustion being regarded as the third stage of the syndrome.

We consider the first stage to be the expression of a general alarm of the organism when suddenly confronted with a critical situation, and therefore term it the 'general alarm reaction'. Since the syndrome as a whole seems to represent a generalised effort of the organism to adapt itself to new conditions, it might be termed the 'general adaptation syndrome'. It might be compared to other general defence reactions such as inflammation or the formation of immune bodies. The symptoms of the alarm reaction are very similar to those of histamine toxicosis or of surgical or anaphylactic shock; it is therefore not unlikely that an essential part in the initiation of the syndrome is the liberation of large quantities of histamine or some similar substance, which may be released from the tissues either mechanically in surgical injury, or by other means in other cases. It seems to us that more or less pronounced forms of this three-stage reaction represent the usual response of the organism to stimuli such as temperature changes, drugs, muscular exercise, etc., to which habituation or inurement can occur.

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Estimation of Fatty Acids in Organic Mixtures

FOR the determination of the volatile fatty acids in cheese, it is usual to subject the acidified cheese mush to a normal steam distillation at constant volume. In this laboratory, it is the custom to collect a volume of distillate equal to three times the volume of the liquid in the distillation flask, and to use this for further estimations of the individual acids.

The study of the rate of recovery of various volatile acids, added in known quantities to the cheese mush, led to doubt as to whether this method of distillation resulted in the complete extraction of the volatile acids (especially the higher members of the series) from the cheese. It appeared that the higher acids were to some extent held back by the constituents of the cheese, and did not therefore distil over at the rate suggested by Dyer's figures[1].

This view was strengthened by a series of experiments in which several acids were distilled from water, and a mixture of fresh, washed butter fat and water. It was evident that there was retention of some of these acids by the butter fat, very marked for lauric acid and high for caprylic, but decreasing through caproic to butyric and the lower members of the series, in which no retention was demonstrated.

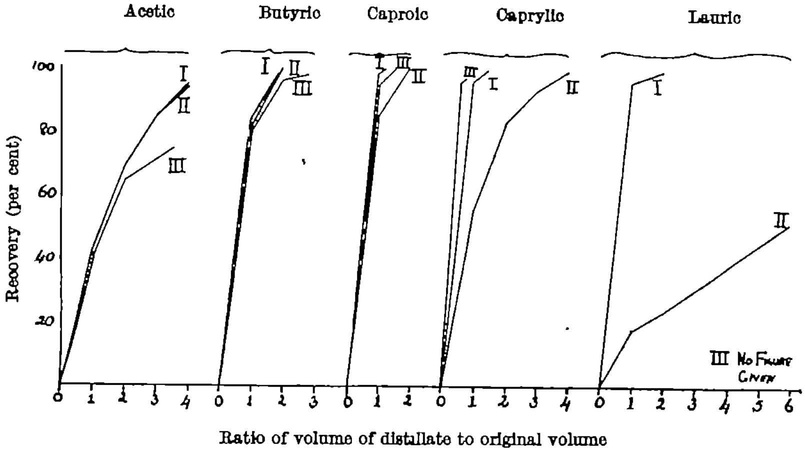

FIG. 1. Fatty acid recovery by steam distillation: I, acid distilled from distilled water; II, acid distilled from pure butter fat; III, distillation figure given by Dyer.

It was found, however, that although the rate of distillation of the higher acids was retarded by the presence of butter fat, almost complete recovery could be effected if the steam distillations were continued for a sufficiently long period. For the acids up to and including caprylic, more than 90 per cent of the added acid could be recovered by collecting a distillate of three times the original volume. For lauric acid, on the other hand, only 50 per cent was recovered even after collecting six times the original volume (cf. Fig. 1).

If the rate of distillation of these acids from a cheese mush is comparable with that from a mixture of butter fat and water, then the practice of collecting a distillate of three times the original volume would allow an estimate of the distribution of volatile acids in cheese which would be sufficiently accurate for many purposes. It is suspected, however, that a still greater retention occurs in the cheese mush, and the influence of cheese fat (as distinct from butter fat) and the protein and salt mixtures of cheese is being examined in an effort to elucidate this question.

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[1] D. C. Dyer, *J. Biol. Chem.*, 28, 445 (1916–17).

The Stock of Antarctic Blue Whales

DURING the current investigations into the conditions of Southern whaling, I have had occasion to consult the publications[1] of the Norwegian Whaling Bureau, in which the catch statistics given in "International Whaling Statistics" have been amplified and to some extent analysed. From these data I have calculated the average length of female Blue whales taken from 1930 to 1935. The results are shown in the following table.

Season	No. of whales considered	Average length (ft.)
1930–31	4,532	82·36
1931–32	close season	— —
1932–33	5,285	81·97
1933–34	6,487	81·85
1934–35	7,253	79·88

A slight annual decrease in length up to 1933–34 is followed by a sharp drop of nearly two feet in 1934–35. Blue females become sexually mature at about 78 ft., when they are approximately two years old. They arrive at maturity in the southern winter, and are found in the Antarctic the following summer with an average length of 80 ft. Pairing in July may result in pregnancy which lasts for ten months[2].

Blue females taken in 1934–35 were, therefore, on the average, killed at the outset of their reproductive career. The consequences of continued intensive killing need scarcely be emphasized.

Average lengths were shown in the Norwegian publications, but the data had been divided, and average lengths were given for immature and adult whales separately. The constancy of the averages from season to season was invoked as evidence that undue depletion of the stock is not yet taking place, but since no account was taken of the rapidly mounting percentage of immature whales in the catch the results are liable to be misleading.

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[1] Hjort, Lie and Ruud, "Hvalrådets Skrifter", 3, 8, 9, 12.
[2] Mackintosh and Wheeler, "Discovery Reports", I, pp. 468–9 (1929).

The Manatee of St. Helena

IN NATURE of March 17, 1934, p. 417, Prof. T. Mortensen quotes Dampier's reasons for refusing to believe in the existence of the sea-cow in St. Helena. The bibliography on the subject appears to be far from complete; but fortunately records by two eye-witnesses are available.

Probably the best account of the St. Helena manatee will be found in Barnes's "Tour of St. Helena" (Richardson, London, 1817, pp. 116 and 117), where a detailed description of the animal is quoted from the manuscript of Lieut. Thomas Leech, "written many years ago". The Leechs were a well-known and highly respectable Island family, and Thomas

Leech, who affirmed that the sea-cow was really a sea lion, is mentioned in Brooke's "History of St. Helena" (1824 ed., p. 51), as one "who by his unwearied pursuits in historical research, and his surprisingly retentive memory had acquired a great degree of general information".

There is another very important reference in Dr. Walter Henry's "Events of a Military Life" (2nd ed., Pickering, London, 1843, vol. 2, pp. 66 and 67), which is as follows:

"We had sea-cows at St. Helena, the Trichechus Dugong, but they were not common. When shooting near Buttermilk Point with another officer one calm evening, we stumbled on one lying on a low rock close to the water's edge, and a hideous ugly brute it was, shaped like a large calf, with bright green eyes as big as saucers. We only caught a glimpse of it for a few seconds, for as soon as it noticed us, it jumped into the sea, in the most awkward and sprawling manner."

Dr. Henry, whose book is well known to Napoleonic students, was an alert and accurate observer of current events, who later reached high rank in the Army Medical Service and died in 1860. His observations were made between 1817 and 1821; probably in 1819.

It may be a convenience to students if I recapitulate the references to be found to sea-cows in the Public Records of Jamestown:

1679, January 27.	First use of the name Manatee Bay.
1682, August 28.	Several sea-cows caught.
1690, March 20.	A very small sea-cow killed.
1691, May 11 (a month before Dampier's visit).	Sea-cow on shore to Windward.
1716, August 29.	400 lb. ambergris found in Manatee Bay.
1739, September 11.	A sea-cow killed.

Burnham's sea-cow of 1810 referred to by Lydekker and Mortensen, I am unable to trace as recorded in the Public Records; but the latter quotes Janisch's confirmation of it to be found in "Scraps from Records" (Government Printer, Jamestown, 1880, to accompany the St. Helena Almanack of that year).

G. C. KITCHING.

The Castle,
St. Helena.
April 18.

A Case of 50 per cent Crossing-over in the Male *Drosophila*

WITH the view of synthesising a double recessive black-vestigial stock of *Drosophila melanogaster*, Dr. G. Eloff[1] made a cross of black and vestigial, both of which are contained in the second chromosome. The F_2 generation, to his surprise, contained many *b vg* flies. To solve the question, the F_1 males were mated with double recessive females (*b vg*), when an independent segregation of black and vestigial was found. He applied the fact to the F_2 data to calculate the crossing-over value between *b* and *vg* in the female, and estimated it to be 17·8 per cent. The value is close to the standard value of 17·0 per cent (18·5 per cent, according to the recent census). For his 50 per cent crossing-over in the male, he writes: "Some other explanation (for example, of chromosomal mutation) must be offered".

In my opinion, Dr. Eloff used by mistake the other mutant, ebony for example, that appears in another chromosome. If so, the black body colour should be inherited independently with vestigial, and it would be quite the natural thing that there should be a 50 per cent crossing-over in the male. According to my understanding, his F_2 data seem to be nothing but the result of an independent segregation, although deviation was considerable.

DAIGORO MORIWAKI.

Furitsu Koto-Gakko,
Biological Institute,
Meguro, Tokyo.
March 6.

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[1] G. Eloff, NATURE, 137, 151 (1936).

SINCE the appearance of my letter in NATURE of January 25, Prof. Tammes of Groningen has written to me as follows: "Gottschewski (of Berlin-Dahlem) is of opinion that the 'black' which you used was probably not the normal black but the so-called 'black Kreidel Holland' which is the same as sooty . . ."

The stock which I received from Groningen was only labelled 'black'. But it probably was a 'sooty' culture from stocks used by Dr. van Herwerden (and her student Kreidel), who got their cultures from America and Berlin-Dahlem. For some reason which is not clear to me at present, this 'sooty' stock was either labelled "black Kreidel Holland" or "black".

In order to make sure that it was the 'black' culture which was responsible for the independent segregation obtained, I this time made use of a vestigial stock from Berlin-Dahlem. The class representations of two series of repulsion back-crosses, the F_2 of which I have just finished counting, were as follows:

F_1 ♂ back-crosses: 204 BV, 235 bV, 194 Bv, 171 bv

$$\frac{BV + bv}{BV + bV + Bv + bv} = \text{approx. } 46 \cdot 6 \text{ per cent.}$$

F_1 ♀ back-crosses: 701 BV, 839 bV, 670 Bv, 698 bv

$$\frac{BV + bv}{BV + bV + Bv + bv} = \text{approx. } 48 \cdot 1 \text{ per cent.}$$

As the data refer to repulsion crosses only, the unequal representation of the classes may be explained by (1) difficult separation of bV and BV phenotypes in some experiments, with the result that BV phenotypes may be included in class bv; (2) poorer viability of classes homozygous for vestigial, namely, Bv and bv. Making allowance for these disturbing factors, it is quite possible that the correct percentage will be 50.

I am satisfied, therefore, that the stock I have used and which was labelled "black" may have been "sooty", so that the results must of necessity show independent segregation.

I regret the misleading results arrived at due to erroneous labelling of the stock, and I wish to thank Mr. Moriwaki for his comment.

G. ELOFF.

Department of Zoology,
University of the Witwatersrand,
Johannesburg.
April 22.

Suggested Cases for Suspension of Rules of Nomenclature

ATTENTION of the zoological profession is invited to the fact that request for the "Suspension of the Rules" has been made in the following cases, on the ground that "the strict application of the Règles will clearly result in greater confusion than uniformity".

According to procedure, one year's notice is hereby published "making it possible for zoologists, particularly specialists in the group in question, to present arguments for or against the suspension under consideration".

Note A.—Suspend rules. Note B.—Insert in Official List with the type as given in parentheses.

Coelenterata.—*Monograptus* Geinitz, 1852 (*priodon*); A, B. *Retiolites* Barrande, 1850 (*geinitzianus*); A, B. *Graptolithus* Linn., 1768, to be suppressed; A.

Echinodermata.—*Luidia* Forbes, 1839 (*fragilissima*); A, B.

Nematoda.—*Anguina* Scopoli, 1777 (*Vibrio tritici*), to be suppressed; A.

Crustacea.—*Squilla* Fabricius, 1787 (*mantis*); A, B.

Insecta.—The so-called "Erlangen List" of 1801 to be suppressed.

Orthoptera.—*Locusta* Linn., 1758 (*Gryllus Locusta migratorius* Linn., 1758); *Phaneroptera* Serville, 1831 (*Gryllus falcatus* Poda, 1761); A. B.

Hymenoptera.—*Cimbex* Olivier, 1790 (*Tenthredo lutea* Linn., 1758); A, B. *Crabro* Fabricius, 1775 (*Sphex cribraria* Linn., 1767); A, B. *Lasius* Fabricius, 1805 (*Formica nigra* Linn., 1758); A, B. *Anthophora* Latreille, 1803 (*Apis pilipes* Fabr., 1775); A, B. *Ichneumon* Linn., 1758 (*Ichneumon extensorius* Linn., 1758); A, B. *Pimpla* Fabr., 1804 (*Ichneumon instigator* Fabr., 1793); A, B. *Ephialtes* Gravenhorst, 1829 (*Ichneumon manifestator* Linn., 1758); A, B. *Bracon* Fabr., 1805 (*Bracon minutator* Fabr., 1798); A, B. *Pompilus* Fabr., 1798 (*Pompilus pulcher* Fabr., 1798); A, B. *Bethylus* Latreille, 1802 (*Omalus fuscicornis* Jurine, 1807); A, B. *Prosopis* Jurine, 1807 (*Sphex signator* Panzer, [1798]); A, B. *Ceraphron* Jurine, 1807 (*Ceraphron sulcatus* Jurine, 1807); A, B. *Torymus* Dalman, 1820 (*Ichneumon bedeguaris* Linn., 1758); A, B. *Proctotrupes* Latreille, 1796 (*Proctotrupes brevipennis* Latreille, 1802); A, B. *Sphex* Linn., 1758 (*Sphex flavipennis* Fabr., 1793); A, B. *Ammophila* Kirby, 1798 (*Sphex sabulosa* Linn., 1758); A, B.

Lepidoptera.—In interpreting the generic names assigned by Freyer in his "Neuere Beiträge zur Schmetterlingskunde" to the species there described, each species is to be regarded as having been described by Freyer as belonging to the genus cited by him at the head of each description and not to the genus with which he actually associated the specific name. For example, Freyer described, under the genus *Hipparchia* Fabricius, a species to which he gave the specific name *eriphyle*, and which he proceeded to name *Papilio eriphyle* Freyer. Freyer is to be deemed to have described this species under the name *Hipparchia eriphyle*, and not under the name *Papilio eriphyle*. A.

Potamis Hübner, *Rusticus* Hübner, and *Mancipium* Hübner to be suppressed in favour of *Morpho* Fabr., *Helicopis* Fabr., and *Pontia* Fabr.; A.

Lepidoptera (Rhopalocera).—*Euploea* Fabr., 1807 (*Papilio corus* Fabr., 1793); A, B. *Satyrus* Latreille, 1810 (*Papilio actaea* Esper, [1780]); A, B. *Argynnis* Fabr., 1807 (*Papilio paphia* Linn., 1758); A, B. *Vanessa* Fabr., 1807 (*Papilio atalanta* Linn., 1758); A, B. *Euthalia* Hübner, [1823] (*Papilio lubentina* Cramer, 1777); A, B. *Nymphidium* Fabr., 1807 (*Papilio caricae* Linn., 1758); A, B. *Colias* Fabr., 1807 (*Papilio hyale* Linn., 1758); A, B.

Species in parentheses are to be declared the types *Lycaeides* Hübner, [1823] (*Papilio argyrognomon* Bergstrasser, 1779); A. *Agriades* Hübner, [1823] (*Papilio glandon* Prunner, 1798); A. *Polyommatus* Latreille, 1804 (*Papilio icarus* Rottemburg, 1775); A. *Euchloë* Hübner, [1823] (*Euchloë ausonia* Hübner, var. *erperi* Kirby, 1871). *Princeps* Hübner, [1807] and *Orpheides* Hübner, [1823] (*Papilio demodocus* Esper, 1798). *Carcharodus* Hübner, [1823] and *Spilothyrus* Duponchel, 1835 (*Papilio fritillarius* Poda, 1761); A.

C. W. Stiles,
Acting Secretary,
International Commission
on Zoological Nomenclature.

U.S. National Museum,
Washington, D.C.
May 1.

Effect of Oxygen on the Auroral Afterglow

During the past year, I have been studying the effect of oxygen on the auroral afterglow in nitrogen. This afterglow is the one the spectrum of which corresponds to the nitrogen part of the auroral spectrum. Attention has been directed elsewhere[1] to some of the more general results of these experiments, but in view of the recent communication by Vegard and Tønsberg[2] on the difference between the spectra of sunlit and ordinary auroras, one aspect of my experiments seems worth special mention here.

Oxygen is introduced into the tube until the blue-green afterglow with continuous spectrum appears. As the tube is allowed to run, the oxygen slowly disappears and the spectrum of the afterglow undergoes some striking changes. The stage of the afterglow which follows the initial blue-green continuous stage is one in which the glow consists of a blue-green background that fills the entire bulb, possesses a banded spectrum and lasts about ten seconds. Superposed on this blue-green glow is an orange-red flash of shorter duration and greater intensity than the background glow. This flash is confined to the centre of the bulb, and its spectrum consists of first positive bands of N_2 and some relatively weak first-negative bands.

Visual examination as well as photographic reproduction of the spectrum shows that the effect of the oxygen is to enhance the first-positive bands relative to the first-negative group. This phenomenon agrees very well with the results of Vegard and Tønsberg on sunlit auroras. The blue-green continuous glow is generally regarded as resulting from the reaction between ozone and nitric oxide. There is therefore probably some ozone present in the orange-red flash stage that follows when the oxygen concentration is slightly reduced.

It is of interest to note that the green auroral line is weaker in this stage of the glow than one would expect, and this also is in agreement with Vegard and Tønsberg's results. It is believed that further study of this orange-red flash will reveal detailed agreement between the laboratory phenomenon here described and the sunlit auroras.

Joseph Kaplan.

University of California
at Los Angeles.
May 21.

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[1] Kaplan, *Trans. Amer. Geophys. Union*, April, 1936.

[2] Vegard and Tønsberg, NATURE, **137**, 778 (1936).

Ground State Vibrational Frequencies

A STUDY of the ground state vibrational frequencies of diatomic molecules in relation to the Periodic Table has shown that the arithmetic mean ω_m of the vibrational frequencies of the two elementary molecules A_2 and B_2 which belong to the same Periodic Group is approximately equal to the frequency of the compound molecule *AB*. All the relevant data are collected in the accompanying table.

Group 1			Group 5			Group 6			Group 7		
Mol.	ω	ω_m	Mol.	ω	ω_m	Mol.	ω	ω_m	Mol.	ω	ω_m
Li_2	352		N_2	2360		O_2	1568		Cl_2	565	
Na_2	159		P_2	778		S_2	727		Br_2	324	
K_2	93		As_2	432		Se_2	388		I_2	214	
Rb_2	58		Sb_2	268		SO	1124	1148	ICl	385	389
Cs_2	41		Bi_2	173		SeO[5]	(910)	978	IBr	267	269
LiK	(207)	223	PN[2]	1337	1569				BrCl	(440)	445
LiRb	(185)	205	AsN[3]	1063	1396						
LiCs	(170)	196	BiSb[4]	220	221						
NaK	123	126									
NaRb[1]	107	109									
NaCs	96	90									

Bracketed values are uncertain.

In Group 5 the BiSb molecule conforms to this rule, whereas the PN and AsN molecules do not. The ω value of the former molecule definitely refers to the ground state, as it is derived from absorption measurements, but there is no such certainty in the case of the latter molecules as their ω values are derived from emission spectra. It is suggested, therefore, that these discrepancies are due to the fact that the ω values presented here for PN and AsN do not refer to their ground states but to excited states. If this is so, it is probable that the actual ground state frequencies will be of the order of 1570 cm.$^{-1}$ and 1400 cm.$^{-1}$ respectively.

This subject will be discussed in greater detail in a future publication.

H. G. HOWELL.

Physics Department,
Armstrong College,
Newcastle-on-Tyne.
May 16.

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[1] Kusch, *Phys. Rev.*, **49**, 218 (1936).
[2] Curry, L. Herzberg and G. Herzberg, *Z. Phys.*, **86**, 348 (1933).
[3] Spinks, *Z. Phys.*, **88**, 511 (1934).
[4] Nakamura and Shidel, *Jap. J. Phys.*, **10**, 11 (1935).
[5] Asundi, Jan-Khan and Samuel, NATURE, **136**, 642 (1935).
Remaining data have been obtained from Jevon's "Report on Band Spectra" (Physical Society, 1932).

A Second Sheath near the Cathode of an Arc Discharge

IN the course of some investigations on arc discharges with oxide-coated cathodes in rare gases, a new dark sheath with a sharp boundary was seen between the well-known Langmuir double space-charge sheath on the cathode and the light of the arc plasma. Fig. 1 shows diagrammatically (*a*) the cylindrical (indirectly heated) barium – strontium oxide coated cathode (viewed end-on), with (*b*) the well-known absolutely dark space-charge sheath, a few tenths of a millimetre in width and concentric with it, and (*c*) the almost dark sheath a few millimetres wide, followed by (*d*) the light of the plasma.

The thickness of this new sheath (*c*) varies approximately inversely with the square root of the current density and only slightly with the gas pressure. At low current density, for example, 0·1 amp. per cm.^{2}, the sheath becomes very indistinct. This dark sheath is only visible in a definite pressure range :

In helium	between	3	and	0·7	mm.	rather indistinct
„ neon + (0·1–1 per cent argon)	„	0·6	„	0·2	„	sharp
„ argon	„	0·2	„	0·02	„	„
„ krypton	„	0·14	„	0·01	„	„
„ xenon	„	0·08	„	0·008	„	„
„ mercury vapour	„	0·03 (60° C.)	and	0·007 (40° C.)		sharp.

In pure neon the sheath was barely visible. In argon, krypton and xenon the colour changes at the lower pressure limit mentioned above and at lower pressures a sheath is observed, which is brighter than the arc plasma, with almost the same dimensions as the dark sheath. At still lower pressures it disappears. In hydrogen, at 0·5 mm., a bright sheath is observed round the cathode with about the same thickness as in the case of the noble gases. Below 0·1 mm. we can see in hydrogen concentric with the dark space-charge sheath a bright and an almost dark sheath followed by the light of the discharge plasma (very distinct at 0·005 mm).

These last phenomena were also observed in argon (though very indistinct) at such a low pressure that the bright sheath had disappeared.

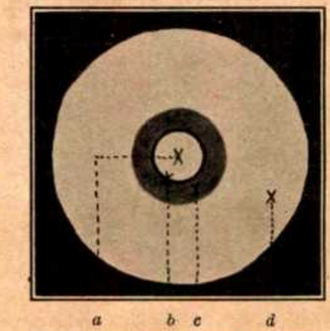

FIG. 1. Diagram of glow from an oxide-coated cathode, in argon at 0·05 mm. pressure, current 2·0 amp., diameter of cathode 4 mm., emitting surface 2·9 sq. cm.

A more extensive report will be published in the Dutch journal *Physica*.

N. WARMOLTZ.

Natuurkundig Laboratorium
der N. V. Philips' Gloeilampenfabrieken,
Eindhoven, Holland.
May 18.

Parallel-Plane Diode Magnetron

IN the discussion on a paper[1] by W. E. Benham on "Electronic Theory and the Magnetron Oscillator", it is remarked that although oscillations should be expected from plane diodes with magnetic field[2], no experimental evidence had been brought forward to support this.

We have constructed a plane diode of the Müller[3] type consisting of a plane indirectly heated oxide-coated cathode, 17 mm. in diameter, and an anode the two plane plates of which were approximately 15 mm. in diameter, situated on either side and at 1 mm. distance from the cathode. The anode plates provide the capacitance of the oscillating circuit, and the conductor joining these two plates (assumed for calculation in this case to be a ring of 21 mm. in diameter), provides the inductance. The anode current is fed to this ring at a voltage node. The arrangement can be seen from Fig. 1.

It was hoped with this valve to obtain diode oscillations[3] of the order of 30 cm. without a magnetic field, but having failed to detect any, owing perhaps to the lack of exact symmetry in the apparatus, a magnetic field was applied parallel to the electrodes. Weak oscillations could be detected with a Lecher wire system coupled capacitatively to the valve, together with rectifier and sensitive galvanometer.

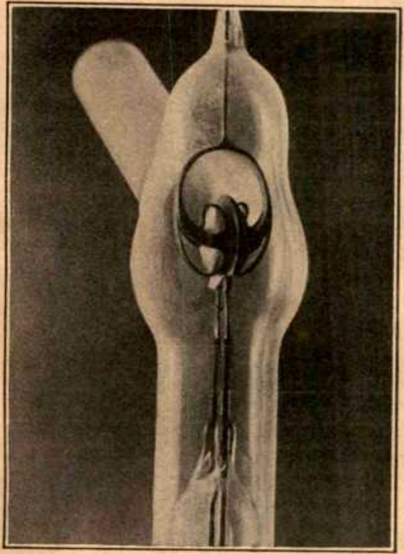

FIG. 1. Parallel-plane diode magnetron.

Until a further valve is built, little more can be said than :

(1) the oscillations occur where the magnetic field starts to cause a reduction in the anode current,

(2) the oscillation intensity falls off as the direction of the magnetic field is altered from that parallel to the electrodes, to that perpendicular to the plane of the electrodes,

(3) the wave-length of the oscillations is of the order of that determined by the oscillating circuit (the anode plates plus connecting wire).

D. M. TOMBS.

Institut für Schwingungsforschung,
Franklinstrasse 1,
Berlin, N.W. 87.
May 12.

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[1] W. E. Benham, *Proc. Phys. Soc.*, **47**, pt. 1, No. 258 (Jan. 1935).
[2] J. Müller, *Z. Hochfreq. und Elektroak.*, **46**, Heft 5 (Nov. 1935).
[3] J. Müller, *Z. Hochfreq. und Elektroak.*, **43**, Heft 5 (June 1934).

Collisional Friction Frequency in the Ionosphere at Allahabad

APPLETON[1] has shown that for the ordinary ray the integrated absorption coefficient k for absorption in the deviating region (that is, in the region where μ approaches zero) may be calculated from the following formula :

$$-2\int_{\mu=1}^{\mu=0} k\,dh = \ln \rho_0 = -\frac{\nu}{2c}\left(P_0'-P_0\right), \quad . \; . \; . \quad (1)$$

where ν, the collisional friction frequency per electron per second, is assumed to be constant throughout the deviating region ; ρ_0 is the reflection coefficient for the ordinary ray ; P'_0 is the group path ; and P_0 is the optical path of the wave.

Late in the night after the magneto-ionic splitting has taken place and the ordinary ray has undergone much group retardation, we are justified in assuming that

$$\triangle\,(\ln \rho_0) = -\frac{\nu}{2c}\,\triangle\,(P_0') \quad . \; . \; . \quad (2)$$

Thus if we plot $\ln \rho_0$ against the equivalent height $P_0'/2$, we should expect a straight line, the slope of which will give us the value of ν. The observations made in this laboratory during last winter show the validity of formula (2) and give an average value of ν of $1 \cdot 2 \times 10^4$ per electron per second.

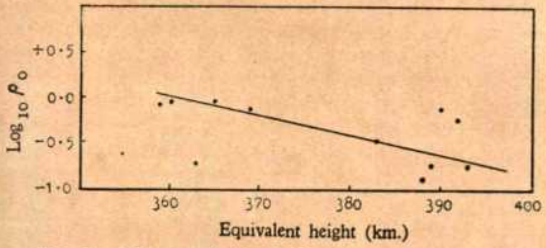

FIG. 1. *F*-layer reflections, March 1, 1936, time 0319–0402 I.S.T.

In Fig. 1, $\log_{10} \rho_0$ has been plotted against the equivalent height for reflections from the *F*-layer. ν comes out to be $1 \cdot 2 \times 10^4$ per electron per second.

The value of ν has also been determined by similar methods in England by Eckersley[2] and Farmer and Ratcliffe[3]. Eckersley has found $\nu = 3 \cdot 6 \times 10^3$ in the daytime for the *F*-region, while Farmer and Ratcliffe's night-time value of ν for the *F*-region is $2 \cdot 1 \times 10^3$ and the daytime value is $1 \cdot 2 \times 10^3$ per electron per second. Thus we see that the value found by us differs considerably from that found by workers in England. At present it is not possible to account for this difference, unless more data extending over a large period are available.

Further observations are being made and details will be published elsewhere.

G. R. TOSHNIWAL.
B. D. PANT.
R. R. BAJPAI.

Physical Laboratory,
University, Allahabad.
May 7.

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[1] Appleton, NATURE, **122**, 879 (1928) ; **135**, 618 (1935).
[2] Eckersley, NATURE, **135**, 435 (1935).
[3] Farmer and Ratcliffe, *Proc. Roy. Soc.*, A, **151**, 370 (1935).

Sensitivity of Photographic Plates in the Region λλ 2500–2100 A.

IT is well known that the sensitivity of an ordinary photographic emulsion begins to fall rapidly just below λ 2500 A., and is very low at λ 2100 A. This fall is due to the absorption of short-wave radiation by the gelatin of the emulsion. It is commonly stated[1] that higher sensitivity in this region may be obtained by greatly reducing the gelatin content of the emulsion, as in the Schumann plate, or by bathing an ordinary plate in a fluorescent substance which can convert the short waves into radiation able to penetrate the gelatin.

Having had occasion recently to photograph spectra of low intensity in this region, we were surprised to find that better results could be obtained with ordinary plates than with plates recommended as having much higher ultra-violet sensitivity. We have therefore carried out some experiments with the view of clearing up this apparently anomalous behaviour.

The procedure was as follows. A heavy-current discharge tube, through which passed a slow stream of air, provided a steady source of the γ-bands of nitric oxide. These bands are characterised by strong, well-defined heads, with long branches slowly degraded in the direction of shorter wave-lengths. The range of intensity thus available makes this band system very suitable for comparison of plate characteristics in the ultra-violet. Using a Hilger *E*2 quartz spectrograph, identical sets of exposures in logarithmic steps were made on each plate under test. Ordinary plates (Imperial) were compared in this way with Schumann plates (Hilger and Agfa), special ultra-violet plates (Eastman and Agfa), *Q*-plates (Ilford), and Imperial plates treated with such common sensitisers as anthracene, sodium salicylate, vaseline and various mineral oils.

In most cases, especially when the source is weak, the spectroscopist wishes

(*a*) to obtain a measurable record of the spectrum with the least possible exposure, and

(*b*) to reproduce, as a range of perceptible density differences, the intensity differences present in the actual spectrum.

Our results show that

(*a*′) every plate tested, except the Ilford *Q*2 plate, gives less blackening for short exposures than does an ordinary plate. That is to say, an ordinary plate fulfils condition (*a*) better than the 'sensitised' plates, with this one exception.

(*b*′) the 'sensitised' plates are capable of showing more intensity contrast than ordinary plates, because they have a greater saturation density. This increased density, however, is obtained only by prolonging exposure beyond that which is needed to reach saturation with ordinary plates.

If, therefore, it is desired merely to detect a weak spectrum in this region, it is undesirable to use 'sensitised' plates. If, on the other hand, the source of radiation is intense, or short exposure time is not aimed at, these plates will give greater contrast and higher saturation density than ordinary ones.

It is perhaps also worth noting that considerable over-exposure in this region does not produce on an ordinary plate densities comparable with those attainable in the nearer ultra-violet or visible region. Apart altogether from considerations of fogging, excessive exposure is detrimental in that it smooths out what little intensity contrast is present in a correctly exposed plate. This is shown by the fact that, on an over-exposed plate, even such a spectrum as that of NO appears almost continuous.

A full account of the experiments will be published shortly.

A. HUNTER.
R. W. B. PEARSE.

Royal College of Science,
South Kensington,
London, S.W.7.
June 3.

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[1] For example, Hopfield and Appleyard, *J. Opt. Soc. America*, **22**, 488 (1932). Weichmann, *Z. wiss. Phot.*, **34**, 140 (1935).

Nova Lacertæ, 1936

SLIT spectra of the nova have been obtained at this Observatory on every night, with one exception, since the discovery was announced on June 19.

The most prominent feature in the spectra is the broad emission bands of the Balmer series of hydrogen, $H\alpha$ being particularly bright. The width of the $H\beta$ and $H\gamma$ emissions on the evening of June 22 was about 50 angstroms. These emissions are flanked on the side of shorter wave-length by rather weak absorption lines. The more displaced component of the two $H\gamma$ absorptions indicated a velocity of about -1100 km./sec. on the morning of June 20; this rose to about -1900 km./sec. by the evening of June 22.

Fe II, Ti II, Mg II, and Ca II are also represented by broad weak emission bands and displaced absorption lines. These absorption lines are weak and hazy, but the sharp interstellar *H* and *K* lines are strongly shown on a plate taken on the evening of June 22.

The general appearance of the spectrum is in sharp contrast with that of Nova Herculis, 1934, at a corresponding stage of development.

T. W. WORMELL.
J. C. DOBBIE.

Solar Physics Observatory,
Cambridge. June 26.

The Background of the Galaxies

IN NATURE of May 30, M. Leontovski[1] shows that "To a most sensitive eye, the background of the galaxies would appear as a dark red." Since the irresolvable background consists of nebulæ receding with nearly the speed of light, the age of these nebulæ, as observed, reckoned in our own time-scale, must be approximately one half the present age of our own surroundings; that is, if *t* is the conventional value of the age of the universe, $\frac{1}{2}t$ is the age of the observed background[2]. Combining these results, we see that the background realizes the poet's dream of

"A rose-red city, half as old as time."[3]

E. A. MILNE.

19 Northmoor Road,
Oxford.

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[1] NATURE, **137**, 904 (1936).

[2] *Mon. Not. Roy. Ast. Soc.*, **93**, 674 (1935); "Relativity, Gravitation and World-Structure" (1935), p. 108 (diagram).

[3] J. W. Burgon, "Petra", Newdigate Prize Poem, 1845.

Glycosides of Madder

THE glycoside obtained from various species of *Galium* and *Rubia* already described in NATURE[1] has now been found to be a primveroside of purpurin carboxylic acid.

The sugar of ruberythric acid, the glycoside of alizarin, which has been known for many years, has been isolated in the pure crystalline condition from the products of enzymic hydrolysis and identified as primverose. A primveroside of rubiadin has also been obtained from the roots of *Galium Verum*.

The three glycosides are rapidly hydrolysed by enzymes present in members of the Primulaceæ. They would appear to be the first examples known of primverosides occurring in the Rubiaceæ.

R. HILL.
D. RICHTER.

Biochemical Laboratory,
Cambridge. June 2.

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[1] NATURE, **134**, 628 (1934).

Points from Foregoing Letters

NEW experiments to find whether there is a correlation between the scattering of gamma radiation and electron recoil are described by Dr. J. C. Jacobsen. In agreement with Bothe and Maier-Leibnitz, and unlike Shankland, the author finds a number of coincidences which is well beyond the experimental error. Commenting on these results, Prof. N. Bohr considers that the grounds for serious doubts concerning the validity of conservation of energy and momentum in atomic phenomena are largely removed. The root of the still unsolved difficulties of quantum electrodynamics may be looked for, he states, in the atomistic nature of electricity, which is as foreign to the classical physical theories as the quantum of action itself.

With reference to the complex molecular nature of solid sulphur trioxide, Prof. H. E. Armstrong directs attention to its value as a sulphonating agent, and recalls incidents in connexion with its early preparation by Frankland.

To account for the similarity in the graphs representing the rate of thermal decomposition and the rate of oxidation of formaldehyde and of acetaldehyde, Prof. M. W. Travers suggests that short-lived intermediates are formed in both cases.

A new vitamin, 'P', which cures pathological permeability of the walls of capillaries to plasma protein, is reported by St. Rusznyák and Prof. A. Szent-Gyorgyi. The new vitamin, closely allied to vitamin C, is found in Hungarian red pepper and lemon juice, and is apparently flavon or flavonol glycoside, one of the vegetable dyes.

Adenylic acid and adenosine (obtained from muscle or yeast) are found by Dr. T. W. Birch and Dr. L. W. Mapson to accentuate considerably the slowing down of the heart-beat (bradycardia) produced in rats by deficiency of vitamin B_1. The authors find, further, that vitamin B_1 helps in the elimination of adenylic acid and suggest that, when the vitamin is absent, there is an accumulation of adenylic acid and that it and similar decomposition products of nuclein are the cause of the bradycardia, not lactic acid, as sometimes stated.

The concept of a pair of equivalent particle-observers, as employed by Milne and Page, is criticised by Prof. J. L. Synge, who deduces that any two particle-observers are equivalent, and their relative velocity is zero for suitably chosen equivalent clocks.

The variations of the magnetic induction with the field applied are found by K. Mendelssohn and R. B. Pontius to follow a smooth and nearly reversible curve in the case of a sphere of tin at very low temperature (in the supra-conducting state), while in a cylindrical specimen, the graph shows step-wise changes, with considerable hysteresis. This behaviour agrees with the assumption that the time effects observed indicate a slow expansion or contraction of macroscopic supra-conducting regions.

Examples showing how the exact value of physical constants (such as density and boiling point) of pure liquids can be estimated with a high degree of accuracy from the change in boiling point of the liquids as they become purer on distillation are given by Dr. M. Wojciechowski and Dr. E. R. Smith.

A greatly increased consumption of oxygen by cartilage tissue, upon addition of methylene blue, is reported by E. G. L. Bywaters. Under ordinary conditions, cartilage splits glucose into lactic acid without the use of oxygen.

Dr. S. Dobinski finds that the haloes obtained by diffraction of electrons on a copper surface polished in air are due to cuprous oxide. Polishing in absence of air gives rise to different haloes of such size as might be expected from degeneration of the usual copper pattern.

On placing living tissue cells in pure water or in a medium free from salts, Prof. H. Grossfeld finds that the cells take a globular shape, and that a vivid Brownian movement and increase in the number of granules takes place. The author ascribes these reversible changes to the loss of diffusible electrolytes, which produces a slow coagulation of the cytoplasm.

A group of symptoms observed when rats have suffered severe injuries from various agents (cold, surgical injuries, poisoning), which seems independent of the nature of the damaging agent, is described by Prof. H. Selye, who describes it as a "general adaptation syndrome". This syndrome, which develops in several stages, includes decrease in the size of thymus, spleen, lymph glands and liver, disappearance of fat tissue, formation of acute erosions in the digestive tract, increase in adrenals, etc.

Prof. J. Kaplan finds that when oxygen is introduced into the auroral afterglow in nitrogen, the spectrum of the resulting afterglow resembles very closely the spectrum of sunlit auroras as reported by Vegard and Tønsberg. He believes that the effect is brought about by ozone as postulated by Vegard and Tønsberg.

Evidence is submitted by Dr. Howell that the ground state vibrational frequency of a molecule AB is very nearly equal to the mean of the frequencies of the elementary molecules A_2 and B_2, where A and B belong to the same group of the Periodic Table.

A new 'dark sheath', with a sharp boundary, near the cathode of an arc discharge between the Langmuir double space-charge sheath on the cathode and the light of the 'arc plasma', is described by N. Warmoltz.

According to theoretical considerations put forward by J. Muller, electromagnetic oscillations are to be expected from a parallel-plane diode magnetron, when the magnetic field is arranged parallel to the plane of the electrodes. D. M. Tombs observes oscillations of the order of 30 cm. confirming this.

A. Hunter and Dr. R. W. B. Pearse find that in the region λλ 2500–2100 A., certain specially sensitised ultra-violet plates are actually less sensitive than ordinary plates when exposures are short or the radiation is weak. 'Sensitisation' in general increases contrast and maximum attainable density, but decreases threshold speed.

Spectra of the new star reported in last week's NATURE are briefly described by Drs. T. W. Wormell and J. C. Dobbie. The hydrogen absorptions indicate velocities which have risen from 1100 to 1900 km./sec. in two and a half days. Certain enhanced metallic lines are also present, in displaced positions, and the sharp lines of interstellar calcium are a prominent feature.

Research Items

Fertility and Contraception in the United States

DATA relating to the reproduction histories of 30,949 women (white and negro) overtly fertile in 1931 and 1932, and residing in or near twenty-six large cities in fifteen States east of the Mississippi and north of the southernmost tier of States, have been collected and are in course of analysis by Prof. Raymond Pearl. An important factor in any discussion of this material is the extent and effectiveness of contraception. It can alter completely the expression of variation in natural innate fertility. An attempt to evaluate the influence of this factor (*Science*, 83, May 22, 1936) shows that among the white population under investigation, 54 per cent have not practised contraception and among the negroes 83 per cent. Contrasting the two classes of contraceptors and non-contraceptors in white and negro respectively, it appears that in white and negro non-contraceptors, the pregnancy rates are identical; but among contraceptors, in the whites contraception is effective in reducing pregnancy 25–50 per cent in the various age classes, while among negroes it is without significant statistical effect in lowering the pregnancy rates below those of comparable classes of non-contraceptors. This confirms the experience of clinics that negroes do not practise contraception effectively, even after instruction. Clearly if no other variables were involved, this would result in a change in the relative proportions of the two elements in the population, which would be apparent in a very short time. There is, however, a much higher rate of production wastage (abortions, miscarriages and still-births), largely owing to the prevalence of venereal disease, among the negroes. This acts as one of several compensating factors in the birth-rate.

Antiscorbutic Activity of a Derivative of Gluconic Acid

IT is now known that a number of compounds chemically related to *l*-ascorbic acid or vitamin C can exert some degree of antiscorbutic activity. An addition to the list is announced in a letter addressed to the Editor by Prof. B. A. Lawrow, Prof. W. M. Rodionow, E. M. Bomdas and N. S. Jarussowa, of the Vitamin Department of the Institute of Nutrition, Moscow. They have found that the methyl ester of 2-ketogluconic acid exerts antiscorbutic activity in guinea-pigs in doses of 100 mgm. or more: 50 mgm. had a curative action in about half of a group of animals suffering from scurvy, but 25 mgm. had very little effect. This ester is an intermediate product in the synthesis of *d*-arabo-ascorbic acid, which has about one-twentieth of the antiscorbutic potency of vitamin C itself (see S. S. Zilva, *Biochem. J.*, 29, 1612; 1935). It thus appears that the ester of ketogluconic acid has about 1 per cent of the activity of *l*-ascorbic acid or vitamin C. The chemical difference between the two ascorbic acids lies in the position of a hydroxyl group in the chain. The Russian authors do not discount the possibility that the gluconic ester is converted first into *d*-arabo-ascorbic acid in the animal body and that the antiscorbutic activity is due to this compound: they also state they they are extending their investigation to include an examination of the action of the ester of ketogulonic acid, which occupies a corresponding position in the synthesis of *l*-ascorbic acid. The question whether antiscorbutic activity depends upon the presence of a cyclic structure in the molecule or can also be exerted by open-chain compounds must await further investigation, but may be difficult to decide if the conditions of conversion *in vitro* can be duplicated in the body.

Sex Change in a Fish

THE actual change of sex that takes place in a teleostean fish, *Sparus longispinis*, is the subject of a memoir by Kinoshita (*J. Sci. Hiroshima Univ.*, Ser. B, Div. 1, 4; 1936). In early life the gonad consists of a thread-like testis. Shortly after, oocytes make their appearance in tissue alongside the testis which now contains ripe spermatozoa. More of them make their appearance until a hermaphrodite condition is realized, but only functional sperms are produced. The final stage is brought about by the degeneration of the gonad of one sex, either male or female, thus leaving the old fish of the other sex. It is only when this stage is reached that functional ova are produced.

Fungi and Graft Unions

THE partnership between stock and scion of a grafted plant is usually well adjusted. There is, however, undoubted evidence that fruit-tree stocks can influence the type of scion growth, and the scion can, under different conditions, control growth of the whole tree. Mr. T. E. T. Bond has investigated the possibility that such relations would have an effect upon the relative susceptibility of herbaceous stocks and scions to attack by disease-producing fungi (*Ann. App. Biol.*, 23, No. 1, 11–29, February 1936). Various graft combinations of potato, tomato, woody nightshade, deadly nightshade, thorn-apple, *Physalis* sp. and henbane were prepared, and were inoculated on one side of the union with either of the fungi *Phytophthora infestans* or *Cladosporium fulvum*. The resulting attacks by these fungi were the same as upon ungrafted material, thus showing no influence of the other participant in the graft union, either in preventing, or helping, fungal attack in the herbaceous plants used for the experiment.

A Disease of the Japanese Laurel

THE common variegated Japanese laurel, *Aucuba japonica*, is but rarely the host of any fungus or bacterial parasite. Dr. G. Trapp has, however, isolated an organism, *Pseudomonas aucubicola*, a new species, which is very closely concerned in a 'die-back' disease of this popular shrub ("A Bacillus isolated from Diseased Plants of *Aucuba japonica* (Thunb.)", *Phytopath.*, 26, No. 3, 257–265, March 1936). Though the organism was consistently isolated from stem, leaf and root lesions of infected plants, very intensive attempts to re-inoculate healthy plants failed to reproduce the malady. It is considered that *P. aucubicola* is not a primary parasite, but can avail itself of a slightly diseased condition induced by some other cause. Morphological, cultural and physiological characters of the organism are set forth at length in the paper.

Atmospheric Vorticity

THE *Journal of the Faculty of Science*, Imperial University of Tokyo, Section 1, vol. 3, part 2, August 1935, contains a number of meteorological papers dealing with atmospheric vorticity. The first, by K. Nakata, with an introduction by Prof. S. Fujiwhara, is a study of the vertical component of vorticity. A number of synoptic weather charts are shown on which are drawn lines of isovorticity together with ordinary isobars for sea-level, for the neighbourhood of Japan for certain dates in the winters of 1922 and 1923. These show that the areas of positive (cyclonic) and negative (anticyclonic) vorticity generally nearly coincide with the cyclonic and anticyclonic areas, but that the two pairs of systems often differ in detail; that the different systems travel together; but that the distribution of vorticity is irregular in the regions lying between an anticyclone and a cyclone. The centres of maximum and minimum vorticity, in spite of the irregularities just mentioned, appeared to coincide very nearly with the main centres of low and high pressure. Later papers in the series by other Japanese writers extend the relationship to features other than the distribution of atmospheric pressure, including cloud and rainfall, and deal with the case of the typhoon. Very little is said of the difficulties that must have arisen from lack of sufficient observational material, and in the application of the classical hydro-dynamical equations to a complex and highly compressible fluid like the atmosphere; it is difficult to assess the importance for meteorology of the very laborious and difficult computations involved in this attack upon a subject which is undoubtedly of the greatest importance for progress in meteorology.

Electrical Contacts

ALL engineers who are familiar with the working of spark coils and the phenomena which take place where the brushes press on the commutator of a dynamo realize the importance of the study of electrical arcs and discharges, but it is only recently that their effects on the resistances of the materials in contact have been considered. In *World Power* of May, G. Windred has given a useful review of recent literature on the subject. The value of the contact resistance between two metals depends largely upon the conditions at the interface between them, but it is also largely affected by the formation of oxides on the faces. It is known that copper oxides produce a marked increase on the contact resistance. For a given current this increases the heating and the cumulative rate of deposit of the oxide. At a certain critical temperature, there is a sudden fall in the contact resistance, and this is of importance in the design of heavy-current contact breakers. The main factors which influence the life of electrical contacts are their hardness and their resistance to the effects of arcing. The relays used in modern telephone practice must operate faultlessly over long periods of time and with the minimum of inspection; their effective life depending on the duty cycle which they perform and the amount of attention which they receive. The disadvantages of using copper and brass are their low melting points and their susceptibility to corrosion. This led in the early days to the use of precious metals for electrical contacts. Papers by Carter and Kingsbury published in America (*Bell Journal Reprints*, April 1928) contain practically all our knowledge of this important subject. Kingsbury deals with the important subject of contact erosion and gives experimental data obtained from eight different contact metals showing their losses in weight, volume and atomic proportions relative to platinum.

Organic Derivatives of Silicon

IN the Bakerian Lecture to the Royal Society delivered on June 25, Prof. F. S. Kipping reviewed the work of the past thirty-five years at University College, Nottingham, on organic derivatives of silicon. With the object of determining whether silicon could give rise, like carbon, to dissymmetric molecules, a number of derivatives belonging to the two types $\mathrm{SiR_1R_2R_3R_4}$ and $\mathrm{(R_1R_2R_3Si)_2O}$ and each containing at least one aromatic nucleus, were prepared. These optically inactive compounds were converted to sulphonic acids, and resolutions with active bases were attempted. In each case only one active base gave the desired result. A remarkable feature was that in many cases the *d*- and *l*-acids, when combined separately with another active base, gave salts which were indistinguishable in all physical properties, including specific rotation. In the course of other investigations, it was found possible to direct attention to the great differences in behaviour between similarly constituted compounds of carbon and silicon. Thus the chlorides $\mathrm{SiR_3Cl}$ are easily hydrolysed by cold water to silicols $\mathrm{SiR_3OH}$, which pass readily into oxides $\mathrm{SiR_3.O.SiR_3}$. In no case has the formation of a simple silicone, $\mathrm{R_2Si{:}O}$, been observed, and indeed it seems probable that the group $\mathrm{>Si{:}O}$ does not exist, nor is there any evidence of the formation of an ethylenic bond between carbon and silicon or between two silicon atoms. The diols $\mathrm{SiR_2(OH)_2}$ and triols $\mathrm{SiR(OH)_3}$ give rise to complex mixtures by progressive condensations, the study of which throws light on the structure of mineral silicates. Acids of the type $\mathrm{R.SiO.OH}$ are probably not formed. The general conclusion is that corresponding carbon and silicon compounds show very little similarity in behaviour, only a few types of carbon compounds being represented by analogous derivatives of silicon.

Monogenic Functions

A FUNCTION of a complex variable is called monogenic at a point if at that point it possesses a unique finite derivative. It is well known that such a function satisfies the differential equations of Cauchy-Riemann; but the converse is not true. The problem of determining conditions that are sufficient for monogeneity and yet are free from unnecessary restrictions has not yet been completely solved, but an account of recent progress is given by Prof. D. Menchoff of Moscow ("Les conditions de monogénéité"; Actualités scientifiques et industrielles 329. Paris: Hermann et Cie., 1936). It is surprising to find that the demonstrations seem necessarily to involve complicated ideas of the modern theory of functions, even when the properties dealt with are apparently independent of these ideas. Perhaps some mathematician will take up the challenge, and supply the simpler proofs which, one is tempted to say, must exist.

The Indian Institute of Science, Bangalore

IN 1926 the Government of India appointed a committee with Sir William Pope as chairman to report upon the Indian Institute of Science, and one of its recommendations was that the activities of the Institute should be subject to review by a committee every five years. Early this year, Sir James Irvine was appointed chairman of the statutory quinquennial committee, and the issue of the report of this committee is awaited with interest. It is untimely, therefore, that the March issue of our Calcutta contemporary, *Science and Culture*, should publish a severely critical article on the present administration of the Institute. Anyone cognisant of the large volume of original work which has issued from the Institute since its foundation cannot doubt that it has more than justified the hopes of its munificent founder, the late Mr. J. N. Tata. The two main heads of the recent criticisms would appear to be (*a*) that the work of the Institute is too academic and (*b*) that, since the students are drawn very largely from South India, it is no longer an all-India research institute.

Whilst it may be true that much of the work carried out in the laboratories of the Institute is concerned mainly with problems of purely scientific interest, it is difficult to see how this could be otherwise. The research work in the Institute is done by young students who go there for a training in the methods of research. If they are not to be discouraged in their early years, it is essential that they should be assigned problems likely to yield results within a reasonable time. Furthermore, we very much doubt if it is possible to undertake *ad hoc* research on industrial problems. The industrial research institutions in Great Britain work in close contact with established industries, and they study fundamental problems related to these. It is very rare indeed that a new industry results directly from an isolated piece of research. We are of opinion that the Indian Institute of Science can best assist industrial development by working in collaboration with industry, as do the universities in Great Britain with Imperial Chemical Industries, Ltd.

The contributions of the Institute to industrial development have not been negligible; we need only instance the valuable researches made in collaboration with the Forest Research Institute at Dehra Dun on the causation of sandal wood disease, the investigations on wireless transmission in the tropics, and the work leading to the establishment of the sandalwood oil and white lead industries.

All industrial advancement is dependent upon pure scientific research, and it is a matter for congratulation that Sir C. V. Raman, the present director, has already built up a school of research in physics and that he was able to attract as a visitor to Bangalore so eminent a theoretical physicist as Dr. Max Born. Whilst the rapid development of research in Indian universities, not foreseen by its founders, has doubtless made necessary a new orientation of the activities of the Institute, we cannot doubt that it will continue to play a great part in the scientific advancement of India.

Progress in Atomic Physics

CONFERENCE AT COPENHAGEN

PROF. NIELS BOHR held a conference on atomic physics on June 17–20 in the Institute for Theoretical Physics at Copenhagen. About eighty physicists attended the discussions, including many from foreign countries.

The outstanding communication to the conference was a paper by W. Heisenberg on the quantum-mechanical theory of cosmic ray showers. Up to the present, no explanation of the fact that particles of very high energy can produce simultaneously, or in a single process, a large number of secondary particles, has been given in terms of the quantum theory of electrodynamics. Such showers of secondary particles have been observed by Hoffmann, Blackett and other experimenters.

According to quantum electrodynamics, the effective cross-sections for the simultaneous formation of n pairs of electrons lead to an extremely small probability for the occurrence of large showers. This calculation was made on the assumption that only the ordinary known electrical forces are of importance in the interaction between charged particles.

The phenomenon of β-disintegration has, however, suggested the idea, as in Fermi's theory, that there exist interaction forces of a new type between electrons and heavy elementary particles such as protons and neutrons. In this new type of interaction, a fourth elementary particle, the neutrino, probably takes part, as has been suggested by Pauli. Without the neutrino, it is impossible to preserve the law of the conservation of energy in the description of β-disintegration. It follows from the existence of these new interaction forces that an electron and neutrino can be created in an atomic nucleus, the electron being emitted as a β-ray, as Fermi pointed out.

Heisenberg has given a general proof that all interaction forces of the type that produce β-disintegration lead to the production of multiple processes and particles, when initiated by particles of high energy. The process may be of the following sort. A high-speed proton strikes a nucleus and produces in the field of the nucleus a great number of β-rays in one elementary action. Heisenberg suggests that the mechanism of the cosmic ray showers is of this type.

He has succeeded in calculating the minimum energy needed by the incident particle to produce this effect, and finds that the order of magnitude is in quite good agreement with the experimental observations of cosmic ray energies.

It is hoped that this new conception of the interaction between elementary particles will suggest methods of solving the difficulties in the theory of quantum electrodynamics, which arise from the incomplete knowledge of the physical laws governing the behaviour of particles of high energy.

V. Weisskopf discussed the Dirac theory of positrons, and showed that its formulation can be simplified, and some of its paradoxes removed. P. Jordan discussed the theoretical possibility of conceiving a light quantum as a pair of neutrinos. M. Born gave an account of his theory of quantum electrodynamics. Kalckar and Bohr gave a detailed mathematical account of their theory of nuclear disintegration. O. R. Frisch and G. Placzek gave an account of the structures of energy levels in heavy nuclei, and the possibility of investigating it by means of the absorption of slow neutrons. Rosenfeld and Bohr discussed the problem of the measurement of charges, and the importance of field and charge fluctuations for the definition of theoretical concepts.

The course of the discussions was, as always, directed by the masterly fundamental criticisms of Bohr. On these occasions, when so many able theorists are gathered together, it is clear that Bohr's physical insight is the power which contributes most to the advance of theoretical atomic physics, and creates the conditions which fertilize the mathematical abilities of theoretical workers elsewhere.

The most interesting and important paper on experimental physics was, perhaps, Jacobsen's account of his repetition of the Shankland experiment (see p. 24 of this issue). Shankland failed to observe coincidences between recoil electrons and scattered quanta when observing with counters at the angles expected according to the Compton theory of the photon scattering process. He used γ-rays from radium, which cover a large range of frequencies. Jacobsen, and Bothe and Maier-Leibnitz have now repeated the experiment with the almost non-chromatic γ-rays from thorium C′. They have taken great care in defining the angles used, and have found the expected number of coincidences. These results are confirmed by some less well-defined experiments by Fermi's collaborators. Thus the suggested failure of the conservation of energy in the Compton effect, so eagerly seized upon by Dirac, in order to get rid of some of the difficulties found in the formulation of a satisfactory relativistic quantum dynamics, is not confirmed. Bohr, Pauli, Heisenberg and other theoretical workers expressed satisfaction at this result, and hoped that further discoveries would mitigate the difficulties on which Dirac comments (see p. 24).

Heitler reported that Anderson has withdrawn his claim that the energy lost by fast electrons in the cosmic rays is much less than expected on general theoretical grounds.

Miss Meitner gave an account of some work on the radioactive effects produced in uranium by the action of slow neutrons. She showed that it is very probable that elements of atomic number 93 and 94 are both formed in the process. Dr. M. L. Oliphant described some recent work carried out in Cambridge, while Goldhaber showed that the mean free path in paraffin of the neutrons produced by the photo-electric disintegration of deuterium does not have the value predicted by the accepted theoretical picture of the interactions between neutrons and protons.

Uhlenbeck described how the modification of the Fermi theory of β-decay, proposed by Uhlenbeck and Konopinski, is in good accord with experiments on the energy distribution of β-particles from both electron and positron emitters of low atomic number. Richardson gave similar evidence in the case of β-emitters of high atomic number.

The general impression left by the conference was that progress in experimental research on the atomic nucleus is very rapid, but that the advance in the theoretical description of the new results is much slower. This is due largely to inadequate theories of the interaction forces between particles of high energy separated by small distances, which are of fundamental importance in the region of the nucleus.

Recent Advances in Wool Research

SEVERAL papers read at the Annual Conference of the Textile Institute held in London on June 3–5 dealt with wool and its characteristics.

Dr. A. B. Wildman, biologist of the Wool Industries Research Association, discussed estimations in the fleece of important wool characteristics, such as fineness variability, length, fleece density and kemp proportion. Emphasis was laid on the necessity for devising speedy and accurate methods of fleece analysis, in order that the relative merits of fleeces from breeders' flocks and from experimental sheep could be accurately measured. A historical résumé of earlier work was given, indicating that conflicting results were often due to lack of representative sampling methods. The author gave an account of his methods, which are subject to statistical control, in commencing analyses of thoroughly sampled fleeces. These investigations are intended to show the kind of variations occurring in fleeces of different types of sheep, and represent an essential prerequisite in the evolution of suitable methods for quality determination.

The quality of a fleece may be modified by exposure to light, air and water. This is attributed by Dr. J. B. Speakman, of the University of Leeds, in a paper on "The Reactivity of the Sulphur Linkage in Animal Fibres", to the oxidation of intact disulphide bonds or their hydrolysis products. More regulated changes of this nature occur in the milling, carrotting, crabbing and blowing processes. Dr. Speakman produced evidence to show that the cystine disulphide cross-linkage is more susceptible to hydrolysis in the stretched than it is in the unstretched fibre. He also showed that the contractile power of treated stretched fibres is dependent on the extent of the hydrolysis of the cystine disulphide cross-linkages, which vary with the *p*H value of the solution in which the fibre is treated.

Raw wool may contain fifty per cent of its weight of grease, suint, dirt and vegetable matter. Its cleaning is, therefore, an intricate process, and was the subject of two papers from the Wool Industries Research Association. Some of the fundamental principles of washing raw wool with solutions of soap and soda were dealt with by Dr. H. Phillips, who showed that the *p*H values of the detergent solutions used influence their wetting and emulsifying powers, and the stability of the emulsions which they form. Variations in the relative proportions of the different impurities in raw wool, caused by variations in the health of the sheep and the climatic conditions, have to be met by alterations in the washing process, which can only be foreseen when the process is under scientific control. Inherent weaknesses in the process are the effect of the alkali used on the wool and the incomplete removal of vegetable matter.

Dr. S. Townend described the frosted wool process, recently developed in the United States, by which it is claimed that large quantities of vegetable matter and grease can be removed from raw wool without subjecting it to alkaline solutions. The wool is cooled to −40° F., and the frozen grease and vegetable matter are broken up and removed by mechanical treatment. The process removes more vegetable matter than the normal washing process, but the finer qualities of wool still require carbonising after treatment. The grease content of the wool cleaned by this process is also relatively high, and for certain purposes the wool has to be washed with soap and soda.

Chemical Engineering Congress of the World Power Conference

H.R.H. THE DUKE OF KENT, in opening on Monday, June 22, the First International Chemical Engineering Congress at the Central Hall, Westminster, and welcoming delegates and members from thirty-seven countries, said: "Proud as each country is of the achievements of her great scientists and inventors, their work once done becomes international and contributes to the well-being and happiness of every race". The Right Hon. Viscount Leverhulme, in his presidential address which followed, dealt with the subject of chemical engineering and stated that the conception of holding an international congress of this kind was due to the late Sir Frederic Nathan, and that the development of that ideal into the present meeting was brought about by the World Power Conference.

About 120 papers from fifteen different countries were presented for discussion, whilst the membership numbered 850, comprising about 350 representatives from thirty-six overseas countries.

Two technical sessions were held before lunch and two in the afternoon on Tuesday, June 23, and Friday, June 26, but as visits to colleges, research institutions and works in and around London had been arranged for Wednesday afternoon and Thursday afternoon, the technical sessions on these days were limited to the forenoon.

Since chemical plant may have to resist corrosive conditions and may have to withstand high temperatures and/or high pressures, both the material of which it is constructed and the method of fabrication are important factors to the chemical engineer. It was therefore not surprising that the papers and discussions at the first two sessions on Tuesday morning were devoted to materials of construction. At the first of these, eight papers were presented dealing with ferrous metals and their alloys designed to resist heat, rust and acid corrosion, the forging of autoclaves and vessels for withstanding liquids at high temperatures and pressures. Nor was cast iron omitted, for included in this section were papers showing the result of recent research work on this material and its application in chemical industry, as well as others on the prevention of corrosion in underground pipe lines made of ferrous metals. The following session covered a much wider field since it contained papers on refractory materials, stoneware, plastics, rubber and such lesser known fibres as jute, coir, and sisal, as well as non-ferrous metals and their alloys, and their application in the construction of chemical plant.

Separation in the chemical industry is such a wide subject that at the third session, after lunch, the papers ranged from the theory of coal-washing through the recovery of benzol and the removal of carbon monoxide from town's gas to the production and treatment of road tars and to problems connected with the distillation of absolute alcohol, fractionation of heavy oils, modern cracking processes and graphical calculations relating to plate columns. Included in this section were other papers on filtration, recent developments in evaporation, crystallization, solvent extraction and drying.

The fourth session, which followed immediately, contained several papers relating to some interesting aspects of size reduction, among which was one describing a plant wherein low-grade fuel such as lignite can be pulverized and fired into the furnace of a boiler in one process, the boiler operating at a very high efficiency.

Another group of papers in this session considered electro-metallurgical and electro-chemical industries, as well as the electrolytic treatment of water for the prevention of corrosion and boiler scale and methods of removing small quantities of iron from soluble aluminium salts, the pasteurization of liquids, anodic oxidation of aluminium and arc welding of low carbon steels.

At the first session on Wednesday morning, the subject under discussion was destructive distillation, in which in addition to a paper on the underground gassification of coal, there was a number of papers on the problems connected with the manufacture of water gas and town's gas from lignite and similar fuels, as well as several papers on the various aspects of the development which has taken place in the gas industry in various parts of the world.

With the rapid growth of large industrial units, the disposal of waste material, whether solid, liquid or gaseous, has become a pertinent and pressing problem to the chemical engineer. It formed the subject of several papers at the next session. Coupled with this series were other papers which showed the recent developments which have taken place in the preparation and treatment of lubricating oils.

Within comparatively recent times, considerable attention has been directed towards the use of high pressures in the synthesis of organic compounds, the hydrogenation of tar and tar distillates and gaseous liquid phase reactions. The first session on Thursday morning was devoted to this subject. Included with this group of papers was one on the use of high vacua.

Few chemical engineers escape the problem of considering the transmission of heat to or the removal of heat from the product at one or more stages in the course of its manufacture. The importance of this subject therefore demanded the attention of the members during the second session on Thursday morning, when papers dealing with the evaporation of solutions liable to be affected by high temperatures, and the use of waste heat for low-temperature evaporation as well as methods by which waste heat may be recovered from intermittent sources, were under discussion.

The attendance and discussion which followed the report upon the papers on Friday morning dealing with the training of a chemical engineer indicated how this subject has been claiming the attention of both industrialists and teachers in America, Austria, Canada, France, Germany, Great Britain, Japan and the U.S.S.R.

In the session which followed were papers from Germany, Great Britain and the United States of America on administration, safety and welfare, and the statistical duties which fall to the lot of the chemical engineer in industry. These papers show how the countries concerned are taking precautionary measures to reduce accidents and occupational risks attendant upon chemical industry, and the factors which influence the choice of site for a works and the cost of the product.

Trend of development was the title allotted to the first session on Friday afternoon, at which papers were presented on a variety of subjects in which amongst others are those relating to water treatment and softening, fumigation, developments in the sulphuric acid industry and the production of concentrated fertilizers from poor phosphates. Although the papers in this group deal with many subjects, their importance to the technical worker cannot be denied, since they consider problems arising in many industries.

The organization of research stations both of a public and private character and the part which fundamental research must play in industrial organizations were the subjects of some of the papers presented at the last session, which also included other papers on rapid methods of determining the standard of the product, the standardization of chemical apparatus and its future development, as well as a number of other aspects of interest to the chemical engineer.

Sir Harold Hartley, chairman of the International Executive Council of the World Power Conference, presided on Saturday morning at the closing meeting of the Congress, at which various reports were presented. Thanks were also tendered by numerous speakers to the various committees and officers, and a striking tribute not only to the success but also to the utility of the Congress was given when it was announced that an invitation had been received from the German National Committee to hold a second International Congress on Chemical Engineering in Berlin in 1940.

Oceanic Macroplankton of the *Dana* Expeditions*

DR. P. JESPERSEN has compared the amount of macroplankton in the various waters investigated by the Carlsberg Foundation's Oceanographical Expedition round the world in 1928–30. Volume determinations were made of 2231 pelagic hauls, distributed in eight regions—North Atlantic and Caribbean Sea, Pacific and Tasmanian Sea, Indo-Malayan region, waters west of Sumatra, Indian Ocean, South Atlantic, Straits of Gibraltar and adjacent waters, and the Mediterranean.

The paper deals solely with the purely quantitative side of the macroplankton as a whole, the only exception being a determination of the fish and fish fry of the different water layers in the regions of the Pacific: otherwise only occasional notice is taken of what organisms may be dominant—so far as volume is concerned—in the composition of the plankton. It is usually the salps which are thus noted, sometimes siphonophores, *Sagitta*, euphausiids and decapods.

A comparison of the microplankton on the two sides of the Panama Isthmus shows a very great difference. Thus in the upper water layers (50–100 metres wire) the quantity is greater in the Caribbean Sea, but in all deeper hauls the volumes are very much greater in the Gulf of Panama. It is shown that in layers corresponding to hauls with 300–600 metres wire the amount of macroplankton in the Gulf of Panama is about twice the amount in the Caribbean Sea, and in depths corresponding to hauls with 1,000–3,000 metres wire the quantities of plankton are six to eight times larger in the Gulf of Panama than in the Caribbean Sea. The remarkably rich plankton fauna in the deeper waters of the Gulf of Panama is of peculiar interest, as nowhere else in the areas of the Pacific, Indian Ocean or the South Atlantic investigated is anything like such large quantities met with. It is only in the North Atlantic at about 30° N. that corresponding quantities of plankton are found in the deeper layers.

It is characteristic of the plankton fauna of the Gulf of Panama that it is considerably richer in the deeper than in the surface layers, a condition quite unique, since at all other places in the regions investigated the quantities of plankton are greatest in the upper layers. It may be said that, on the whole, the quantity of macroplankton in the deeper layers (hauls with at least 1,000 metres wire) is comparatively small and fairly uniform in most of the tropical and temperate oceanic regions. The one exception is the Gulf of Panama, where we find a remarkably large quantity of plankton in the deeper layers.

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* The Carlsberg Foundation's Oceanographical Expedition round the World, 1928–30, and previous *Dana*-Expeditions. *Dana*-Report No. 7: Quantitative Investigations on the Distribution of Macroplankton in different Oceanic Regions. By P. Jespersen. Pp. 44. (Copenhagen C. A. Reitzel's Forlag; London: Oxford University Press, 1935. 7s.

Educational Topics and Events

Birmingham.—The degree of D.Sc. has been awarded to the following: C. T. Barber, for published papers dealing mainly with the geology of certain districts of Burma, with particular reference to natural gas and oil resources; Mabel E. Tomlinson, for papers in the *Quarterly Journal of the Geological Society* on river terraces of the lower valley of the Warwickshire Avon, and on the superficial deposits of the country north of Stratford-on-Avon, and a paper on the drifts of the Stour–Evenlode watershed (*Proc. Birmingham Nat. His. and Phil. Soc.*); G. D. Elsdon, for published work on edible oils and fats, analysis of drugs and chemicals, and numerous papers on chemical investigations in subjects relating to public health.

Cambridge.—G. C. Evans, of St. John's College, has been appointed to the Frank Smart University studentship in botany, and Dr. L. E. R. Picken of Trinity College to the Balfour studentship.

A grant of £25 has been made from the Balfour Fund to J. D. Robertson, of St. John's College, for research on the calcareous skeletons formed by marine animals.

Glasgow.—The Bellahouston Bequest Fund Trustees have made a grant of £5,000 towards the cost of erection of the new chemistry buildings.

Prof. Gilbert Cook, professor of mechanical engineering, King's College, University of London, has been appointed regius professor of civil engineering and mechanics in succession to the late Prof. J. D. Cormack.

Prof. J. Shaw Dunn, St. Mungo-Notman professor of pathology in the University, has been elected professor of pathology in succession to Sir Robert Muir, who has retired.

Dr. H. B. Cott has been appointed lecturer in zoology.

The Gibson Lecture for 1936–37, on the history of mathematics, will be delivered by Dr. John Dougall at the Royal Technical College, Glasgow.

Leeds.—Dr. Archibald Durward has been elected to the chair of anatomy in the University in succession to Prof. J. Kay Jamieson, who has resigned. Dr. Durward has been a member of the anatomical staff of University College, London, since 1931; he was educated in New Zealand, and held appointments for six years in the Anatomy Department of the University of Otago.

Mr. Frank Parkinson, of Messrs. Crompton Parkinson, Ltd., Manufacturing Electrical Engineers, has placed a fund of £50,000 in the hands of the Council on loan, free of interest, which is to become the absolute property of the University after seven years. The gift is to be used as a Scholarship Endowment Fund, to be applied to the foundation of research fellowships or scholarships for graduates and scholarships or grants for undergraduates. Pending receipt of interest from the fund, Mr. Parkinson has offered a sum up to £1,500 to be granted in scholarships during the first year.

Liverpool.—The following appointments have recently been made: Dr. A. G. Walker, lecturer in the Department of Pure Mathematics, in succession to Dr. Haslam-Jones, who has been elected a fellow of Queen's College, Oxford; Dr. H. R. Hulme, lecturer in the Department of Applied Mathematics, in succession to Dr. G. C. McVittie, who has been elected to a readership at King's College, London; Dr. C. J. Williams, Leverhulme Foundation lecturer in the Department of Physics, in succession to Dr. Norman Feather, who has been elected to a fellowship at Trinity College, Cambridge.

London.—The title of reader in neurological anatomy in the University has been conferred on Miss U. L. Fielding in respect of the post held by her at University College.

The degree of D.Sc. in botany has been conferred on Mr. D. G. Catcheside, a recognised teacher at King's College.

University postgraduate travelling studentships of the value of £275 for one year have been awarded to Dr. C. J. B. Clews (Queen Mary College), and K. Stewart (Imperial College—Royal College of Science). Dr. Clews proposes to do further research in X-rays under the direction of Prof. K. M. G. Siegbahn at the University of Uppsala, and Mr. Stewart intends to study the chemical reactions in the electric discharge under the supervision of Prof. P. Harteck at Hamburg. University postgraduate studentships of the value of £150 for one year have been awarded to W. A. Cowdrey (University College); A. J. P. Crick (King's College); J. A. Downes (Imperial College—Royal College of Science); J. Gold (University College); A. M. Houghton (King's College); Margaret M. Jamison (Bedford College); L. J. Jolley (University College); J. Lawton (University College); and the studentship awarded to Joel Hirschfield in 1935 has been renewed for a second year.

Oxford.—At Encænia on June 24, the honorary degree of D.Sc. was conferred on Prof. E. D. Adrian, Foulerton research professor of the Royal Society.

Sir George Macdonald has been elected an honorary fellow of Balliol College.

W. E. Grimshaw, Corpus Christi College, has been granted the degree of D.Sc. for his work on plastico-viscous deformation and on combustion problems.

Dr. W. Stephenson, of the Psychology Department, University College, London, has been appointed assistant director of the newly-founded Institute of Experimental Psychology (see p. 14 of this issue).

St. Andrews.—On June 26, the honorary degree of LL.D. was conferred on the following, among others: Prof. E. Waymouth Reid, emeritus professor of physiology, University College, Dundee; Prof. J. E. Littlewood, Rouse Ball professor of mathematics in the University of Cambridge; Mr. David Anderson, consulting engineer, London.

The degree of D.Sc. has been conferred upon H. Greene, for a thesis entitled "Investigations on the Soil of the Eastern Gezira, Anglo-Egyptian Sudan", and on G. J. Robertson for his investigations on Walden inversions in the sugar group.

The fifth Congress of the Universities of the British Empire will be held in Cambridge on July 13–17, under the presidency of the Right Hon. Stanley Baldwin. Further information can be obtained from the Secretary, Universities Bureau of the British Empire, 88a Gower Street, London, W.C.1.

Science News a Century Ago

Patent Laws of the United States

THE act of Congress establishing the United States Patent Office under a commissioner was passed on July 4, 1836, and from that time American patents have been numbered serially. The issue of patents was provided for in the first article of the Constitution, where Congress was given power "To promote the progress of science and useful arts by securing for limited times to authors and inventors the exclusive rights to their respective writings and discoveries", and the first act of Congress specifying how patents were to be issued was passed on April 10, 1790. The act of July 4, 1836, was the outcome of a Select Committee of Congress appointed "to take into consideration the State and Condition of the Patent Office and the laws relating to the issuing of Patents for New and Useful Inventions and Discoveries". In the report of this Committee, it was stated that the average number of patents issued annually from 1790 until 1800 was but 26; from 1800 until 1810 the average was 71; from 1810 until 1820 it was 200 and for the ten years previous to 1836 it had been 535. The whole number of patents issued under the laws of the United States up to March 31, 1836, was 9,731. This was more than double the number which had been issued in France or England during the same period.

The Entomological Society

AT a meeting of the Entomological Society held on July 4, 1836, the Rev. F. W. Hope, president, being in the chair, Count Gotthelf Fischer de Waldheim, of Moscow, was elected an ordinary foreign member of the Society. The secretary made some observations upon an extensive series of specimens, represented by anglers as their artificial flies, collected by Mr. Ronalds for his work entitled "The Fly-fisher's Entomology". The president also made some observations upon the system adopted in North America whereby two crops of silk are produced in a season, as described by Mr. Kenrick in his work lately published upon that subject in the United States. (*Athenæum.*)

The Rev. Frederick William Hope (1797–1862) who was elected president of the Entomological Society in 1835 and 1846 was a graduate of Christ Church, Oxford. He presented his collection of insects and prints to the University and was the founder of the professorship of zoology.

Lyell and Mantell

WRITING on July 6, 1836, from Kinnordy, Kirriemuir, N.B., to Mantell at Brighton, Lyell said: "Here I am rusticating in a very beautiful country, not too hot, but with weather much like a fine English spring. I am now and then devoting some stray hours to my 'Elements', like Buckland's 'Bridgewater' long promised—but not yet reviewed, thank heavens. I have received a very pleasant letter from Alexander Burnes, who has returned to Cutch and re-examined the delta of the Indus. He reports that the submerged tract which sank in 1819 is *in statu quo*. He has sent me off some Cutch secondary fossils, ammonites, belemnites, etc. His letter came in nine weeks per steamer from Cutch! A letter from Dr. Silliman informs me that my 'Principles' are being printed in Philadelphia, and nearly ready. John Murray was in hopes he had reduced the price so as to prevent this happening."

Darwin at St. Helena

SAILING from Mauritius on May 9, 1836, H.M.S. *Beagle* called at the Cape of Good Hope and on July 8 arrived at St. Helena. "The next day," Darwin wrote in his Journal, "I obtained lodgings within a stone's throw of Napoleon's tomb: it was a capital central situation, whence I could make excursions in every direction. During the four days I stayed here, I wandered over the island from morning to night, and examined its geological history. My lodgings were situated at a height of about 2000 feet. . . . Near the coast the rough lava is bare; in the central and higher parts, feldspathic rocks by their decomposition have produced a clayey soil which, where not covered by vegetation, is stained in broad bands of many bright colours. . . . Beneath the upper and central green circle, the wild valleys are desolate and untenanted. Here, to the geologist, there are scenes of high interest, showing successive changes and complicated disturbances. According to my views, St. Helena has existed as an island from a very remote epoch; some obscure proofs, however, of the elevation of the land are still extant. I believe that the central and highest peaks form part of the rim of a great crater, the southern half of which has been entirely removed by the waves of the sea: there is, moreover, an external wall of black basaltic rocks, like the coast mountains of Mauritius, which are older than the central volcanic streams."

Trans-Atlantic Steam Navigation

IN July 1836 the books of subscription were opened of the British and American Steam Navigation Company, the first of the pioneer companies to construct a steam vessel for regular work on the North Atlantic. The company had been formed through the exertions of the American lawyer and business man Junius Smith (1780–1853). In 1832–33 he had crossed from England to the United States and back again by sailing packets. His outward journey had taken 54 days, his return journey 32 days, and it was these passages which led to his determination to promote steam navigation across the Atlantic. At first he met with no encouragement, but finally with the aid of Macgregor Laird (1808–61), the African explorer, he was able to float a company. When sufficient money was forthcoming, a contract for the *British Queen* was made with Messrs. Curling and Young, of Limehouse, and Smith wrote to his New York correspondents: "I have the pleasure to inform you that the Directors of the 'British and American Steam Navigation Company' have contracted for the building of the largest and intended to be the most splendid steamship ever built expressly for the New York and London trade. She will measure one thousand seven hundred tons, two hundred feet keel, forty feet beam, three decks and everything in proportion. She will carry two engines of two hundred and twenty-five horse-power each, seventy-six inch cylinder, and nine feet stroke. The expense of this steam frigate is estimated at £60,000."

The *British Queen* was the first steam vessel constructed expressly for the Atlantic trade; but she did not make her first passage until July 1839, by which time the *Sirius*, *Great Western*, *Royal William* and *Liverpool* had all made passages to the United States and back.

Societies and Academies

Edinburgh

Royal Society, June 1.

E. M. Anderson: The dynamics of the formation of cone-sheets, ring-dykes, and caldron-subsidences. Cone-sheet and ring-dyke systems are best known in Scotland and Northern Ireland, but are not confined to these districts. Cone-sheet formation may be explained by an excess of pressure, and ring-dyke formation by a defect of pressure, in an underlying magma basin, with a more or less dome-shaped roof. Solutions of the equations of equilibrium corresponding to certain shapes of basin have been found by the author.

J. B. Simpson: Fossil pollen in Scottish Tertiary coals. Lignites of early Tertiary age from Ardnamurchan and Mull, treated with Schulze's solution and alkali, yield a residue rich in well-preserved pollen. By this means, twenty genera of plants have been identified so far, including several not previously recorded as Scottish fossils. Of the gymnosperms *Cedrus* pollen is most abundant; *Abies* also has been noted. Dicotyledons include *Alnus, Engelhardtia, Magnolia, Planera*, five of the Asiatic genera of the Hamamelidaceæ and the Madagascan genus *Dicoryphe*. The present-day eastern Asiatic flora shows marked affinities with this ancient Scottish flora. (See also Nature, Feb. 22, p. 321.)

H. P. Donald: On the suppression of Tangled in *Drosophila pseudo-obscura*. An additive interaction of genes causing gaps in the venation with one causing extra tangled venation has shown that the phenotypic manifestation of a gene is no indication of its capacity to suppress the effects of another, and that genes with a recessive manifestation may have a dominant suppressing action which is not localized to the regions where the gene itself has visible effects.

H. W. Turnbull: The revised prepared system of the quadratic complex. This deals with one aspect of the invariant theory of quadratic forms in six variables by supplementing a previous communication in 1928 to the Society.

W. Ledermann: On singular pencils of Zehfuss, compound and Schläflian matrices. The paper is concerned with obtaining the canonical form of pencils of matrices related to two given matrices. The types considered are the compound, power and product transformations. Quite recently Roth, Aitken and Littlewood have dealt with the non-singular cases of these. The present paper completes the work of these authors by enumerating and solving all the outstanding singular cases.

Paris

Academy of Sciences, May 25 (*C.R.*, 202, 1725–1824).

Dimitri Riabouchinsky: Comparative research on the aerodynamics of small and of large velocities.

Jacques de Lapparent: The formula and structural scheme of attapulgite.

Daniel Dugué: Certain modes of convergence of laws of estimation.

Serge Finikoff: Some conjugated networks.

Constantin Dramba: The singularities of the restricted problem of three bodies.

Eugène Leimanis: The solutions of a differential system in the neighbourhood of a singular multiplicity.

A. D. Michal and E. W. Paxson: The differential in linear abstract spaces with a topology.

Florin Vasilesco: The generalized problem of Dirichlet and its relations with *balayage*.

Raymond Valtat: A calculating machine based on the use of binary numeration.

Maurice d'Ocagne: Remarks on the preceding note of Raymond Valtat.

Paulino Castells Vidal: A machine for resolving systems of linear equations.

Joseph Chalom: Reaction pumps.

A. Toussaint and S. Pivko: Guided plane stream. The influence on the aerodynamical characteristics of supporting wings.

Louis Breguet: The possibilities of speed and radius of action of gyroplanes. From a theoretical study it is concluded, that in addition to the advantages of vertical take-off and alighting, gyroplanes (helicopters) should, other conditions being equal, have a higher velocity and greater radius of action than ordinary aeroplanes.

Max Serruys: The influence of turbulence on the polytropic coefficient of expansion in petrol motors.

Stéphan Serghiesco: The formula of Fresnel in a corpuscular theory of light.

Georges Durand: The application of the mass-luminosity relation to the visual double stars.

Pierre Vernotte: The theoretical dimensions of the cellular vortices of Bénard.

Roger Julia and Jean Fallou: The extension of the properties of the quadripole to the most general balanced polyphase systems.

André Michel: The conditions of demagnetization of rhombohedral ferric oxide.

Roger Servant: Measurements of double refraction in the extreme ultra-violet. The measurements of P. Sève were given to 2400 A.; the author extends these to about 1860 A. and intends to extend the work in the Schumann region up to the extreme limit of transparency of the crystalline specimens.

Léandre Capatos and Nicolas Perakis: The magnetic study of the mixed crystals of divalent copper and silver. Measurements made with the complex compounds of pyridine with persulphate of copper and of silver, and of mixed crystals of the type $(Ag_xCu_y.4Py)S_2O_8$, where x and y vary from 0 to 1.

Georges Ahier: Christiansen filters. These light filters consist of a cell containing powdered glass rendered transparent by immersion in a liquid of the same refractive index. For the liquid, solutions of bromomercurate or iodomercurate of potassium and barium fulfil the required conditions better than the organic liquids usually employed.

Victor Lombard, Charles Eichner and Maxime Albert: The permeability of palladium to hydrogen. Loss of the diffusing power of pure palladium under the action of temperature. Regeneration of the poisoned palladium. A sheet of pure palladium, after exposure to a temperature of 500° C. or higher, suffers a marked diminution in its permeability to hydrogen. Oxidation in a current of air at 500° C. with subsequent reduction in hydrogen below 140° C. restores the permeability almost to the original figure.

Mlle. O. Hun: The determination of the total hydration of the ions of potassium iodide, by the cryoscopic method.

AUGUSTIN BOUTARIC and MLLE. PAULETTE BERTHIER: The mechanism of the ascent of hydrosols and of coloured solution through porous bodies.

MLLE. LUCIENNE CHAUMETON: The silver salts of amidosulphonic acid.

OSIAS BINDER and PIERRE SPACU: The action of malonic acid on cobaltidichloro-*trans*-diethylenediamine chloride.

ANDRÉ BOULLÉ: Calcium metaphosphates and pyrophosphates.

PAUL LACOMBE and GEORGES CHAUDRON: The mechanism of the decomposition of aluminium-magnesium solid solutions.

HENRI FOURNIER: The application of the methods of micro-chemical analysis to the study of the corrosion of light aluminium alloys. Two alloys were studied, duralumin and an aluminium alloy with 8 per cent magnesium. The amounts of aluminium determined were of the order of micrograms.

ROGER PAJEAU: The action of bromine in excess on some benzene derivatives in the presence of beryllium bromide.

LOUIS DANGEARD: Study of the oolitic limestones by staining and decalcification. Staining followed by slow decalcification brings out details of certain micro-organisms concerned in the precipitation of calcium carbonate and in the evolution of a large number of ooliths.

THÉODORE MONOD: New data on the structure of the western Sahara.

MARCEL GAUTIER: The stratigraphy of the region of Nemours (Algeria).

ARMAND RENIER: The structural plan of the subsoil of Belgium, chiefly from mining operations.

EMILE BELOT: Geophysical and mineralogical consequences of the hypothesis that the earth has had a vortex tube for origin.

HUBERT GARRIGUE: New results on the light of the night sky.

HENRI MARCELET: The presence of hydrocarbons in the product removed by deodorization in the refining of arachis oil.

PAUL RIOU, GÉRARD DELORME and HORMISDAS: The distribution of manganese and iron in the pines of Quebec.

ETIENNE FŒX and MAURICE LANSADE: The pathogenic action of a form of ***Fusarium oxysporum*** isolated from the potato.

DOMINGO M. GOMEZ: The decrease of arterial pressure as a function of time. Its determination in man by a piezoelectric method.

LÉOPOLD NÈGRE, ALBERT BERTHELOT and JEAN BRETEY: The action of ethyl stearate on the evolution of experimental tuberculosis of the guinea pig. In guinea pigs submitted to the action of ethyl stearate, the lesions appear later than in untreated animals.

PIERRE DRACH: The water absorbed in the process of exuviation; fundamental data for the physiological study of moulting. Definitions and quantitative determinations.

MME. VÉRA DANTCHAKOFF: Some factors determining secondary sexual characters.

MLLE. N. CHOUCROUN: Superficial electrification, a specific character of bacteria.

Vienna

Academy of Sciences, April 23.

GÜNTHER LOCK and GÜNTHER NOTTES: Derivatives of 3,5-dimethoxybenzaldehyde (5). The Cannizzaro reaction. In the chlorination, bromination and nitration of 3,5-dimethoxybenzaldehyde, only the hydrogen atom next to the aldehyde group undergoes substitution.

OTTO DISCHENDORFER and AUGUST VERDINO: Condensation of benzoin and thymol (2). Determination of the constitution of the nitration products of 4-methyl-7-*iso*propyl-2,3-diphenylcumarone.

MAX PESTEMER and FRIEDRICH MANCHEN: Ultraviolet absorption of some aromatic hydrocarbons (4). Constitution of hexahydropyrene.

OTTO REDLICH and WALTER STRICKS: Raman spectra of *o*-dideuteriobenzene and *N*-deuteriopyrrole.

ANTON KAILAN and SIEGFRIED ROSENBLATT: Velocity of esterification of alcohols in formic and acetic acid, and of formic acid in tertiary butyl alcohol.

L. ZECHMEISTER and L. v. CHOLNOKY: Thirty years of colour science.

R. JAGITSCH and A. MASCHIN: Reactions in the solid state (2). A study of the formation of copper ferrite by the Hahn emanation method.

LUDWIG ECKHART: The line of striction of a hyperbolic ruled surface.

HUGO BONDY and VIKTOR VANICEK: Relative abundance of potassium and lithium isotopes and the emission of alkali ions from glass melts. The abundance ratios of potassium and lithium isotopes from different glass melts were found to be ^{39}K/^{41}K = 14·1 and ^{7}Li/^{6}Li = 12. If a glass melt contains several alkali metals, the emission at low temperatures is due almost entirely to the element with the lowest ionization potential, and the surface of the melt undergoes impoverishment of the elements of higher ionization potential.

ERWIN FISCHER COLBRIE: Nuclear disintegration by a radium B + C source (2). Nitrogen. Protons liberated by radium C′ α-particles from nitrogen are found, by absorption measurements, to form two groups of different energy.

ADRIAN SCHUSTER: Tenebrionid (Col.) finds of Prof. Franz Werner and Dr. Otto Wettstein in the Greek Ægean Isles and in the Italian Dodecanese in 1934 and 1935.

E. STEINACH, H. KUN and O. PECZENIK: Recent researches on the action of sex hormones. (1) Castrated male rats do not show hyperæmia of the brain on injection with androsterone unless this contains œstrogenic substances. (2) The minimum dose of free male hormone required by castrated rats before copulation with a female occurs is reduced to nearly a third by the injection of female hormone. (3) The male organism is capable of converting excess male hormone into a substance with œstrogenic properties.

KARL KARAS: Kinematics of an expanding sheet.

April 30.

F. E. SUESS: Interpretation of the occurrence of pumice stone at Kofels in Ötztale. It is suggested that this occurrence and the peculiarities of the surrounding terrain are best explained as the result of the impact of a large meteorite.

FRITZ LIEBEN and BELLA BAUMINGER: The behaviour of sugars and formic acid in the presence of oxidizing bacteria.

RICHARD SCHUMANN: The moon, sun, and variations of latitude (1).

Forthcoming Events

Friday, July 10

ASSOCIATION OF APPLIED BIOLOGISTS.—Summer Meeting to be held at the Royal Horticultural Society's Gardens, Wisley, Sussex.

Saturday, July 11

BRITISH MYCOLOGICAL SOCIETY, at 11.45.—Annual Phytopathological Meeting to be held at the University of Bristol Research Station, Long Ashton, near Bristol.

MUSEUMS ASSOCIATION, July 6–10. Forty-seventh Annual Conference to be held at Leeds.

July 7, at 10 a.m.—Sir Eric Maclagan: Presidential Address.

SOCIETY OF CHEMICAL INDUSTRY, July 6–10. Fifty-fifth Annual Meeting to be held at Liverpool.

July 7, at 10.45.—W. A. S. Calder: "The Chemist as World Citizen" (Presidential Address).

July 8, at 11.30.—Sir Robert Mond: "Works as I have seen them grow" (Messel Lecture).

DECHEMA (Deutsche Gesellschaft fur Chemisches Apparatewesen), July 9–10. To be held in Munich.

GENERAL ASSEMBLY OF THE INTERNATIONAL ASTRONOMICAL UNION, July 10–17. To be held in Paris.

Official Publications Received

Great Britain and Ireland

Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, read at the Annual Visitation of the Royal Observatory, 1936 June 6. Pp. 28 (London: Royal Observatory.) [86

Joint Board of Research for Mental Disease: City and University of Birmingham Annual Report, 1935–36. Pp. 14. (Birmingham: The University.) [106

Technical Publications of the International Tin Research and Development Council. Series A, No. 40. The Detection and Colorimetric Determination of Tin by means of Substituted 1 2-Dimercaptobenzenes; A Specific Reagent for Tin. By Dr. R. E. D. Clark. Pp 6. Free. Series A, No. 41: The Preparation of Substituted Benzene-*o*-dithiols for use as Specific Reagents for Tin. By Dr. R. E. D. Clark. Pp. 7. Free. (London: International Tin Research and Development Council.) [106

The Lister Institute for Preventive Medicine Report of the Governing Body, 1936 Pp. 28. (London: Lister Institute) [116

Experimental and Research Station, Nursery and Market Garden Industries' Development Society, Ltd. Twenty-first Annual Report, 1935. Pp 96 (Cheshunt · Nursery and Market Garden Industries' Development Society, Ltd) [116

Imperial Bureau of Plant Genetics (for Crops other than Herbage) Plant Breeding Abstracts Supplement 2 · Summary of Reports received from Stations in the British Empire, 1932–35. Pp. 63. (Cambridge: School of Agriculture) 5*s*. [126

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1669 (Strut. 235): Behaviour in Bending of Thin-Walled Tubes and Channels By D. Williams. Pp. 13+5 plates. 1*s*. net. No. 1670 (Strut. 256): Successive Approximation Method of Solving Continuous Beam Problem. By D. Williams. Pp. 21+6 plates. 1*s*. 3*d*. net. No. 1672 (Strut 241): Loads and Bending Moments in Members of a Plane Braced Frame with Rigid Joints. By J. Morris. Pp. 42+4 plates. 2*s*. net. (London: H.M. Stationery Office.) [126

British Science Guild. The Annual Report of the Council of Management, 1935–1936. Pp. 23. (London · British Science Guild.) 1*s*. [156

London Shellac Research Bureau. Technical Paper No. 7: Fundamental Physical Properties of Lac. Part 3 Electrical Properties. By Dr. L. C. Verman. Pp. 21. Technical Paper No. 8: Darkening of Lac Solutions and the Effect of Oxalic Acid Thereon. By Dr. Lal C. Verman and Dr. R. Bhattacharya. Pp. 22. (London: London Shellac Research Bureau.) [166

City of Leeds Public Libraries: Commercial and Technical Library Bulletin Engineering Series No. 1: Mechanics and Materials. Pp. 6. Engineering Series No. 2: Mechanical Engineering. Pp. 6 Engineering Series No. 3: Workshop Practice. Pp. 6. Engineering Series No. 4: Civil Engineering. Pp. 6. Engineering Séries No. 5 Mining Engineering. Pp 4. Engineering Series No. 6. Metallurgy and Metal Working. Pp. 6. Engineering Series No. 7: Electrical Engineering, Part 1. Pp. 6. Engineering Series No. 8: Electrical Engineering, Part 2. Pp. 4. (Leeds Public Libraries) [176

Department of Scientific and Industrial Research. Report of Test by the Director of Fuel Research on a Report of the Coal Research Syndicate, Ltd., at Mansfield Colliery, Mansfield, Nottinghamshire—Test carried out 28th September to 4th October 1935. Pp. iv+28. (London: H.M. Stationery Office.) 9*d*. net. [186

Other Countries

Union of South Africa. Report of the South African Museum for the Year ended 31st December 1935 Pp. 18. (Pretoria: Government Printer.) [26

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Research and Finance

THE Parliamentary Science Committee has prepared a memorandum on the development and finance of the Department of Scientific and Industrial Research, including research associations. The memorandum is based upon a preliminary memorandum previously formulated by a joint committee of the British Science Guild and the Association of Scientific Workers. This joint committee may be regarded as the forerunner of the Parliamentary Science Committee, which is now, however, an independent body supported by a number of scientific institutions.

It is, of course, all to the good that a body, the membership of which embraces many distinguished scientific workers as well as industrialists, should devote its thought and energy to the question of how scientific research, and, perhaps, more especially, industrial research, in Great Britain should be developed and financed; but, equally of course, the Parliamentary Science Committee cannot claim to speak with paramount authority on this subject. Its views are its own, and the memorandum under consideration is to be regarded as its serious and constructive contribution to the general question stated above. The memorandum, when it is published in its final form, will no doubt be carefully considered, as it will deserve to be considered, by the Government and by such bodies as the Advisory Council of the Department of Scientific and Industrial Research, the Conference of Research Associations, the British Association, the Royal Society, and, it may be hoped, the Federation of British Industries—all of which having a direct interest in the subject matter of the memorandum, and each capable of contributing its own special knowledge and experience. We have been allowed to peruse the memorandum in its present form, and it may help to a constructive consideration of the very important questions raised if we endeavour to summarize briefly its argument and recommendations and to comment on them. We shall confine ourselves to the question of industrial research.

The memorandum starts by accepting as unquestionable the value of scientific research applied to the methods of industrial production, and pays ungrudging tribute to the work done by the research associations—numbering now some twenty—established under the scheme of the Department of Scientific and Industrial Research. "From six research councils only at the expense of less than £400,000 in all have come researches which have made possible a saving of £3,200,000 per annum. The aggregate saving from the work of all the Research Associations must be several times this sum and must represent a return on money invested of between 500 and 2,000 per cent."

Notwithstanding the demonstrated financial benefits that have resulted from scientific research, the problem of how to finance industrial research on a scale adequate for its maintenance and development is still acute. The real value of scientific research, whether pure or applied, is spread widely and can be financed only by finding an equally comprehensive basis for the collection of the necessary funds. Moreover, since one of the primary requirements of organised scientific research, and especially of industrial research, is that it should be prosecuted in a considered direction for a number of years, finance must provide for continuity.

The memorandum reviews briefly the methods adopted during the last eighteen years to finance the industrial research associations. At first it was intended that, after an initial period, the research associations should be entirely dependent on the support of their respective industries. In order to set the associations going and to convince industry of the value of research, a grant of £1,000,000 was made by Government, and this fund was used to supplement the subscriptions of the industries on a £ for £ basis over this initial period, which was first sanguinely estimated at five years. This plan proved impracticable; the five years' period was extended to ten years, but, as the exhaustion of the million fund coincided with the depth of the industrial depression, it was decided that Government assistance should be continued on a different basis.

The grants in aid of the research associations now come from the sums annually voted by Parliament for the Department of Scientific and Industrial Research, and a new system—"the datum line system"—has been instituted. Under this system the Department gives grants to the research associations on a £ for £ basis in respect of all subscriptions raised above a certain fixed datum, considered necessary for the upkeep of the association on a minimum basis of efficiency. The datum varies with the industry concerned, and there is an upper limit to the Government grant, now fixed generally at three times the datum figure. Thus if the schemes were fully utilized, the relative share of the Government would be two fifths of the total income available for expenditure on research. Moreover, the principle of Government grants in aid of research is now, apparently, accepted as a permanent policy—at least as permanent as is, say, the principle of State aid for education.

The Parliamentary Science Committee's chief criticism of the existing system of finance is "the rapidly fluctuating amount of money available for research and the lack of provision for the steady development of scientific research in industry". Accordingly, the memorandum sets forth certain "proposals for finance". In effect, they are proposals for the permanent endowment of research. "The ultimate sources of money needed for research," the Committee states, "are Government and Industry," and it is suggested that *both* should contribute to provide this endowment.

Incidentally, we may point out here that, in the long run, Government money can come only from the pockets of the citizens and, therefore, ultimately, from industry. It may be convenient to speak of both Government and industry contributing, but it will be as well to keep in mind that in the real "ultimate sources" it is industry that will have to find the money. It will serve, however, to regard the contribution of industry to research as being the direct contributions of the individual firms concerned as members of the several research associations; and to regard the Government grant as being the indirect contribution of industry generally, in return for the fruits of research, of which the general consumer is in the long run the greatest beneficiary.

The Parliamentary Science Committee rejects the method of raising contributions from the several industries by a statutory levy (as is done, for example, in the case of the woollen industry) on the ground that "the effectiveness of the application of scientific research depends to a large extent on the voluntary character of the collaboration between industry and science". On the other hand, the Committee rejects the alternative system of voluntary contributions because it has "the double disadvantage of penalising those firms who contribute as against those who do not and affording an extremely irregular income for scientific research".

We think the Committee's objections to the method of raising funds for research by means of a statutory levy are sound. There may be a few industries in which it is practicable, but in many industries it would be impossible to decide which firms did and which did not fall within the ambit of the industry under levy. Moreover, it is certain that there would be widespread opposition to such a plan on the part of a very great number of industries. The need for voluntary collaboration between industry and science, if the application of scientific research to industry is to be effective, was recognized from the outset of the research associations' scheme, and was well stated in one of the early annual reports of the Department of Scientific and Industrial Research.

The argument that those firms which contribute to research associations are 'penalised' as against those who do not, seems to us entirely misconceived. Voluntarily subscribing member firms of research associations derive directly, from the research work carried out and in other ways, benefits which are not available to non-members. It is true that in the long run non-member firms must benefit, and that ultimately, as has already been pointed out, the consumer will be the major beneficiary, but at first and for a time the subscribing members of the associations must be benefited and not penalized as against non-members. This must be a recurrent advantage with each successive discovery or advance, and is the main reason why members pay their subscriptions.

The argument that the system of voluntary contributions affords "an extremely irregular income for scientific research" has substance, but it can easily be pushed too far. Some fluctuations of income are inevitable in all organizations, whether devoted to scientific research or not, that are dependent largely for their income on voluntary contributions. It may be doubted whether the fluctuations of income in the case of the research associations, due to the voluntary character of the contributions from industry, are so "extremely irregular" as is suggested. The real trouble is not so much the magnitude of the fluctuations in the income from subscriptions, but the fact that the general average of the contributions is much too low, as the memorandum of the Parliamentary Science Committee recognizes. In any event, the fluctuations of income present a problem to the research associations not essentially different in character or, possibly, in extent, from that which individual industrial firms and whole industries have from time to time to solve. If the average income were enough, the fluctuations could well be managed, as similar irregularities are managed in business, by the building up and utilization of adequate reserve funds. These funds could well serve to 'iron out' irregularities in income. Scientific organizations in particular may be trusted to understand the functions of a fly-wheel. It seems to us that the Parliamentary Science Committee is prone to make too much of a bogey of fluctuations in income.

Having thus rejected both the statutory levy and voluntary contributions, mainly because they yield a fluctuating income, the Parliamentary Science Committee reaches, by an almost naïve logic, the conclusions that it is necessary to find some way of converting variable contributions into a fixed income and that this can be done only by the endowment of scientific research. Its proposal is "to set up a fund derived both from Government and Industry to provide a steady income sufficiently large for the basic needs of scientific research and for its expansion at a definite rate". The Committee estimates the amount required to be between £30,000,000 and £50,000,000, which might be raised immediately or by successive grants of two, three or four million pounds annually for a number of years. It is suggested, however, that the most equitable way of raising the sum would be to make it a charge on the revenue derived from the new Customs duties, such a compulsory grant to scientific research being regarded as compensation to the consumer for the loss of a free market.

"Once a Government contribution was assured, there would be no corresponding necessity for a steady contribution from industry," though the memorandum envisages contributions to the endowment fund from other sources, such as royalties from patents for the results of the work of the research associations and from statutory or quasi-statutory bodies.

Out of the annual contributions, raised as just indicated, and the interest on the sum already invested, the memorandum proceeds to say, "the current expenses for scientific research could be met according to a budget determined for some years ahead. In the end it would be hoped that science would be able to depend entirely on the interest from the fund and thus become independent of contributions from Government or Industry, although they might be required if any new developments on a large scale appeared to be necessary."

Such, stated very briefly (but not, it is hoped, so briefly as to be misleading), are the main features of the argument and proposals of the Parliamentary Science Committee for the establishment of a fund of, say, fifty million pounds, for the permanent endowment of scientific research, more especially in relation to industry.

The plan, it must be admitted, is both simple and bold. To many, indeed, it will seem grandiose. It would be impossible within the limits of a single article to examine adequately the proposals of the memorandum. But let us take one cardinal point. On what grounds is it possible to justify the removal from all Parliamentary control and criticism of the administration of essentially national funds raised by authority of Parliament ? Suppose the argument to be applied to our national system of education, that, in order to secure stability and "to convert variable contributions into a fixed income", it must be permanently endowed and thus rendered independent of Government grants and, therefore, of Parliamentary control. What would be the likely response of Parliament or of the electors generally to such a proposal ? To put it bluntly, are the proposals of the Parliamentary Science Committee 'practical politics' ?

Again, suppose such a fifty millions fund to be raised from national resources for the permanent endowment of research. What is to prevent some future Chancellor of the Exchequer, in desperate straits to balance his budget, from raiding the research fund, as previous Chancellors have raided road funds or sinking funds? No Government can bind future Governments.

The question should be considered whether research could not better be permanently endowed by each research association building up its own reserve fund. A Chancellor of the Exchequer in a tight corner would find it more difficult to raid these several scattered 'nest eggs' than to pounce upon some big central fund. The Department of Scientific and Industrial Research should encourage the formation of such reserve funds by the research associations.

The root problem remains, of course, how to secure for the research associations increased financial support so as to give them assurance not only of life but also of an expanded and expanding life. We cannot enter into this question fully here, but one point may be stressed. It has already been pointed out that so-called "Government grants" to research associations are in the last resort the indirect contributions of industry. Government is prone to complain that industry is not making a sufficiently large direct contribution to research. Government has it in its power to increase the indirect contribution of industry by the simple device of increasing the Government grants in aid. Experience has shown that increased contributions from Government do lead to an increase in direct contributions from industry, not merely to the research associations as such but also to the individual research work of the firms concerned. Finally, we agree with the Parliamentary Science Committee that a great deal more might be done by means of organized education, publicity and propaganda to secure wider and increased financial aid for the research associations.

Theory of Elasticity

An Introduction to the Theory of Elasticity: for Engineers and Physicists. By Prof. R. V. Southwell. (Oxford Engineering Science Series.) Pp. ix+510. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 30*s*. net.

A CONSIDERABLE gap exists between the preparation in engineering mechanics which is usually given in engineering schools and the preparation required to read such fundamental books as A. E. H. Love's "Mathematical Theory of Elasticity" or Lord Rayleigh's "Theory of Sound". Owing to this gap, new developments in the theoretical sciences are very slow to find their way into engineering literature, and it sometimes happens that very powerful methods which could be utilized in solving engineering problems remain for many years without applications. A striking example of this situation is represented by Clerk Maxwell's important paper "On the Calculation of the Equilibrium and Stiffness of Frames" (*Phil. Mag.*, 27; 1864). In this very condensed paper a general method of analysis of statically indeterminate trusses was developed for the first time. Although the problem of handling statically indetermined structures is of great practical importance, Maxwell's solution of the problem remained unknown to engineers until ten years later, when the method was rediscovered by O. Mohr (*Z. Architekten- und Ingenieur-Vereins zu Hannover*, p. 223; 1874), and put in the form which is now largely used in our theory of structures. Another example is represented by Rayleigh's method of approximate solution of vibration problems, which is so extensively and skilfully used by Prof. R. V. Southwell in the book under notice. Although the method was developed more than fifty years ago, its incorporation into English engineering books is a recent development.

Modern development of engineering is in the direction of more and more intensive utilization of pure science in solving practical problems. A designer interested in problems of strength of machine parts or engineering structures can no longer be satisfied with semi-empirical formulæ of strength of materials, and very often must go into a more refined analysis of stress distribution which can be done only by using the theory of elasticity. Under these conditions, engineers at the present time are becoming more and more interested in advanced study, and the purpose of Prof. Southwell's book is to provide the necessary preparation in the theory of elasticity required for reading more advanced books in that field.

The first three chapters of the book deal with problems which are usually discussed in books on the theory of structures. The author, by using Hooke's law and the principle of superposition, develops such fundamental theorems as the reciprocity theorem and Castigliano's theorems. The importance of these theorems is illustrated by many interesting examples. There is given also a general proof of the principle of superposition which is based on the use of Hooke's law. However, since there are exceptional cases in which Hooke's law holds while the principle of superposition cannot be applied, it would seem more satisfactory simply to postulate the principle of superposition and limit the discussion to those problems where it holds. The third chapter of the book deals with 'self-strained' bodies and structures. These important problems are usually treated with great brevity in books on strength of materials, and engineers should be thankful to Prof. Southwell for his very complete presentation of this subject. Beginning with very simple problems, he finally develops the general theory for handling self-stressed systems and gives an original and very instructive proof of Castigliano's theorem of least work, which enables him to introduce an interesting discussion of Saint Venant's principle.

The following four chapters contain material usually treated in books on strength of materials. An elementary theory of stress and strain is given and also the application of this theory to problems of torsion and flexure. It seems that in this place also the Mohr circle might have been discussed advantageously, instead of postponing its presentation to a more advanced chapter on the general analysis of stresses. In discussing deflections of beams, Macaulay's method is given. On the Continent, it is usually called Saint Venant's method, since Saint Venant originated the special method of integration which reduces the deflection problem under various conditions of lateral loading to the determination of only two constants of integration. The last of these four chapters deals with more complicated problems of stress analysis, including a treatment of helical springs, beams on elastic foundations, crankshafts and an elementary theory of bending of plates. A very complete discussion of boundary conditions in the theory of plates is added to this chapter.

The next five chapters deal with the fundamentals of the theory of elasticity. The discussion begins with a general analysis of stress and strain which at once requires a more elaborate system of notations than was used in the earlier portion of the book. Beginners in theory of elasticity usually have difficulty with symbols, and would appreciate the use of a system of notation which can be applied both in elementary strength of materials and in the theory of elasticity. In a book attempting to bridge the gap between elementary strength of materials and the theory of elasticity, this unification of symbols seems doubly desirable. However, Prof. Southwell prefers to change his symbols at the beginning of the chapters on elasticity, and he adopts in these chapters the notations of Kirchhoff and Love. From the point of view of engineers and designers, it seems very desirable to have some unification of symbols used in the theory of elasticity, and perhaps it is time to do some work in this direction. However, Prof. Southwell is sceptical regarding the possibility of any international agreement in regard to symbols after so much has been written in this field.

In Chapters xi and xii, the general equations of the theory of elasticity are applied to such important problems as torsion and bending of prismatical bars (Saint Venant's problem), to two-dimensional problems, and to cases of axially symmetrical stress systems. The author gives not only the theoretical solutions of the problems, but discusses also various experimental methods of solution such as the soap film and photo-elastic methods, which in recent times have been developing so rapidly in connexion with technical applications of the theory of elasticity.

The last two chapters of the book deal with stability and vibration problems. Here it is shown how these problems can be advantageously handled by using Rayleigh's approximate method. At the end, Prof. Southwell raises the controversial question of priority connected with the Rayleigh-Ritz method. Without doubt, the fundamental idea of this method belongs to Rayleigh, but the part of Ritz should not be minimized, since he added much in its development. Rayleigh used the method only for an approximate calculation of frequency of the gravest mode of vibration of complicated systems, and was doubtful (see Rayleigh's papers in *Phil. Mag.*, 47, 566; 1899: 22, 225; 1911) regarding its application to the investigation of higher modes of vibration. Ritz generalized the method and made of it a powerful tool for solving problems of engineering and mathematical physics.

It is the belief of the reviewer that in this book, Prof. Southwell has made a very valuable contribution to the literature of the engineering sciences. It can be recommended both to students who wish to pursue advanced studies in the field of elasticity and also to engineers interested in application of the theory of elasticity to problems of machine and structural design. Throughout the book one finds a clear presentation of the subject given by a man who himself has contributed to its development. The book contains many interesting problems which give the student an opportunity to try his own skill and thus to improve his knowledge by exercise. S. TIMOSHENKO.

Insulin

Insulin:
its Production, Purification and Physiological Action. By Douglas W. Hill and Dr. Frederick O. Howitt. Pp. xi+219+4 plates. (London: Hutchinson's Scientific and Technical Publications, 1936.) 12*s*. 6*d*. net.

IN the fascinating history of the gradual unfolding—it is too early yet to say elucidation—of the function carried out by the pancreas by means of its internal secretion, insulin, one is above all impressed by the ingenuity of the physiological experiments, which, in the early days, at all events, rather overshadowed the chemical work.

When the authors of this monograph set themselves the task of sifting the evidence that has accumulated since the first preparation of insulin, it was indeed a difficult one. "Very little systematic work under well-defined and what may be called standard conditions has been recorded. Hence it is difficult to place a fair estimate on the value of the results from each set of experiments". They make this observation concerning the action of insulin, but, with some notable exceptions, the criticism is true of much of the work on this hormone. Among the exceptions, the authors might have given greater prominence to the outstanding work of Abel, Freudenberg, Scott and their collaborators.

The book attains a highly valuable object in that it is provocative of further research. Whether it be some important question of principle or theory, or some smaller point of observation of fact, it is certain that it must stimulate the seeker after truth to find the answer to many problems left unsolved. Time and again the authors show how contradictory are the results that have been published: one set of workers forming one conclusion, whilst the evidence of another group leads to the reverse. The reason for the diversities of opinion is nearly always to be found in one or both of two causes: either too little allowance has been made for animal variations (for example, one rabbit serving as control for another), or, effects ascribed to insulin have, in reality, been obtained with samples of such impurity that they would be more correctly described as protein mixtures containing some insulin. It is frequent in the literature to find no reference made either to the method of test or to the potency of the sample used, which makes it quite impossible to assess the value of conclusions.

Before the chapters on the chemical, physical and physiological properties of insulin, the authors wisely direct attention to the relative impurity of much of the material used, which, as they suggest, may yet furnish records of some value. It is difficult to see, however, how any value could be attached to observations on the solubility of 'insulin' of potency 40 units/gm., that is, containing 99·8 per cent of impurity. Even in 1923, when these observations were published, much purer material was available.

Of particular interest is the chapter that deals with the effect of the other hormones upon insulin action, and it is a tribute to the authors that one should be led to speculate beyond the subject that they set themselves to treat, stimulated to inquire further into the question of endocrine balance.

The section on standardisation calls for some criticism. The emphasis laid on such questions as the distribution of sugar between plasma and corpuscles, which has little bearing on standardisation, in which whole blood is always laked, is an extravagant use of valuable space when some interesting aspects of testing could not even be touched on. In a work of which the stated object is to sift the evidence, it is surprising to find quoted an observation made in 1923 to the effect that at least three rabbits should be used for a test, whilst no mention is made that for years now about five tests on twenty rabbits each would be considered a reasonable number for an accurate assay. The suggestion of the greater regularity of behaviour of mice is not in accord with the general consensus of opinion to-day. The observation of Marks, that the mouse test gives results 15–30 per cent higher than the rabbit test, was made with crystalline or highly active amorphous insulin using a standard of much lower activity: it has been shown that the discrepancy may be in the opposite direction when relatively inactive substances are assayed.

The book is attractively presented, and the subject matter most clearly arranged. Above all, the bibliographies at the end of every chapter will be of inestimable value.

K. C. L.

A Book of Fishes

Naturgeschichte und wirtschaftliche Bedeutung der Seefische Nordeuropas
Von Prof. Dr. Ernst Ehrenbaum. (Sonderausgabe aus dem Handbuch der Seefischerei Nordeuropas, Band 2.) Pp. x+337+26 plates. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele) G.m.b.H., 1936.) 44 gold marks.

DR. ERNST EHRENBAUM, formerly of Heligoland, afterwards director of the Fisheries Institute in Hamburg, has been for many years one of the best known and most trusted of all the many naturalists engaged in fishery investigation. Dr. H. Lübbert, once better known as Captain Lübbert, is a rare blend of seaman and scientific man; he has had more to do than any other man with the development of the German sea-fisheries, and he has been called in to advise Governments in many parts of the world. Thirty years ago, Captain Lübbert founded *Die Fischerbote*, one of the very best of all fishery journals; and for most of the time since then the two have edited it together. Now they have embarked on the great enterprise of publishing a "Handbuch der Seefischerei", of which a good many parts are now ready, and which will form at last an encyclopædia of all our northern fisheries—from the Murman Coast to Brittany, from oysters to whales. Nearly two hundred years ago Duhamel du Monceau did much the same thing, and did it wonderfully well; another hundred years and we come to Isaac Walton and Cotton's "Universal Angler"—little, but good; yet another fifteen hundred years and we make the best we can of Oppian.

The first volume of the great "Handbook" contains, or will contain, a sketch of oceanography, a description of the sea-bottom, an account of marine vegetation, a discussion of the diet and ultimate sources of nutrition of marine animals, and in general of the balance of Nature in the sea. The book before us is the second volume, and deals systematically with the fish of our northern seas; it gives a full but very concise account, in some 300 closely printed and richly illustrated pages, of all our marine fishes; and not only the salmon but also most of our fresh-water fishes come into the story also, as inhabitants of the Baltic Sea. Almost every fish has its figure, except a very few which are obviously not needed here: such as some of the rarer deep-sea *Macruri*, or some of the Mediterranean and Atlantic fishes, *Box*, *Sparus*, *Pagellus* and the like, which only come to our northern seas as errant stragglers. Few of the figures are original; they are mostly drawn, and admirably reproduced, from Smitt, Collett, Joubin, Day, and occasionally Cuvier.

This is a book not only about fish but also about fisheries; for ours is a commercial age, and we want to know the fish in the market as well as the fish in the sea. Day's "British Fishes", written fifty years ago, and for most purposes our standby still, is an excellent book, full of information and knowledge. But the fisheries of the world have changed mightily in the half-century from Day to Ehrenbaum. When Day wrote, the saithe (for example) was caught "by angling, or line-fishing, the lugworm being found a good bait"; it was "not much sought after, being held in little esteem". But now, as Ehrenbaum tells us, 100,000 tons (114 million kilos) were brought to market in 1932 from our northern seas, all the way from the North Sea to Iceland and Spitsbergen. Fifty years ago, the megrim was a rare fish, to be recorded one by one; to-day at least 6,000 tons come to market every year, and it fetches a good price, in Germany even a high one.

The catch and the value of each and all of the marketable fishes are dealt with briefly but adequately in this book, but so indeed is every other part of the subject; Dr. Ehrenbaum omits little, and forgets nothing. The few pages on the cod tell how G. O. Sars studied its development, how Michael Graham and others have studied its rate of growth, what Hjort has written on its migrations, how Einar Lea has studied its scales. An excellent account of the mackerel tells of its migrations between the deep sea and the coastal waters, how its diet changes with place and season, and how it fasts about Christmas or New Year; how we catch it, on one hand by line and on the other by the trawl; and how, unlike the salmon or the sprat, it seems to spawn at one and the same time, whether off the Irish coast or at Heligoland. The part on the tunnies, tunny, bonito, germon, pelamyd, albacore and so on, in all their puzzling and shifting nomenclature, is particularly good. There is an up-to-date account, based mostly on R. S. Clark's work, of the many northern skates or rays and their eggs; Holt's work on the gobies, Tate

Regan's amazing account of the males of *Ceratias*, the work of C. J. G. Petersen and many others on the varying rate of growth of plaice according to the density of population and the available food, and of course Johannes Schmidt's epoch-making studies of the eel—all these are among the many matters clearly and lucidly explained.

In short, this is a good book and a useful one all through. It is not for easy reading but for reference and study; and few will open it without finding what they want to know. D. W. T.

The New Agriculture and World Peace

Nations can live at Home
By Dr. O. W. Willcox. Pp. 279. (London: George Allen and Unwin, Ltd., 1935.) 10*s*. net.

PEACE is the paramount need of the world to-day. Of the many factors, complex, obscure and profound, which tend to endanger peace and produce war, one at least can be definitely diagnosed as the increasing pressure of population, in some parts of the world, on land resources. Any practical means that can be applied to reduce that pressure should, if coupled with the requisite social and political adjustments, become a powerful agent of world peace. Such is the message of this book, a message of profound and vital importance, of particular interest to scientific agriculturists and students of population problems, but also of wide general appeal. Many nations are at present quite unable to obtain from their own soil all their requirements in food and raw material, which they must import accordingly and pay for by exports. But with the vast shrinkage in international trade and the increasing difficulties of keen and world-wide competition, this method of obtaining the desired supplies may appear, to some of the nations so situated, as much more difficult and less satisfactory than that of actual, and if need be aggressively, warlike attempts to find additional territory outside their own boundaries. Dr. Willcox, however, now offers to the peoples in these straitened and parlous circumstances a simpler, easier and much more effective method: that of greatly increasing the yields of their own soil, by using to their fullest extent the wonderful powers of crop productiveness that modern plant-breeding and soil science—the new agriculture or agrobiology—has placed within their reach.

The book makes a powerful and compelling twofold appeal: first, because of the inherent interest of the wonderful results claimed on behalf of agrobiology in respect to vastly increased yields from the land; and secondly, the profound economic, social and political consequences of such agrobiological advance.

Whilst fully admitting, however, that plant-breeding or genetics and soil science have made immense strides and produced results of the kind and magnitude herein described, backed up indeed by large-scale field work in many parts of the world, it nevertheless seems to the present reviewer that the difficulties due to such things as plant pests, drought, flood and other meteorological disturbance, the human element, and above all costs, have just possibly been brushed aside a little too indifferently.

It was perhaps scarcely possible, within a book of this compass, to deal fully with all the practical difficulties in technique. The far greater difficulty is that of getting the new methods generally adopted by those very conservative and sceptical people, the farmers. In the very interesting chapter dealing with the special conditions in various 'deficit' or 'beyond the threshold' countries—Great Britain, Germany, Italy, Japan—Dr. Willcox describes the remarkable results obtained by the Better Farming Association in Japan, in the matter of rice yields. The best type of farmer, using the best and most productive variety of rice plant, under the best agrobiologic conditions, obtained yields several hundred per cent above the average. But it was very difficult, if not impossible, to arouse the interest of the majority of farmers in Japan.

There is, of course, the further complication of over-production in those parts of the world which are mainly agricultural, and supply world markets. This is touched upon in the present book, and provided for plausibly if not too convincingly.

Some of the figures given for crop yields or possibilities are startling enough, especially when combined with reduced crop cycles so that several crops can be taken from the unit of land each year. These are studied at some length in relation to population density, and the relative values of different crops from the protein–carbohydrate ratio point of view. It is generally concluded that population densities up to 15,000 or more per square mile are not beyond the bounds of agrobiological possibility; but it is scarcely fair to the author to state these bald figures without the accompanying well-reasoned arguments in support.

W. G. L. C.

Libraries for Scientific Research in Europe and America

By H. Philip Spratt. Pp. 227. (London: Grafton and Co., 1936.) 10*s.* 6*d.* net.

THIS informative little book is the result of a series of tours made by the author in Europe and North America, and sets out to describe the research facilities existing in the more important specialist libraries of the two continents—not only from the point of view of the librarian who wants to know the latest methods in actual use, but also from that of the research worker anxious to learn in what way modern libraries administer to his needs in the search for published information on his subject.

After describing six representative libraries in London, the author takes us *via* Paris and Brussels to Scandinavia, Germany, Poland, and Russia—finding in the latter country that most of the libraries are dominated by "books on science (and communism)"—and thence to America, to which about one half of the book is devoted. In the case of each library—and nearly a hundred are included in the book—Mr. Spratt gives details of the arrangement of catalogues and indexes, of the classification used (with a distinct leaning towards the Universal Decimal Classification), of information services and the provision of photographic and other apparatus, and of the general administration in so far as this interests the public as users.

The survey is thorough and there is evidence throughout of the author's practical knowledge of the problems involved and of his first-hand inquiry into the present methods of dealing with them. The index is well constructed but lacks balance. The entry "British Museum, 47" supplies the information that the Bibliothèque Nationale ranks with the British Museum, while "John Crerar Library, 186" refers the reader to a five-page description of that institution.

A. G.

Primitive Law

By A. S. Diamond. Pp. x+451. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1935.) 25*s.* net.

MR. DIAMOND holds that Sir Henry Maine's conception of primitive law as inseparable from the concepts of primitive religion and morality is no longer tenable in the light of modern research, and, further, that in the development of early law there is a parallelism which corresponds with economic and social progress. Thus the code of Hammurabi, for example, is formulated in a society which corresponds in economic development with the societies which produced the codes of medieval Europe. The undoubted religious elements which appear in the codes as they have come down to us are due, he holds, not to the fact that they embody survivals from an earlier stage in which religious belief, law and morality were undifferentiated, but are due to introductions by priestly scribes at a date later than the formulation of the codes.

Mr. Diamond has made a careful analysis of such early codes as have survived, and has surveyed in detail the practice of modern primitive peoples for evidence in support of his view. This vast mass of fact brings out clearly certain weaknesses in the over-simplification inherent in Maine's point of view and method. On the other hand, as regards Mr. Diamond's principal contention, however much may be conceded to priestly intervention, the distinction by which the author would seek to rule out Maine's view is largely a question of definition and determination of the point at which what he regards as law begins.

The Extra Pharmacopœia of Martindale and Westcott

(Published by direction of the Council of the Pharmaceutical Society of Great Britain.) Twentieth edition. Vol. 2. Pp. xxxvi+889. (London: The Pharmaceutical Press; H. K. Lewis and Co., Ltd., 1935.) 22*s.* 6*d.* net.

W. H. MARTINDALE, who had for many years carried on his father's work as author of the "Extra Pharmacopœia", died in 1933. He had brought out a new edition every four years and the book has become indispensable. He produced the first volume of the twentieth edition in 1932. The second volume has now been prepared by a committee of the Pharmaceutical Society—under the editorship of Mr. C. E. Corfield, the editor of the "British Pharmaceutical Codex". This committee has undertaken the heavy task of preparing future editions. It has always been a source of wonder that Dr. Martindale should be able to do all this by himself; Dr. Westcott's collaboration only lasted for a period.

The first volume deals with the manufacture, composition and uses of drugs. The second volume consists of a series of appendixes dealing with diverse subjects such as the analysis of bread and butter, health resorts, disinfectants and proprietary medicines. The committee has managed to carry out a thorough revision without destroying the book's individuality. Most of the familiar sections are still there, expanded slightly and brought up to date. The section on modern views of atomic structure now occupies six pages. Modern methods of biological assay have been included, and there is much interesting information about recent work on hormones and vitamins.

Mechanics and Hydrostatics

By Dr. R. G. Mitton. (Dent's Modern Science Series.) Pp. ix+275. (London: J. M. Dent and Sons, Ltd., 1936.) 3*s.*

THIS volume has been designed to cover the School Certificate and Matriculation courses in mechanics and hydrostatics. The author has presented the subject matter in a very lucid and interesting manner, and a noteworthy feature is the number of excellent photographic reproductions illustrating the practical applications in industry of the principles discussed. It will also be encouraging to up-to-date teachers to find that the author has adopted the policy of treating absolute units as fundamental from the earliest stages.

The book is amply supplied with exercises, many of which have been taken from the various School Certificate and Matriculation examination papers. Answers to these are also given.

Seasonal Changes in the Underwaters of Bermuda

By Prof. Walter Garstang

AFTER a visit last year to the Bermuda Biological Station, I directed attention in a semi-popular article to the unique opportunities at this lonely Atlantic island for oceanographic research, and suggested that continuous local investigation of the deep water around the island would be likely to hasten a solution of the "Atlantic Water" problem, which has such important bearings on European fishery and other questions (*Discovery*, December 1935). This opinion has been considerably strengthened by the subsequent study of various hydrographic reports, and especially by a collation of the published data recorded by various research vessels in the immediate neighbourhood of the island.

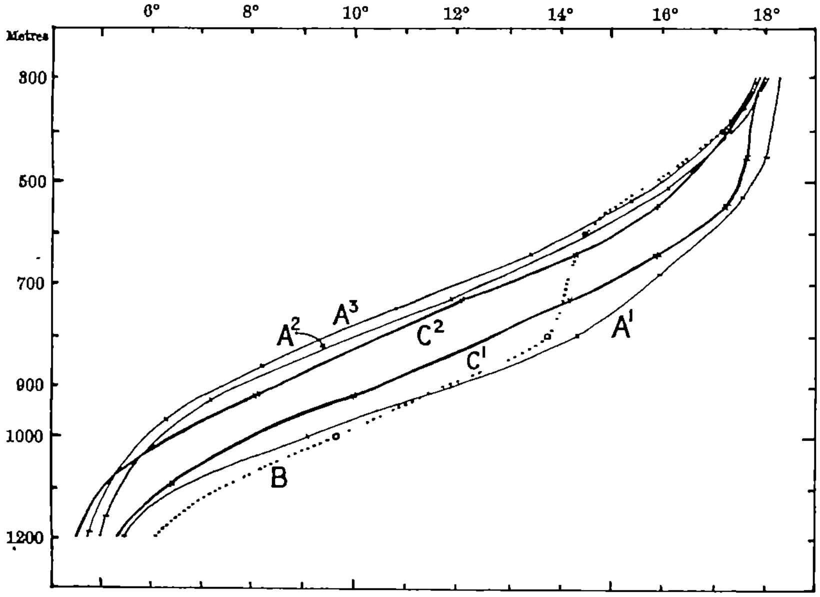

FIG. 1. Temperature curves of selected Bermuda stations (intermediate layer only). A^1, A^2, A^3: *Atlantis*, February, April and December 1932, respectively. B: *Bache*, February 1914. C^1, C^2: *Challenger*, April and May 1873, respectively.

Temperature and salinity determinations at the following stations have been used: H.M.S. *Challenger* (temperatures only), stations 37 (April 24, 1873) and 57 (May 30, 1873); st. 10179 of the U.S. Fish Commission's vessel *Bache* (Feb. 18, 1914); st. 1339 of the Danish *Dana* Expedition (May 10, 1922); and six stations of the Woods Hole Oceanographic Institution's vessel *Atlantis*, namely, 1125 (Dec. 5, 1931), 1145 (Feb. 17, 1932), 1220 (April 17, 1932), 1359 (Aug. 27, 1932), 1431 (Dec. 5, 1932), and 1464 (Feb. 12, 1933). These stations are dotted about the island in various directions, all within a radius of sixty miles, except the first *Atlantis* station (1125), which lay 120 miles to the north-west. The data for this station furnish one of the extremes in the range of variation, but its inclusion seems to be amply warranted by a comparison with other stations at the same period.

The general characteristics of the water-column in the Sargasso Sea are well-known, and many temperature curves from the region have been figured by the *Challenger*, *Dana* and other expeditions. All show beneath the variable surface region two more or less vertical portions, representing relatively uniform layers: (*a*) a sub-surface layer of high salinity (*c*. 36·5 per mille) below the influence of solar radiation (150–400 metres), but preserving the effects of winter convection at a nearly constant temperature of 17°–18° (the average surface minimum), and (*b*) the deep waters (below 1,000 metres) of low salinity (less than 35·0 per mille) and temperature less than 5°. Between these two strata lies an intermediate layer (*c*. 400–1,000 metres) the variations in which are the main subject of this communication. It ranges over a considerable series of closely stratified temperatures and salinities, which confer a characteristic slope upon this portion of the curve. When the curves of the various Bermuda stations are superimposed upon the same large sheet of graph paper, it can be seen that the slope representing the intermediate layer changes its position with the season of the year, running at a higher level and to the left (that is, nearer the surface and through lower temperatures) during the summer and autumn, and lower down to the right (that is, through higher temperatures) during the winter and early spring—the very opposite of seasonal changes at the surface. Temperature and salinity curves follow the same orderly cycle, which, so far as the records go, differs only in amplitude from one year to another

(Fig. 1). The *Bache* curve for February is unique in showing autumn conditions above and winter conditions below. The soundings must have been taken while the winter change was in progress.

In the available space only a few of the curves can be conveniently reproduced, but the regularity of the sequence and the varying amplitude of the annual change come out almost equally well if we take a few representative isotherms and isohalines from the curves, and plot their levels in the water-column at the various times of the year represented. The invaluable *Atlantis* data naturally furnish the basis of such a diagram (Fig. 2). The continuous lines represent the varying depth of the isotherms 17°, 15°, 11·5°, 8° and 6° and between the first four of these the isohalines 36·2, 35·6 and 35·2 per mille run as lines of dots and dashes. The *Challenger* records in 1873 for April (C^1) and May (C^2) have been connected with those of the first *Atlantis* February, the *Dana's* for May 1922 with the *Atlantis* April, and the *Bache's* for February 1914 with the second *Atlantis* December—of course, merely for convenience of reading.

It is plain from the figure that the active parts of the annual cycle are concentrated in the period from December to April or May. In February there is a sharp drop in the level of the isotherms (and isohalines) by some 100–300 metres, and in April (or April and May) a corresponding, but not necessarily an equivalent, rise. It should be borne in mind that, owing to the normal graduation of temperature and salinity from above downwards, the lowering of an isotherm implies a deepening of the mass of warmer water above it, and the lowering of a whole series of isotherms a general increase of temperature throughout the water-column represented. Similarly, a raising of the isotherms implies an upward extension of the colder waters and a corresponding decrease of temperature at the depths under consideration; so also with isohalines and salinity, *mutatis mutandis*. From April to December, the *Atlantis* isotherms and isohalines show little or no changes of level, though there is a slight upward tendency, especially of the isohalines. It may therefore be inferred that the relatively low levels of the *Challenger* isotherms in May 1873 and the high levels of the *Dana* isotherms in May 1922 were probably maintained throughout the summer of their respective years, implying relatively high temperatures throughout the intermediate layer in the summer of 1873, and low temperatures in 1922. The conditions in 1932 were intermediate, but nearer those of 1873 than of 1922, though attained earlier, in April instead of May. Confirmation of the exceptional warmth of the intermediate waters throughout the Sargasso Sea in the summer of 1873 has in fact already been given by Helland Hansen when comparing the *Challenger* station 65 (halfway between Bermuda and the Azores) with corresponding stations of the *Michael Sars* in June 1910 (Murray and Hjort, 1912, Fig. 210).

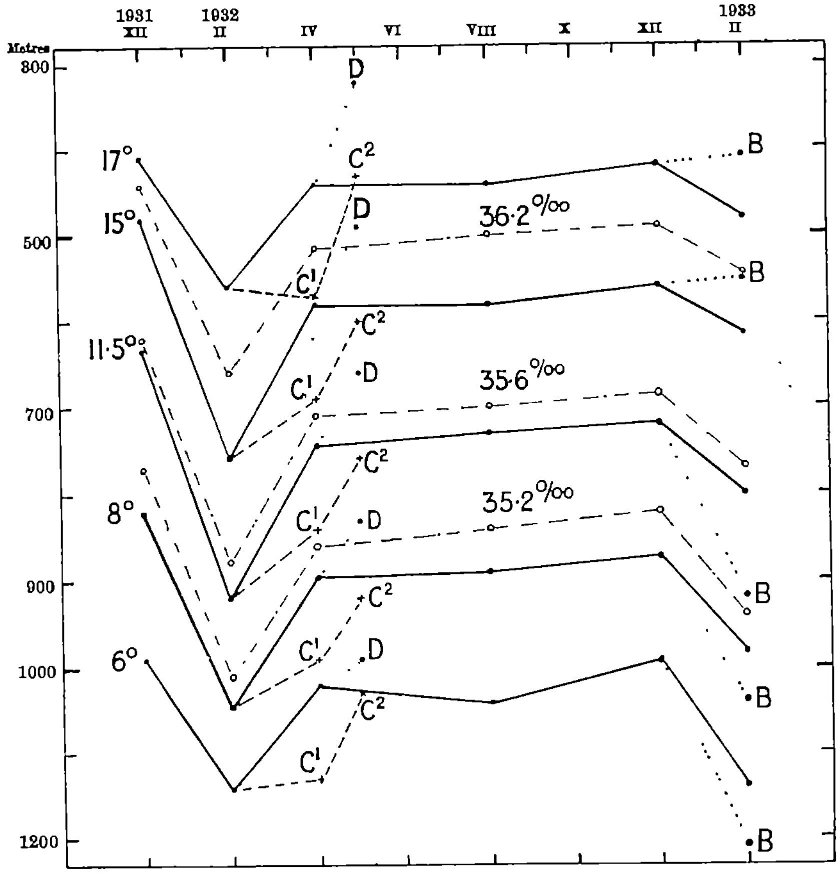

FIG. 2. Depth of selected isotherms and isohalines from the complete curves, showing monthly changes.
●—, *Atlantis* isotherms.
○—·—, *Atlantis* isohalines.
×— —, *Challenger* isotherms (C^1, April; C^2, May 1873).
● . . . , *Dana* (*D*) and *Bache* (*B*) isotherms.

So far, I have described this sequence in terms of obvious changes in the level of isotherms and isohalines, which, as oceanographers know, are liable to disturbance from a variety of causes. Although some of these factors could at once be eliminated from the present case, it is sufficient here to note that the Bermuda cycle is not conditioned simply by a periodic undulation of the isotherms, but by measurable changes in the temperature-salinity ratio. Fig. 3 shows the salient differences in the salinity associated with various degrees of temperature at the Bermuda stations regardless of depth. The ratio of salinity to temperature attained a maximum height in December 1931, and was followed in February by a smart fall, which continued to April. The *Dana's* records for May 1922 show the minimum for the whole series, thus pointing to the probability that a fall in the salinity ratio is a regular phenomenon from February until April or May. After April 1932, the ratio rose slightly through the summer and autumn to December, when it was succeeded by a marked rise in the following February, greater for the lower degrees of temperature than the higher.

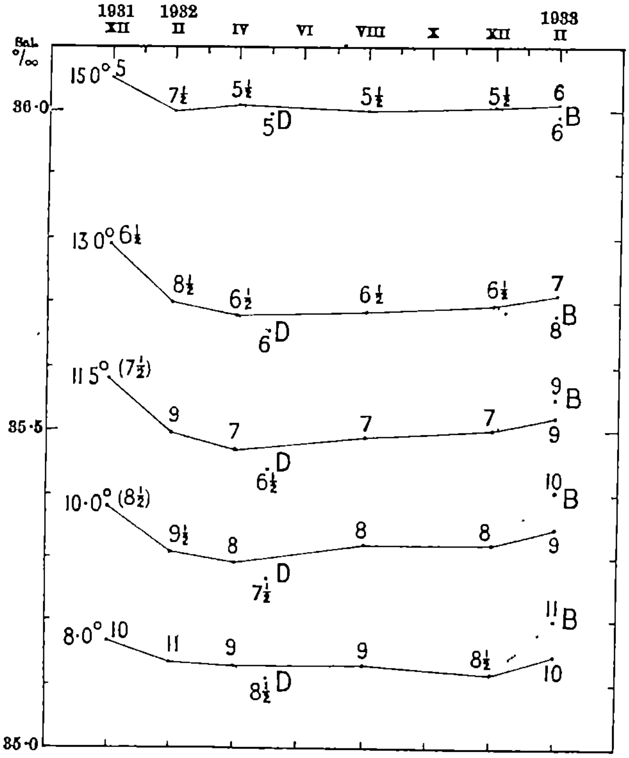

FIG. 3. Salinity ratios for selected degrees of temperature (from *T/S* curves). The numerals represent approximate depths in hektometres. *Atlantis* data with addition of *Dana* (May) and *Bache* (February).

The apparent inference to be drawn from these changes is that occasionally in February (1932), and regularly in April or May, there takes place a general infiltration of alien water of less than normal salinity, the influx of which declines during the summer and autumn and is usually cut off more or less completely in February (1914, 1933). This cycle is, of course, precisely that of ice-bound coastal waters, locked up by frost in winter, and released in full flood in spring. The only possible source of such water in the present case is the coastal tract of mixed waters on the north side of the Gulf Stream, mainly derived, according to Bigelow, from the Gulf of St. Lawrence by the Cabot Strait, but mixed undoubtedly with Gulf Stream overflows and the coastal waters of the Gulf of Maine, probably also in severely 'Arctic' years like 1929 with contributions from the Labrador Current itself.

This conclusion may seem to conflict with some recent opinions as to the nature and relations of the Gulf Stream, but, so far as I can see, it is not opposed by any established facts. If we turn to Jacobsen's hydrodynamic current-charts (1929, figs. 53–56) we find the hub of the Atlantic circulation placed off Cape Hatteras in lat. 36° N., long. 74° W., where Gulf Stream and Antillean Current turn markedly east and give rise to great eddies on the right, some of which are completed as inner, middle and outer anticyclonic circuits, the middle one bathing Bermuda on its way to the Windward Isles to a depth of some 500 metres. As the depth of reference is only 1,000 metres and the deep waters, admittedly recruited from the "cold wall", are certainly moving in spring, these charts cannot be regarded as defining the bottom limit of the currents indicated. The *Challenger*, in fact, at st. 37 in April found a south-east undercurrent at Bermuda from 200 fathoms down to 400 fathoms (350–750 metres) moving at a rate of about ¼ mile per hour above and 1/10 mile below. Such a current would require at least two months to bring water to Bermuda from the water-parting off Cape Hatteras, but it may well have been twice or three times as strong during the climax of the May flood.

It is also noteworthy that exactly abreast of Jacobsen's water-parting (vortex ?), but on the landward side of the Gulf Stream, lay the *Bache* station 158 and the *Dana* station 1349 (the former in lat. 36° 12′, long. 74° 25′, the latter in lat. 36° 16′, long. 74° 33′), which presumably reveal the relations of the coastal waters to the Gulf Stream in February and May respectively. In February, Bigelow found an isolated 'tongue' of water of temperature 11°–12° and salinity less than 35·2 per mille dipping down from the surface like a 'waterfall' over the edge of the continental shelf to a depth of some 300 metres, and separated from the Gulf Stream by a nearly vertical wall of water 500 metres deep, of 35·5–36·0 per mille salinity. In May the *Dana* found this wall, from

200 metres downwards, bent outwards as an inclined plane, beneath which the mass of coastal water, *colder and less saline throughout than in February* 1914, was completely continuous (except the most superficial stratum less than 35·0 per mille) with the intermediate layers of the Gulf Stream column. At 300 metres the temperature and salinity at the *Bache* station were 11·4° and 35·19 per mille; at the *Dana* station in May they were down to 8·17° and 35·08 per mille. At the *Dana* station 1351, in the Gulf Stream itself, water with approximately this temperature and salinity lay 600 metres deep. At Bermuda at the same time it lay at 900 metres.

There can indeed be little doubt, after comparing these facts and the illuminating sections* provided in their respective reports by Bigelow (1915, figs. 11, 12, and 49), Nielsen (1925, Section 4), and Jacobsen (1929, fig. 11), that during the flood period in spring the pent-up coastal waters are incessantly mixing with the left side of the Gulf Stream, to pass through it in part, and for the rest to be swirled eastwards into the general circulation of the Sargasso Sea (cf. Jacobsen, p. 19). Iselin also, in a preliminary forecast of *Atlantis* results, has remarked of the Gulf Stream: "Very little of the Gulf water remains when Cape Hatteras is reached. The current is of course continuous, but gradually the Gulf of Mexico water becomes replaced at all depths by Sargasso Sea water *or a mixture of this and Slope Water*" (1933, p. 231).

Altogether, in spite of the fragmentary data on which it necessarily rests at present, the case for a seasonal cycle in the Sargasso Sea and its dependence on the periodic release of ice-bound coastal water seems unmistakable. The interest of the relation is practical as well as theoretical, for it opens up at once the prospect of our ability to attack the 'Atlantic Water' problem from a new and much more promising angle. The periodic incorporation into the intermediate layer of the Sargasso Sea of millions of tons of alien water must result in a periodic eastward spreading of the whole water mass. Annual variations in the amplitude of the extension may well be concerned in determining the irregularities of Atlantic incursions upon the coasts of Europe. If this argument is sound, the first step should obviously be to confirm the periodicity at Bermuda by regular observations at much more frequent intervals, especially from December to May, so as to date the changes with greater precision, and over a period of years sufficient to include the greater annual fluctuations. Only at Bermuda is such a continuous record practicable. Unfortunately, we have missed the opportunity of recordthe effects on the Sargasso Sea of the great frost and floods of the last American winter.

In conclusion, my thanks are gratefully tendered to Dr. E. J. Allen, of Plymouth, Mr. Donald Matthews, of the Admiralty, Dr. J. N. Carruthers, of Lowestoft, and Mr. A. J. Clowes, of the *Discovery* Expedition, for help in getting access to relevant literature.

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* A temperature section from *Atlantis* data given by Iselin (1933, fig. 2) for the same region in February cannot readily be compared owing to lack of isohalines. It is noteworthy, however, that the isotherms are shown appreciably lower than in the *Dana*'s sections for May, though with less difference than at Bermuda.

The 'Specific Action' of Ultra-short Wireless Waves

By Prof. W. E. Curtis, F.R.S., Dr. F. Dickens, and S. F. Evans

DURING the last ten years or so many investigations have been made concerning the biological and medical effects of short wave radiation. The absorption of such radiation by tissues necessarily results in the liberation of heat, and many of the effects observed are admittedly due to this cause. They could alternatively be produced by other methods of heating, although the radiation method frequently offers special advantages and potentialities. It is being pursued energetically in various laboratories and clinics, and appears to rest on a sound theoretical and experimental basis[1].

The literature of the subject, however, contains frequent references to other effects, usually termed 'specific', in the sense that they can only be produced by the short-wave method, that is to say, that they are not primarily thermal in origin. In some cases also it is claimed that the effects are restricted to certain wave-lengths, or that an optimum wave-length exists. So far as is known at present, from physical and chemical evidence, radiation of these wave-lengths (3–15 metres) is not directly convertible into atomic or molecular energy, and such observations, if substantiated, would be of great interest and importance. We have therefore thought it desirable to scrutinise the evidence rather carefully, tracing the various references to their sources, and attempting, where possible, to repeat the experiments in question.

The effects claimed are diverse in character, including metabolic changes in tissues, physical changes in liquids and colloids, decolorisation of dyestuffs, bactericidal action and so forth. The one feature common to them all, we find, is the absence of any incontrovertible proof of their existence, and this in spite of their unquestioned acceptance by numerous authors of reviews and research publications. The details which follow should serve to expose the very unsatisfactory situation which exists at present, and perhaps to stimulate further investigation of the alleged phenomena.

(1) As an instance of effects which are probably due to the inadequacy of the precautions against heating, we may take the results of Reiter[2], who claimed to have established the existence of an immediate destructive action on the metabolism of malignant tissue when exposed to radiation of wave-length 3·4 metres. In attempting to repeat these observations*, we found that to maintain approximate constancy of temperature it was necessary to take much more drastic measures than Reiter appears to have done. For example, in order to keep the tissue contained in a suitable vessel, at 40° C., it had to be immersed in a bath containing liquid paraffin at 6° C. Under these conditions, no effect on metabolism was observed[3] when the specimen was subjected to intense irradiation on a wave-length of 3·4 m.

(2) The importance of surface tension effects has been stressed by Schliephake and Compère[4], who claim to have observed a lowering of surface tension in certain colloidal solutions including blood and serum. They consider that although earlier observations might conceivably be explicable as heat actions, "it is already permissible to say that we have now obtained for the first time certain proof of the existence of an effect of ultra-short waves that cannot be explained by the action of heat alone". The experiments referred to were made by allowing serum and other liquids to run from a stalagmometer placed between the electrodes of a 6-metre transmitter, surface tension being measured in the usual way by counting the number of drops for a given volume. It is stated without supporting data that "even a rise of temperature of several degrees had no influence whatever on the drop formation", and also that any possibility of a heat effect was rigorously excluded by comparative experiments in which the drops were warmed by radiant heat. No details of field strength or of the concentrations of the reagents used are given, although Schliephake in his book[5] (p. 52) states that definite dilutions are necessary. We have attempted to repeat this work, but without success. The stalagmometric method of measurement of surface tension was found to be entirely unsuitable for this purpose, since the heating effect was very great and the temperature of the drops could not be measured with precision. Using the more accurate and convenient torsion balance method, which further allows the determination of the temperature of the mass of liquid, we were unable to find any effect whatever on the surface tension of serum, although an effect of the magnitude reported by Schliephake would have been readily detected. The field used was of such strength that in stalagmometer experiments the drops of serum were heated through about 5° C. in 10 seconds. The variation of surface tension in the short wave field has been referred to in the literature as the "Schliephake Effect" but, in our opinion, proof of its existence is entirely lacking.

(3) Some further examples of specific action are given by Schliephake in his book. Working with Recknagel, he claims to have observed changes in the viscosity and stability of colloids which are opposite to those caused by rise of temperature. Only sixteen lines of description of these fundamental phenomena are given, and in reply to a request for fuller information it was learned that this could not be given "on personal grounds".

(4) Of particular therapeutic interest are the claims put forward in respect of bacteriological effects. Haase and Schliephake[7] claim that they have demonstrated killing of staphylococci and tubercle bacilli by exposure at body temperature to short wave radiation; Recknagel and Schliephake[8] report a marked reduction of the activity of diphtheria antitoxin following similar treatment, and attention is directed to the confirmatory work done by Szymanowski and Hicks[9]. In a paper[9] published six months later, however, Szymanowski and Hicks withdraw their earlier results on toxin and also report that, repeating the work of Schliephake and Haase on staphylococci, they were unable to establish any effect of the high-frequency field. They conclude that "the consistently negative results reported in this paper lend further evidence to the belief that the only direct therapeutic action of ultra-high frequency radiation is related to the problems of conductivity in tissues and consists in an elevation of temperature". In his book Schliephake does not refer to the latter paper.

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* On behalf of the British Empire Cancer Campaign.

(5) A book on "The Foundations of Short-Wave Therapy" by Holzer and Weissenberg[10] has recently appeared. These authors are vague in their references to 'specific actions', but refer to colour reactions, notably decolorisation of the dye pinacyanol in a short-wave field[11]. As this appeared to be a simple and striking example of the effect of short waves, we attempted to repeat it in our laboratory, but without success, and we are informed in a personal communication from Dr. Holzer that he has since been unable to reproduce the effect.

(6) Another similar example which we unsuccessfully attempted to verify is Esau's observation, quoted by Pflomm[12], that turpentine oil could be hardened by exposure to a short-wave field ; no details were available, and although we have asked Prof. Esau for fuller information we have as yet received no reply. Still more mysterious are the effects on operators of short wave appliances reported by both Holzer and Schliephake. The precise nature of these effects appears somewhat indefinite, but their principal manifestations are psychological and can be prevented by suitably screening the apparatus. The present writers, working on 3 metres with totally unscreened apparatus using a power much greater than that quoted by Schliephake, have failed to notice any effects following daily exposure, and they have been informed by research engineers working with very high power on ultra-short wave-lengths that such effects are unknown in their experience.

(7) One of the most promising lines of attack would appear to be the investigation of anomalies in dielectric constants at these frequencies, with a view to possible correlation with dipole moment phenomena. Hausser[13] has published work in which such effects were observed for sphingomyelin at a frequency corresponding to a wave-length of 5 metres. This example, if confirmed, would constitute the nearest approach to the clear demonstration of a specific effect yet made ; it is therefore of particular interest, though it appears from personal communication with the author that the position is not yet cleared up to her entire satisfaction. In any case its relationship, if any, to the spectacular effects claimed by the more enthusiastic protagonists of specific short-wave actions is still obscure.

We believe that, with the exception of the last example, the above selection of experiments and observations is typical of those upon which the hypothesis of a specific action has been built. If such an effect exists, it should be possible for the discoverers to describe at least one clear-cut experiment which could be repeated by other workers. In the absence of such evidence we consider that the great mass of inconclusive observations which has been presented is a very insecure foundation for the rapidly growing belief in specific short-wave therapy. Whilst the possible existence of specific actions of ultra-short waves cannot be denied, in our opinion such effects have not as yet been adequately demonstrated. We therefore find ourselves in agreement with the conclusions of a recent report to the Council on Physical Therapy of the American Medical Association, by Mortimer and Osborne[14] :

"There is no conclusive evidence from the literature nor were we able to substantiate the claim of specific biologic action of high frequency currents (short-wave diathermy). In our opinion the burden of proof still lies on those who claim any biologic action of these currents other than heat."

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[1] J. C. McLennan and A. C. Burton, *Can. J. Res.*, **5**, 550 (1931) ; ibid., 3, 224 (1930).

[2] T. Reiter, *Deut. Med. Woch.*, **59**, 1497 (1933).

[3] F. Dickens, S. F. Evans and H. Weil-Malherbe, in publication.

[4] E. Schliephake and A. Compère, *Klin. Woch.*, **12**, 1729 (1933).

[5] E. Schliephake, "Kurzwellentherapie", Fischer, Jena, 1935.

[6] ibid., p. 52.

[7] W. Haase and E. Schliephake, *Strahlentherapie*, **40**, 138 (1931).

[8] W. T. Szymanowsky and R. A. Hicks, *J. Infect. Dis.*, **50**, 1 (1932).

[9] ibid., **50**, 466 (1932).

[10] W. Holzer and E. Weissenberg, "Foundations of Short-Wave Therapy", Hutchinson, London (1935).

[11] W. Holzer, *Akad. Anzeig.*, Dec. 7, 1933.

[12] E. Pflomm, *Munch. Med. Woch.*, **77**, 1854 (1930).

[13] I. Hausser, *Sitz. Heid. Akad. Wiss.*, 6 Abh., 1–41 (1935).

[14] B. Mortimer and S. L. Osborne, *J. Amer. Med. Assoc.*, **104**, 1418 1935).

Obituary

Prof. W. E. Dalby, F.R.S.

PROF. WILLIAM ERNEST DALBY, emeritus professor of engineering in the University of London, who died at his home at Ealing on June 25 at the age of seventy-two years, received his practical training in engineering in the Stratford locomotive works of the Great Eastern Railway, and afterwards at the L. and N.W.R. works at Crewe. His duties at Crewe afforded him exceptional facilities for gaining experience in all branches of engineering work, and in construction and maintenance of both permanent way and locomotive. In 1894 he was at the University of Cambridge as assistant to the late Sir Alfred Ewing, who was then developing a Department of Engineering in that University. He left Cambridge to become professor of mechanical engineering and applied mathematics at the Finsbury Technical College, and in 1904 he succeeded the late Prof. W. C. Unwin as University professor of engineering at the Central Technical College, South Kensington. When that College was incorporated in the Imperial College of Science and Technology as the City and

Guilds (Engineering) College in 1907, he was made a member of its governing body and remained so until his retirement from the professorship in 1931. He was Dean of the City and Guilds College from 1906 until his retirement, and at the jubilee celebrations of the College in 1934 he was elected honorary fellow of the City and Guilds of London Institute.

Prof. Dalby served as dean of the Faculty of Engineering in the University of London for four years and as senator for eight years. He was elected a fellow of the Royal Society in 1913, was for some years vice-president of the Institution of Mechanical Engineers, and at the time of his death was a vice-president of the Institution of Civil Engineers. The Institution of Naval Architects also elected him honorary vice-president. He was president of Section G (Engineering) of the British Association in 1910, and was a member of some of that Association's research committees, notably the Gaseous Explosions Committee. During the Great War, Prof. Dalby served on several Government committees, and carried out much confidential research work for all three of the fighting Services. Of the many committees on which he served during the War and afterwards, mention may be made of the Board of Invention and Research, the Engineering Section of the War Committee of the Royal Society, for which he acted as secretary, and the Bridge Stress Committee.

It was only natural that Prof. Dalby's close connexion with railway problems during his service at the locomotive works should direct his attention to the many mechanical problems that arise in steam engine practice, and in the earlier part of his professional career his interest was largely centred on such problems. Towards the end of the nineteenth century, the demand for increased speed of engines brought into prominence the closer study of the methods of balancing rotating and reciprocating masses of engines. Prof. Dalby devoted considerable attention to this problem, and at the spring meeting of the Institution of Naval Architects in 1898 he described a new method which he had devised of solving balancing problems. The advantage of his method was that, by using a 'reference plane', the problem was reduced to one of graphical vector addition. This method he developed in his book "Balancing of Engines", which was first published in 1902. It has received such wide acceptance and has been so generally adopted that its authorship is in danger of being forgotten. In the latest edition of this work (1929) the author rightly states in the preface that his method "has found its way into textbooks with *and without* acknowledgment". Designers of high-speed engines are indebted to Prof. Dalby for so clear and simple a method of solving their balancing problems, and these problems are also not without interest for civil engineers, as the Report of the Bridge Stress Committee conclusively shows. In 1906 he published his second book on engine mechanism, namely, "Valves and Valve Gear Mechanism".

In connexion with the British Association's Gaseous Explosions Committee, Prof. Dalby was associated with the late Prof. H. L. Callendar in attempts to measure directly the temperatures inside the cylinders of gas engines. The method they employed required accurate indicating of the engine, and as the optical indicators then available were not sufficiently accurate for their purpose, Prof. Dalby improved on the design and produced the 'Dalby Watson optical indicator', which gave remarkably fine and accurate indicator diagrams.

Prof. Dalby was not slow to realize that such an indicator would prove invaluable in the rapid testing of materials, and shortly afterwards he designed his 'optical load extension recorder'. In this instrument he measured the load on the test specimen by the elastic extension of a hollow steel weigh-bar, the small elastic extensions being magnified optically to any desired scale. A photographic record of a load extension test could thus be obtained. Inertia effects in such an instrument being practically eliminated, test pieces could be rapidly loaded without sacrifice in accuracy of measurement. To effect such rapid loading he designed a special hydraulic testing machine, and thus he obtained a load extension diagram of a test-piece broken in one second of time. The instrument is described in several papers contributed to the learned societies and also in his book published in 1923, "Strength and Structure of Steel and Other Metals", wherein will be found records of researches carried out by its use.

The largest of Prof. Dalby's publications was "Steam Power". It was published in 1915 and brought into one volume comprehensive studies of steam plants, the properties of steam and the various dynamic and other problems associated with such plant. His last book, published in 1931, was entitled "Power and the Internal Combustion Engine". In addition to the five books mentioned above, he was the author of numerous papers contributed to learned societies and institutions.

In his teaching and lecturing, Prof. Dalby was clear in exposition and could make attractive any subject he presented to his audience. He was wholeheartedly interested in his profession, and his enthusiasm was an inspiration to those who were associated with him. His work at the College and for the many committees on which he served left him little time for recreation, and that recreation he often sought in change of work, for he was always happy at his drawing board designing or improving apparatus for conducting his researches. The many students who have come under his influence, and the wider circle of those who have read his publications or listened to his lectures, will regret the passing of one who has done much for the advancement of engineering science.

WE regret to announce the following deaths:

Dr. H. J. Hansen, of Copenhagen, a foreign member of the Linnean Society of London, on June 26.

Prof. Julius A. Nieuwland, professor of chemistry in Notre Dame University, U.S.A., known for his work on synthetic rubber and lewisite, on June 11, aged fifty-eight years.

News and Views

Royal Society of Edinburgh: Honorary Fellows

THE following have been elected British honorary fellows of the Royal Society of Edinburgh: Sir Charles Boys; Sir Henry Dale, director of the National Institute for Medical Research; Prof. F. G. Donnan, professor of chemistry in the University of London, University College, London. Foreign honorary fellows have been elected as follows: Prof. L. H. Baekeland, honorary professor of chemical engineering, Columbia University, New York; Prof. M. Lugeon, professor of geology, University of Lausanne; Dr. George Sarton, editor of *Isis* and *Osiris*; Dr. G. L. Streeter, director of the Department of Embryology, Carnegie Institution of Washington; N. I. Vavilov, director of the Institute of Genetics, Academy of Sciences, Leningrad; Prof. W. M. Wheeler, emeritus professor of entomology, Harvard University.

Dr. W. S. Bruce Memorial Prize

A COMMITTEE consisting of representatives of the Royal Society of Edinburgh, the Royal Physical Society and the Royal Scottish Geographical Society, has awarded the Dr. W. S. Bruce Memorial Prize to James W. S. Marr, who first went to Polar regions with Sir Ernest Shackleton in the *Quest* in 1921, sailing as a boy scout. On Shackleton's death, the expedition continued under Commander Worsley into the Weddell Sea. Marr next sailed with Commander Worsley in 1925 to Spitsbergen and White Island in the Algarsson expedition. In 1927 he joined the staff of the R.R.S. *Discovery* and since then, with brief intervals at home, he has spent his time in the Southern Ocean, partly in the old *Discovery* and partly in *Discovery II*. From 1929 until 1931 he was in *Discovery* when she was lent to Sir Douglas Mawson for the British-Australian-New Zealand Expedition which found many new stretches of the coast line of Antarctica. Last year Marr published in the "Discovery Reports" a large monograph on the South Orkney Islands, which extended the original researches of Dr. W. S. Bruce on that Antarctic Group.

Dr. F. G. Novy

DR. FREDERICK GEORGE NOVY, formerly professor of bacteriology and dean of the Medical School of the University of Michigan, was presented with the 250,000th microscope produced by Messrs. Bausch and Lomb at a luncheon given to members of the American Association for the Advancement of Science during its summer sessions at Rochester, New York. Dr. Novy was selected for this honour by the executive committee of the American Association, for outstanding research in the field of bacteriology and immunology. He discovered and isolated the *Bacillus Novyi*, the agent of gas gangrene; he was the first to culture *Trypanosoma Lewisi*, and is the discoverer and isolator of *Spirochæta Novyi*, the cause of American relapsing fever. He has also made notable contributions to the study of filterable viruses, the respiratory processes of bacteria, and the causes of diphtheria, yellow fever and bubonic plague. A student of both Koch and Pasteur, Dr. Novy has the distinction of being the only person in the United States to-day who studied under Pasteur. France has made him a Chevalier of the Legion of Honour; Czechoslovakia created him a member of the Order of the White Lion, and Sinclair Lewis has romanticized him in his book, "Arrowsmith". For nearly fifty years, Dr. Novy was a member of the Medical Faculty of the University of Michigan, and is almost the last of the distinguished group gathered together by the late Dean Victor C. Vaughan. Dr. Novy's address at the luncheon, on "Some Results of Microscopic Research of Specific Significance for Human Welfare", was preceded by brief addresses by Dr. Edwin G. Conklin, president of the American Association, Herbert Eisenhart, president of Bausch and Lomb, and Dr. Edward Bausch who presented the 250,000th microscope of the company. It was Dr. Bausch's fifty-ninth year as a member of the Association.

The Use of Knowledge

IN his address at the graduation ceremony of the University of St. Andrews on June 26, Sir James Irvine, referring to the way in which new knowledge is being acquired at a rate much faster than man's capacity to absorb it, and to the way in which the impact of changing conditions has caught us unprepared, suggested that the machinery of Government should include a 'Ministry of Knowledge', the functions of which would be to predict the repercussions of new knowledge on all phases of life. Through such an organization, it might be possible to frame in advance a national policy in which due regard is paid to such far-reaching problems as the future sources of energy, such fundamental questions as to whether our coal supplies are to be used merely for power or as raw material for manufactured products, or whether our forests will be utilized for the purposes for which they were planted or devoted to alternative uses already looming in sight.

UNDOUBTEDLY the rapid diminution almost to vanishing point of the lag between the origin of new knowledge and its application has left man with less time than ever to adapt himself to the repercussions of the new ideas he has evolved. The need for foresight and intelligent anticipation in such matters as the development of industry, transport and town-planning cannot be disputed. While Sir James Irvine's suggestion deserves serious consideration, it is at least doubtful whether the existence of such organized knowledge thirty years ago could have spared the world much of the devastation of unemployment; or whether it is possible to plan in advance when conditions are rapidly changing. Apart from the difficulty of predicting with any accuracy the effect of scientific discoveries on society, the wise use of knowledge involved in planning requires not merely the use of existing knowledge to avoid mistakes committed in the past, but also adaptability, an enlightened opportunism and a readiness to examine all matters in the spirit and method of science. It is, however, a hopeful sign that leaders of scientific thought are to an increasing extent concerning themselves with the consequences of the application of scientific discoveries. Organizations such as the Scottish Development Council and the National Trust, cited by Sir James, already exist for the wise use or conservation of our national resources, and they deserve the support of all who are in any measure equipped to guide opinion and direct progress.

Social Economics in the University of Manchester

THE Council of the University of Manchester has announced its decision to revive the second chair in the Faculty of Commerce and Administration, which has been in abeyance since 1932, with the title of "Chair of Social Economics". Mr. John Jewkes, who has been in charge of the Economics Research Section of the Faculty, which has been responsible for such important investigations as the industrial surveys of Lancashire and also Cumberland and Furness, undertaken for the Board of Trade, and the study of juvenile unemployment, has been elected to the chair as from September next. The duties will include the conduct of research and supervision of the work in the Economics Research Section, the creation of which was a new development in Great Britain in the organization of economic research within a university. It has now passed the experimental stage, and Mr. Jewkes's appointment is a recognition of it as an integral and permanent part of the work of the Department of Economics at the University of Manchester. Among a number of important inquiries which are in hand may be mentioned a study of the case histories of 2,000 juveniles in Lancashire who left school at Easter 1934; a study of the location of British industry, the changes proceeding and the forces behind them; a re-assessment of the industrial situation in Lancashire, being carried out at the invitation of the Lancashire Industrial Development Council; and a study of the systems of wage payment and labour conditions in the Lancashire cotton-weaving industry.

Manganese and Plant Growth

MANGANESE is now recognized as an essential element for normal plant growth, and most soils contain sufficient of it in an available form to supply the needs of all vegetation. There are certain soils, however, mainly reclaimed swamp soils and soils with a very high calcium carbonate content, in which manganese is either not present in sufficient quantity, or not in an available enough form, to support the growth of certain crops. Characteristic diseases then result, of which the best known are the grey speck disease of oats, a disease of beet in Holland, chlorosis of spinach on Long Island and diseases of tomatoes and other crops on the Everglade soils of Florida, although in the last case deficiency of copper appears to be concerned as well as of manganese. The availability of the manganese in the soil is influenced to some extent by weather conditions and by cultural practices. In general, dry conditions aggravate the diseases, and also manurial treatments, such as liming, which tend to make the soil more alkaline. In Denmark a formula is now used, known as the 'manganese value' (Steenbjerg, Trans. Third Int. Congr. Soil Sci. Oxford, 1935), which is based on a determination of the exchangeable manganese by leaching with magnesium nitrate, and on a factor which is a measure of the energy displayed by the soil colloids in keeping the exchangeable manganese. It is advocated that the manganese value of a soil should always be determined before liming, especially in the case of sandy soils, so that a calculation can be made of the largest allowable increase in pH which would not entail danger of grey speck disease. In the same report, Gerretsen claims that the symptoms of manganese deficiency are largely the result of the absorption of toxic products from bacteria which multiply more profusely on the roots of manganese-deficient plants.

Eastern Frontiers of the Roman Empire

SIR AUREL STEIN has made an offer to the authorities concerned to make a detailed survey of that part of the eastern frontier of the ancient Roman Empire which lies within Transjordania and Iraq. It will be necessary that a great part of this survey should be carried out from the air, as many of the sites are situated in the desert, and can be located only by this method. The proposal has the support of the British Academy and the Society of Antiquaries of London. It will form part of the scheme for the complete survey of the Roman Empire on a scale of 1 : 1,000,000, for which the British Ordnance Survey has already accepted its share of responsibility. The French have now completed the survey of that part of the frontier within the mandated territory of Syria. The survey was made by the French Air Force acting in conjunction with the Académie des Inscriptions et Lettres, and records observations of ancient roads, forts and defensive posts, as well as water supply. It is proposed that similar observations should be made in the survey projected by Sir Aurel Stein.

Racial Elements in Sumerian Art

ARCHÆOLOGISTS at times may seem over-bold in attributing racial values to the terms of their cultural analyses, although the practice frequently has much to be said in its favour, when it is followed, with due reservation, as a convenient form of shorthand while a question of origins is still in suspense. Sir

Leonard Woolley's lecture on "The Racial Elements in Sumerian Art History" before the Royal Society of Arts on February 19 (*J. Roy. Soc. Arts*, **84**, April 3, 1936) afforded an example of the pregnant inferences to be drawn from study of the geographical distribution of cultural elements to be related to those found at Ur and kindred sites in Mesopotamia in its bearing on the solution of the racial problem in Sumeria. As he pointed out, various theories have been put forward at different times, as knowledge has grown, to interpret evidence of the physical characters of the early population of Sumeria. Sir Leonard himself, by citing specific elements which go to make up the complex of Sumerian art, was able to show that it is a compound of three cultural streams. Of these the Asianic or Iranian goes back at Ur to pre-diluvial times, its most marked characteristics there being the painted pottery, while it extends from Mesopotamia to China; a second is derivative from Anatolia and the third comes from northern Syria. In these three cultural elements he finds, hypothetically, a parallel to the distinction which is drawn in the evidence for three differentiated physical types in the population. In this instance, it is to be admitted, there would appear to be good ground for the view put forward that the brilliant achievement of Sumerian art, in which these cultural streams unite, was due to that cross-fertilization of racial strains, which Sir Leonard maintains lies at the root of all great achievements in the art of a people as a whole. It is to be expected that Sir Leonard's new field of exploration in northern Syria will throw further light on the racial as well as the cultural problem.

Roman Leicester

EXCAVATION of Roman remains at Leicester now in progress has resolved an archæological doubt of long standing. While instructed opinion has hesitated between identifying the well-known Jewry wall, one of the highest surviving Roman walls in Britain, popularly regarded as a temple of Janas, as a Roman bath building, a basilica or even a town gate, it has now been shown, according to a report in *The Times* of July 4, to be part one of the external walls of the basilica in the forum of Roman Leicester, dating probably from about A.D. 100. A large part of the adjacent site, until recently occupied by a factory, is being cleared by the Corporation for the erection of public baths, and advantage has been taken of the opportunity to carry out these excavations. The base of the Jewry wall has been uncovered to some ten feet below the present surface, giving a total height of existing masonry of more than thirty-five feet. Two arched openings, previously thought to be doorways, are now revealed as windows. Beneath the Jewry wall, timber and masonry are associated with pottery and coins going back to the earliest Roman occupation of Britain. To the west of the wall is emerging a courtyard about 175 ft. wide, flanked by ranges of rooms or shops opening on to the courtyard by porticoes. This is the forum, of which the basilica forms part. Fronting the forum and abutting centrally on the basilica are the massive foundations of an architectural feature, probably once surmounted by a pediment, which dominated the forum and faced the main entrance. Outside the northern wall of the forum a stretch of cobbled roadway, deeply scored by wheels, has been uncovered. Massive walls and fragments of columns found on the factory site some years ago may now be identified as fragments of the forum and its colonnades. The road on the southern side of the forum is largely covered by St. Nicholas Street, near which is preserved one of the mosaic pavements for which Roman Leicester is famous. The excavations are being carried out by Miss Kathleen Kenyon under a committee, of which the Duke of Rutland is president, in co-operation with the Corporation of Leicester.

Electricity Distribution in Great Britain

THE report of the Committee on Electricity Distribution has now been published (Ministry of Transport. London: H.M. Stationery Office. 2*s*. net). The chairman was Sir Harry McGowan, and Sir John Snell was a member of the Committee. The evidence, some of which was conflicting, has all been carefully considered, and definite recommendations are given which seem thoroughly justified. The Committee does not suggest nationalization or the setting up of a Distribution Commission. It advises a reduction in the present number of undertakings by amalgamating the smaller and less efficient stations with the larger ones. It is stated that any attempt to carry through a scheme of re-organization on a voluntary basis is bound to fail, and legislation must confer definite and adequate compulsory powers. The schemes of re-organization should make provision for the possibility of ultimate public ownership of all undertakings, including those not at present subject to purchase by the local authorities. It is proposed that no undertakings should be transferred compulsorily under a scheme of re-organization without a prior local investigation. To this end the Electricity Commissioners should be empowered to delimit the country into a number of areas and to appoint for each area a temporary district commissioner, with such technical and financial assistance as may be necessary. The district commissioner would bring under review all electric undertakings in his area. The Electricity Commissioners, after publishing a scheme and considering any representations, should be empowered to approve it and, if agreed, it should become operative at once.

WITH regard to the London and Home Counties Electricity District, which covers an area with a large number of undertakings, some with duplication of powers, many with differing systems and tariffs, and offering very unequal facilities, the criticisms recently made by the public are often justified. A substantial measure of amalgamation and co-ordination is possible and necessary. The present constitution of the London and Home Counties Joint Electricity and Authority should be brought under review. Complete standardization of systems and voltages should be the ultimate objective, but it is difficult to see how this can be done equitably. The amalgamation of undertakings into a smaller number of larger undertakings is an important step towards standardization of methods of charging and more uniform prices. The Minister of Transport should be empowered to require all undertakers to offer an improved statutory two-part tariff for domestic supplies, as an optional alternative to a flat-rate charge. The fixed charge under an approved two-part tariff should be based either on the floor area of the house or on its rateable value, and all undertakers should be required to publish the actual scale of fixed charges under their two-part tariff. If these suggestions were adopted there should result a general, though necessarily gradual, reduction in costs. Amongst other recommendations, it is suggested that where gas and electricity undertakings are left under the joint ownership of a local authority, it would assist in the more rapid development of the electricity undertaking if the authority were required to have separate committees. Evidence was given which showed that restrictions had been imposed on the development of the electrical undertaking in order to prevent the financial position of the gas undertaking from being adversely affected. Both public activities should be equally untrammelled.

Meteorology in India

IN the Report on the Administration of the Meteorological Department of the Government of India in 1934–35 (Delhi: Manager of Publications, 1935), an account is given of an important change in the arrangements for dealing with the increasing meteorological requirements of aviation along the trans-India air route. In previous years, a separate forecast had been issued to each aircraft in respect of the route covered by it each day from the forecasting centre concerned; but it became evident that it would soon be impossible for the two centres at Karachi and Calcutta to continue to do this for the four thousand miles of the route between Bahrein and Victoria Point. Arrangements were therefore made to broadcast forecasts for each section of the route regularly at fixed times, and to distribute data relating to upper winds and cloud height by wireless from pilot balloon stations along the trans-India route twice daily. The Agricultural Meteorology Branch carried out a number of researches, mainly at the Central Agricultural Meteorological Observatory, Poona; instruments for the study of microclimatology were designed and tested, and a number of papers were written dealing with the correlation between meteorological conditions in the open and among growing crops; researches into evaporation, percolation and effective rainfall were also made. Experiments on the effect on soil temperature of a thin covering of soil of different colours and from different districts showed that coverings of certain soils had a big effect on the climate of the soil beneath. Other investigations were made into the albedo of different types of soil and vegetation. The scheme of crop-weather precision observations was applied to wheat and jowar at Poona, to rice at Karjat and to bajri at Baroda. The study of frost damage and methods of preventing it was also included in this branch's activities. The Upper Air Observatory at Agra released seventy-seven sounding balloons with recording instruments, and nearly half of these were recovered.

Physiology of Indian Crop Plants

FOR some time past, the staff of the Institute of Agricultural Research of the Benares Hindu University has been engaged, under the leadership of Prof. B. N. Singh, in detailed and comparative studies of the physiology of Indian crop plants. A considerable number of publications on this subject has now been issued, mainly in the *Proceedings of the Indian Academy of Sciences*, and good progress has evidently been made in a highly interesting and important field of work. The most extensive work completed is that dealing with photosynthesis under different conditions of light, temperature and carbon dioxide supply. Since a large part of previous research on this subject has been carried out in temperate climates, it will be obvious that detailed studies of tropical plants are likely to be of considerable value. One striking result of this work is that tropical plants are found to have a higher light requirement in photosynthesis than similar species grown under temperate climatic conditions. Another especially interesting problem under investigation is that of the differences in respiration rate found to exist in plants differing in their duration of life. Short-lived plants are apparently characterised by a low respiration rate, which also falls off very rapidly as the age of the plant increases. Long-lived plants, on the other hand, not only have a high respiration rate but also are able to maintain this higher rate throughout life. Other subjects under investigation by comparative methods include the water requirements of seeds possessing different structural and biochemical properties, and the effects on plant growth of irradiating seeds with X-rays.

Electricity in Horticulture

ELECTRO-CULTURE has to take into account the effects of electric heating, electric lighting and the voltage stress on the life of plants. The first application of electricity took the form of high-voltage discharges produced in close proximity to various plants in an endeavour to obtain artificial stimulation. In the Engineering Supplement for May of *Siemens Magazine*, a survey is given of recent developments, and the photographs shown of the effects produced are convincing. It has often been noticed that an increased growth of crops sometimes occurs during thundery weather. In the Arctic, where the average atmospheric potential gradient is high, it has been observed that the growth of vegetation during the short summer is more vigorous than in southern climates. Experiments have been carried out on cereals, potatoes, beets, tomatoes, strawberries and raspberries, and increases up to forty per cent have been obtained. Electricity in the form of light was the next application in the aid of horticulture. For vigorous plant growth a minimum of about 4 hours of sunshine and altogether about 10 hours of daylight per day are required. As an example of the effect obtained by providing lighting for 10 hours each night with an illumination of about 4 foot candles, pansies after 83 days gave an average of approximately 16 flowers per plant as against 2 flowers for unlighted plants; and asters after 157 days' treatment bloomed 33 days earlier than usual. The red-yellow rays accelerate growth by stimulating the chlorophyll and the absorption of carbonic acid. Electric cables are also described which are used for heating the soil, and excellent economical results have been obtained.

Ancient Heating and Lighting Appliances

ONE of the world's largest collections of heating and lighting appliances has recently been presented to the Smithsonian Institution together with an endowment for its maintenance. It begins from the fire drills with which primitive peoples started a flame by friction, and goes on to some of the latest appliances for lighting and heating. A description of the collection has been issued by the Smithsonian Institution. After the fire drill, the account passes to the percussion method, in which a hard stone, such as flint, gives a spark when struck against steel. The steel used was frequently made in an artistic form, and was called a 'briquet'. Some of these briquets dating from about A.D. 500 were unearthed in a farm in France in 1902. One specimen is inlaid with gold, and has bits of ruby-coloured glass embedded in it. There are also pistol-action lighters, which employ the principle of the flint and steel but simplify it by means of a trigger. This way of starting a fire came into general use about 1700, and was developed from the flint-lock gun, the first of which appeared in England about 1626. Illustrating the period preceding matches, when light was obtained by chemical action, the collection contains a Döbereiner jar, introduced about 1823. Flame was produced by letting hydrogen come into contact with certain other substances. The lamps range from one about the size of a thumb to another as tall as a man. The latter was obtained from a Buddhist temple. Another curiosity is a rolling lamp which was used at Hindu weddings; the light remains upright when the globe is rolled along the ground. There is also a horological lamp which tells the time of night by the amount of oil consumed.

Anti-Vivisection Finance

THE honorary treasurer of the Research Defence Society, Sir Leonard Rogers, in a recent issue of the *Fight Against Disease* (**24**, No. 1) directs attention to the sums spent on propaganda by anti-vivisection societies within recent years. Analysing the certified annual accounts from 1912 onwards, and making allowance on one side for missing reports, and upon the other for useful work for animals done by some societies, it is estimated that a sum of approximately £600,000 has been received for 'anti-vivisection' work, and nearly £500,000 expended. The success in raising funds, in spite of the verdicts of two Royal Commissions against them, would appear to be partly due to a facile appeal to sentiment, aided by the lack of adequate medical and scientific knowledge of the masses to enable them to sift the 'anti-' statements. Anti-vivisection propaganda has sought to curtail the work of hospitals and veterinary colleges, and the one piece of useful work that might have been accomplished with the huge accumulated funds, the support of the 'Anti-Vivisection Hospital' at Battersea, has been allowed to lapse.

Prevention of Disease in the Tropics

A MEETING of the Industrial Advisory Committee of the Ross Institute (London School of Hygiene and Tropical Medicine) was held on April 16 under the chairmanship of Mr. G. H. Masefield, when reports were received upon the Institute's activities in India, Ceylon, and South, East, and West Africa. Malaria prevention has received much attention, and instances were given of the value of mosquito control in combating this disease. Other diseases, including yellow fever and the eye-fly pest of India and Ceylon, were also discussed. Allusion was made to the value of reinforced aluminium foil as a heat insulator; in a tea factory in Ceylon a reduction of temperature of 7° F. at noon in the rolling room had been obtained by its use.

British Medical Association: Annual Meeting

THE one hundred and fourth annual meeting of the British Medical Association will be held in Oxford on July 17–25, under the presidency of Sir E. Farquhar Buzzard, regius professor of medicine in the University of Oxford. The meeting will be divided into the following sections under the presidents indicated: Medicine (Dr. A. G. Gibson); Surgery (Prof. G. E. Gask); Obstetrics and Gynæcology (Prof. H. Beckwith Whitehouse); Ophthalmology (Dr. P. E. H. Adams); Pathology and Bacteriology (Dr. E. W. Ainley Walker); Anatomy (Prof. W. E. Le Gros Clark); Diseases of Children (Dr. R. C. Jewesbury); Neurology and Psychological Medicine (T. S. Good); Orthopædics (G. R. Girdlestone); Oto-Rhino-Laryngology (L. Golledge); Pharmacology and Therapeutics, with Anæsthetics (Prof. J. A. Gunn); Physical Medicine (Dr. W. J. Turrell); Physiology and Biochemistry (Prof. R. A. Peters); Radiology (R. H. Sankey); Tuberculosis (Dr. W. Stobie); Dermatology (Dr. S. E. Dore); History of Medicine (Dr. A. Chaplin); Medical Sociology (Sir George Newman); Nutrition (Dr. A. F. Hurst); Public Medicine (Dr. W. M. Willoughby). A popular lecture, entitled "Anthropology and Medicine", will be delivered on July 24 at 8 p.m. by Dr. R. R. Marett. In addition to the usual professional exhibitions, an exhibition of pictures illustrating the history of Oxford medicine will be open at the University Museum from July 20 until July 25. Further information can be obtained from the Secretary, B.M.A. Office, The Cottage, Keble Road, Oxford.

Announcements

AT the annual meeting of the Royal Anthropological Institute, the following officers for the year 1936–37 were elected. *President:* Dr. H. S. Harrison; *Vice-President:* Dr. H. J. Fleure; *Hon. Secretary:* Dr. R. W. Firth; *Hon. Treasurer:* H. Coote Lake; *Hon. Editor:* R. U. Sayce. The Rivers Memorial Medal for 1936 was awarded to Prof. Peter H. Buck (Te Rangi Hiroa) for anthropological work in the allied fields of New Zealand, Central and Eastern Polynesia. The Wellcome Gold Medal for 1935 was awarded to Dr. Lucy Philip Mair for an essay entitled "An Anthropologist's Estimate of African Policies".

THE following appointments in the Colonial Service have recently been made: P. F. Mason, to be assistant conservator of forests, Nigeria; J. C. K. McElderry, to be assistant conservator of forests, Nigeria; M. L. Pattullo, to be assistant conservator of forests, Nigeria; R. G. M. S. Macgregor, to be professor of physiology, Malaya; W. Orr, to be veterinary officer, Malaya; A. L. Craig-Bennett, to be chief fisheries officer, Palestine; A. H. S. Megaw, to be director of antiquities, Cyprus; F. P. Jepson, controller of plant pests and assistant entomologist, to be deputy director of agriculture, Ceylon; D. E. Wilson, medical officer, to be pathologist, Medical Department, Tanganyika.

PROF. JEAN SABRAZÈS, professor of pathological anatomy and clinical microscopy in the University of Bordeaux, has been elected *Correspondant* for the Section of Medicine and Surgery of the Paris Academy of Sciences, in succession to the late Prof. Léon Fréderícq.

AN institute for the investigation of rheumatism, the first of its kind in Austria, has been founded at Baden near Vienna. A balneological investigation department will be added later. The honorary director of the institute is Prof. R. Ewald.

THE Soviet Government has decided to erect a monument to the late Prof. Pavlov as well as to name an institute after him and to publish his works in four languages. His brain is to be preserved in the Moscow Institute for Cerebral Research, and his widow is to receive a pension of 1,000 roubles monthly.

THE ninth International Dental Congress will be held in Vienna on August 2–8 under the presidency of Dr. Hans Pichler, and will consist of fifteen sections. Further information can be obtained from Mr. A. E. Rowlett, 165 London Road, Leicester.

THE prefecture of Tokyo is to found a museum of hygiene, the inauguration of which is to coincide with the celebration of the 2600th anniversary of the Japanese era in 1940. The Society of School Hygiene at Tokyo proposes to organize on this occasion a general meeting, and to undertake active propaganda in favour of school hygiene.

IN order to permit more time for the preparation of material, the First International Conference on Fever Therapy, originally arranged to be held in New York on September 29–October 23 (see NATURE, 137, 989, 1936), has been postponed until March 30–April 2, 1937. Further information can be obtained from Dr. William Bierman, 471 Park Avenue, New York City, U.S.A.

A COMPETITION was held some time ago by the 'EPIDOS' (International Association of Bone Glue Manufacturers) with the object of stimulating research in the increase and improvement of outlets for bone glue. Several promising ideas were put before the Association. A total sum of 30,000 Swiss francs was distributed to the winners of this competition. EPIDOS has decided to continue its investigations in this direction. It has set aside a certain sum for the purpose of encouraging research by those who will put forward interesting ideas for the use of glue, and also recompensing those with proposals already ripe for development. Further information can be obtained from the General Secretariat of the International Association, 40 Rue du Colisée, Paris.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A teacher of general elementary science and mathematics in the Technical College, Wolverton—The Principal (July 13).

A lecturer in mechanical engineering in the Walsall Technical College—The Director of Education, Education Offices, Council House, Walsall (July 16).

A head of the Applied Mathematics Department in the Rochdale Municipal Technical School—The Principal (July 16).

An assistant in the Science Department (zoology and botany) in the Barnsley Mining and Technical College—The Principal (July 18).

Two University demonstrators in anatomy in the University of Cambridge—Dr. Roughton, Department of Physiology (July 19).

An assistant lecturer in electrical engineering in the Imperial College of Science and Technology (City and Guilds College)—The Secretary, Imperial College of Science and Technology, Prince Consort Road, S.W.7 (July 24).

An assistant inspector (Grade 2) in the Aeronautical Inspection Directorate of the Air Ministry—The Secretary (S.2.d.), Air Ministry (July 25).

An assistant director of research in medicine in the University of Cambridge—The Regius Professor of Physic (August 1).

A general manager of the Dudley Zoo—The Secretary, Dudley Zoological Society, Ltd., The Earl of Dudley's Estate Offices, Dudley, Worcs. (August 1).

A University reader in mathematics in the Imperial College—Royal College of Science—The Academic Registrar, University of London, S.W.7 (August 21).

A professor of biology in the University of Otago—The High Commissioner for New Zealand, 415 Strand, London, W.C.2 (August 31).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 81.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Corona during the Total Solar Eclipse of June 19

OUR small amateur party (Miss Gerasimova and I) had an opportunity of observing the total solar eclipse of June 19, from the eclipse camp at Ak Boulak (near Orenburg, U.S.S.R.). The expedition of Poulkova Observatory and that of Harvard University conducted their work there.

For taking photographs of the total phase, we had two reflecting telescopes equipped with parabolic mirrors, which were ground, polished and figured by myself. The installation was a most primitive one. No guiding mechanism was available; consequently, only short exposures (from half a second to one second) could be used in order to obtain good definition.

Atmospheric conditions were splendid, which was an agreeable surprise to us, since the weather was very poor during three preceding days. To see the eclipse, thousands of people gathered on the hill where the camp was situated. Many of them came from Orenburg and even from farther distant localities.

The magnificent panorama of the total eclipse was opened to our eyes at the expected moment. The sky became of deep steel tint with a conspicuous shade of lilac. Venus appeared on the right upper side quite close to the sun; between the two, Mars was clearly seen. The horizon was orange red. The singing of skylarks seemed louder in the profound silence.

The corona was unusually bright; it emitted apparently more light than the full moon. Its colour could be described as silvery and silky. The shape of the corona was typical of the period of high activity of the sun, and somewhat reminded us of a five-pointed star. Two prominences of a bright ruby colour could be easily seen by the naked eye at the edge of the velvety black disk of the moon.

The photograph reproduced here (Fig. 1) was taken directly in the focus of our six-inch mirror (140 cm. focal distance), and gives some idea of the appearance of the inner corona viewed through a low-power telescope; in reproduction it has been enlarged about 5 diameters. This photograph was taken shortly after the beginning of the total phase. A second was taken somewhat after the central moment, and the third a few seconds before the end of the total phase. Prominences are very conspicuous on all the photographs; the greatest of them attains the height of at least 100,000 km.

The duration of the total phase was almost two minutes, a period of time sufficient for making more than three photographs, even with our primitive equipment. However, we were able to make only three exposures; the precious instants were gone surprisingly soon. This psychological effect should be undoubtedly attributed to great excitement caused by viewing this rare natural phenomenon.

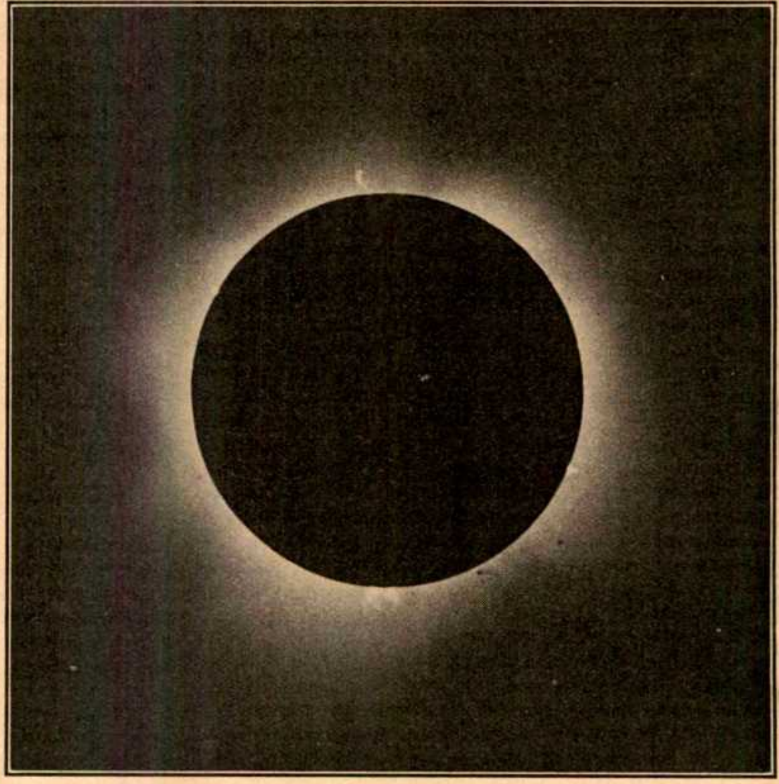

FIG. 1. Total solar eclipse of June 19, photographed at Ak Boulak.

Thanks are due to Prof. B. P. Gerasimovič, head of the Expedition, for admitting us to the Ak Boulak eclipse camp.

M. NAVASHIN.

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Moscow.

The Nature of Viscid Fluid Threads

THE considerations which follow gained the interest of Sir William Hardy, a specialist in such matters, when discussed with him briefly not a few years ago. As I am not aware of any record, at any rate in reasonably simple form, I venture to submit a brief statement.

The fact that permanent viscid threads can be pulled out of a plastic mass, after the manner of fibres of silk or of rayon before they solidify, does not lose its mechanical mystery through familiarity. If such a thread is suspended from one end, which oscillates up and down, it expands and contracts in length over a large range in dynamical unison with the oscillation, without breaking. The great amplitude may be imagined as due to the effective molecules being shaped like long dumb-bells, such as naturally interact mainly by force between their ends. If two rows of them lie parallel, there is a position of equilibrium when the ends are opposite each other. If one row is slid along, an elastic reaction comes into play which increases to a maximum, then diminishes as the attraction of the next pole becomes important, until it vanishes, when each attracted pole in the row is equidistant from the two influencing ones. This is an intermediate unstable position.

This peculiar complex type of viscid alternating elasticity holds a possible key to one type of phenomena: the expansion consists of rows of molecules within the threads sliding past one another, thus permitting reversible extension of large range without rupture in a way which we need not here follow in detail. The ruling idea came from the theory of the homologous hydrocarbon series provided by organic chemistry in its very early days, giving dumb-bell pictures which were then taken to be symbolic, but now under the scrutiny of X-ray diffraction reveal a geometrical reality.

A similar, but much less definite multiplication of basic molecular elements, is actually formed in hyper-molecules of substances of cellulose type, such as the plastic threads would require. But how is it that the parallel rows are not dispersed sideways from one another? Observe a hanging thread: it shrinks up at the free end into a spherical blob, like a dew-drop, obviously by surface tension holding it firm; higher up the length-wise surface tension has to hold up the lower part of the thread against its weight, while the transverse tension round the section holds the thread together. The section changes during an imposed vibration, the supporting force thus altering rhythmically as required. There is room for a mathematical theory here, if enough is known of the facts.

A somewhat cognate subject is the tension theory of the foreign monomolecular surface-layers discovered by Miss Pockels of Heidelberg and the late Lord Rayleigh, and developed extensively mainly by I. Langmuir and N. K. Adam. But one may insist that this effect is superposed on the Young–Laplace theory of an intrinsic surface tension at a pure interface and by no means replaces it.

One recalls also another cognate subject. Among my early recollections is the vision of Lord Kelvin standing, cup and saucer in hand, orating on the wisdom of the technique of the ladies' tea table, which spread a film of water in the saucer to prevent the cup of tea sliding over it. For, as he insisted, this brings a new type of intimate friction, entirely different from the smooth viscosity developed into hydro-dynamic theory by his friend and prophet Stokes, a theory which was to receive so vast expansion into the practical realms of ship-resistance and lubrication largely in the hands of Osborne Reynolds. All these topics, so simple in essence, now ramify very extensively throughout the most recent marvellous technology, with no slight reaction backward on abstract science.

JOSEPH LARMOR.

Holywood,
Co. Down.
June 13.

Inactivation of Crystalline Pepsin

CRYSTALLINE pepsin, in solutions of constant ionic strength on the alkaline side of its stability maximum, inactivates unimolecularly at a rate which is inversely proportional to the *fifth* power of the hydrogen ion concentration. This unusual relationship has been demonstrated over a velocity interval of 1 to 5,000 in nearly a hundred kinetic experiments at two temperatures with four different buffers. The rate varies with the buffer, but the fifth-power relation does not. As the buffer ratios change by different amounts in the same *p*H range, general basic catalysis is therefore excluded. It is likewise improbable that simple hydroxyl ion catalysis determines the rate.

The dependence on ionic strength is striking. Between $\mu = 0{\cdot}012$ and $\mu = 0{\cdot}10$, the velocity at constant *p*H increases by more than thirty times, regardless of the mono-monovalent salt used. At higher concentrations the change is smaller and finally reverses. The effect is complex, since the curve relating log-velocity to *p*H is shifted along both axes. Various relations to acidity earlier described[1] are partly fortuitous, owing to failure to control ionic strength.

This description applies only when the solutions are not agitated. On shaking, a heterogeneous reaction, independent of *p*H and μ over wide limits, obscures the results. The fifth power appears only at *p*H above 6·2 ($\mu = 0{\cdot}1$), where the homogeneous reaction is rapid enough to predominate. In more acid solutions the half-period of the latter may exceed five years at 25°.

The large exponent probably indicates that equilibria governing the concentration of an unstable species of pepsin ion determine the rate. Five acid groups must dissociate in the formation of this ion; the dissociation of the strongest group must also be fairly small in this range of acidity. Pepsin contains a limited variety of widely-spaced acid radicals; thus, it is conceivable that the five groups are alike and possess nearly identical dissociation constants. If they differ only by limiting statistical factors, the failure of the fifth-power dependence to hold exactly at *p*H above 6·45 means that the dissociation constants are near $1{\cdot}7 \times 10^{-7}$. This is slightly stronger than the positively charged ammonium groups in the simpler polypeptides[2] and in a simple protein[3], and approximately correct if the free amino groups of pepsin come from cystine rather than lysine. There are probably just five cystine residues in the enzyme, but Herriott and Northrop find four rather than five primary amino groups in pepsin[4].

If account is taken of the effect of temperature on the size of the pepsin fraction present as the unstable ion, the temperature effect on the rate of the actual reaction (decomposition of this ion) is much smaller than the observed change in velocity. When the ratio $k_{25°}/k_{15°}$ (about 30) is used to calculate the critical increment, the result is 64,000 calories—a high figure, characteristic of protein denaturation. When the shift in the pH dependence is allowed for (assuming all five groups alike) a quite ordinary value, 20,000 calories, is obtained. The exponent produces a large disparity, though the heat of dissociation of each group is only 9,000 calories. The latter value is favourable to the view that primary amino groups are involved, if the possible complications of tautomerism may be neglected. (Michaelis and Rothstein concluded that temperature changes only bring about changes in hydroxyl ion concentration. This unwarranted conclusion depends on the assumption that the inverse kinetic relation to hydrogen ions signifies a direct dependence on hydroxyl ions.)

Should this procedure apply to proteins generally, the statistical-mechanical difficulties arising from the great temperature effect in denaturation may prove to be illusory. The frequently observed variation of critical increment with pH, and its decline to a limiting value at high temperatures, can also be explained.

These measurements, to be described in detail elsewhere, owe much to the generous interest of Prof. J. N. Brønsted.

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Institute of Physical Chemistry,
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April 5.

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[1] L. Michaelis and M. Rothstein, *Biochem. Z*, 105, 60 (1920); R. Ege, *Z. physiol. Chem.*, 143, 159 (1925); A. M. Goulding, H. Wasteneys and H. Borsook, *J. Gen Physiol.*, 10, 451 (1926–27).

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[3] K. Linderstrøm-Lang, *Trans Far. Soc.*, 31, 1 (1935).

[4] R. M. Herriott and J. H. Northrop, *J. Gen. Physiol.*, 18, 35 (1934).

The Nitroprusside Reaction as a Test for Reduced Glutathione

THIS test was first introduced by Morner[1]. He added sodium nitroprusside and then alkali to cystein and obtained a deep purple red. This changed into a reddish brown and finally disappeared. Cystin gave no reaction. Mörner used a solution of pure cystein, and whether or not he heated his solution prior to the test he did not state. Heating in this case would not affect the results materially. In 1921 Hopkins[2] very casually suggested heating tissue in weak acetic acid in order to intensify the reaction before applying the test. This unchallenged suggestion has led other workers to heat tissues with acetic acid prior to the application of the test, thus obtaining wholly meaningless results (see, for example, Fink[3], Camp[4] and Coldwater[5]). In 1923 Harris[6] showed that native proteins which are non-reactive to nitroprusside become reactive when warmed with acid or base. For example, fresh ovalbumin is placed in three test-tubes and to tube *A* nothing is added; to tube *B* acetic acid is added; and to tube *C* acetic acid is added, and this tube is heated. All tubes are rendered alkaline with ammonium sulphate. The nitroprusside test is then negative in tubes *A* and *B* and positive only in the tube that was heated. Heat denatures proteins and liberates free $-SH$ radicals if the protein contains such in combined form.

Coldwater allowed tadpole tails to regenerate for 14 days, applied the nitroprusside test, and found that the regenerating part gave a more intense colour. I allowed tails of overwintering tadpoles (*Rana clamitans*) to regenerate for 3 weeks at 13°–16° C., keeping the animals without food. The tips, *C* (Fig. 1), of the tails were analysed quantitatively for GSH as soon as cut. After the elapse of the given time for regeneration (at the end of which the tails were less than half regenerated) regions *A*, *B*, and the regenerated region *R* were analysed for GSH. Two series of 35 tadpoles in each were analysed. The results are indicated in the accompanying table and are expressed in percentages of wet weight.

Per cent GSH of wet weight of different regions of a tadpole's tail

Series	Region of tail			
	A	*B*	(Regenerate) *R*	*C*
I	0·028	0·024	0·021	0·025
II	0·033	0·021	0·016	0·030
Average	0·030	0·022	0·018	0·027
Probable Error	± 0·001	± 0·0006	± 0·001	± 0·001

It is clear that the regenerating area has a lower concentration of GSH than the non-regenerating muscular regions. If the bone present in the old portion of the tail were removed, or if the results were reckoned in terms of dry weight, the differences would have been even greater. These results, of course, in no way contradict any hypotheses put forward by others that the $-SH$ radical may be a factor in regeneration, since the amount of GSH necessary for muscle metabolism might be far in excess of the small amount required for regeneration. This work does show, however, the fallacious results obtained by heating tissues prior to the application of the nitroprusside test.

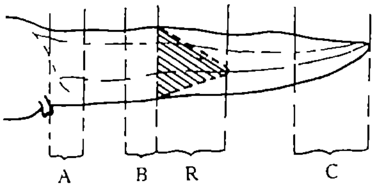

FIG. 1. Tail of *Rana clamitans* tadpole. *A*, *B* and *C* are the regions of the old tail analysed for GSH. *R* is the regenerating area.

The nitroprusside test was applied to pieces of *Euplanaria maculata* at different time intervals after cutting (2, 3, and 7 days). The initial result was an intense purple red throughout. Fading began in the lateral and regenerating areas of the reconstituting organism. If the permeability factor was not completely eliminated by acetic acid, then the areas shown to be more permeable to methylene blue stained first (that is, the lateral areas and the regenerating tissue). The other tissues stained later, but just as intensely, and the colour disappeared later. The intensity of colour was not at a maximum at the same time throughout the animal. Incidentally, it may also be mentioned that the nitroprusside reaction was applied to *Hydra grisea*. The immediate result was an initial flash of colour of about equal intensity throughout. The colour in the tentacles and in the stalk faded out at a very definitely earlier period than that in the main body region. Prior to the test, the animals were chloretonised and were in an expanded condition. Coldwater's results can easily be interpreted as due to differences in penetration of the reagents in the regenerating and non-regenerating regions.

The specificity of the nitroprusside test for reduced glutathione in living tissues has also been questioned. Now Sullivan[7] noted that, apart from free cystein, substances giving a positive nitroprusside test are not present in normal tissues. These substances include acetone, ethyl aceto-acetic acid, and cyanacetamide. There is, moreover, no authentic record indicating the presence of free cystein in living tissues. Applying Sullivan's test for cystein, Tunnicliffe[8], Thompson and Voegtlin[9], Gregory and Goss[10] and I failed to find free cystein in living tissues. It may thus be concluded that the nitroprusside test is specific for reduced glutathione *when applied to normal living tissues and when ammonium hydroxide is used as the alkali and no heat is applied.*

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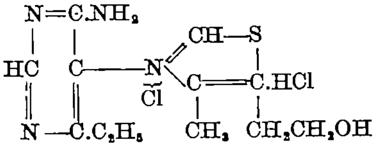
The Structure of Aneurin and Thiochrome

R. R. WILLIAMS has just published[1] a note on the structure of aneurin (vitamin B_1). From a study of degradation products of the vitamin, he concludes that his original formula (I)[2] for aneurin is wrong, and that it should be represented by (II: where $R_1 = CH_3$; $R_2 = H$); this new structure is similar in essentials to that suggested on theoretical grounds by K. Makino and T. I. Imai (II: where $R_1 = H$; $R_2 = CH_3$)[3].



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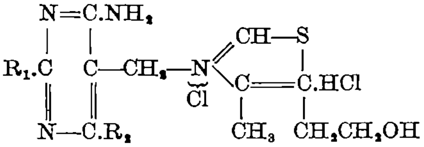

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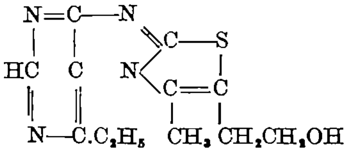

III

For thiochrome, which is formed from aneurin by mild oxidation, we suggested on the basis of formula (I) the structure (III)[4]. In the course of subsequent synthetic work we observed that thiazpurines, prepared as models for a thiochrome synthesis, although blue fluorescent in ultra-violet light, never showed fluorescence in daylight. This led us to suspect that (I) might not represent aneurin, and our suspicion was confirmed on completing the synthesis of the compound having structure (I). The synthetic substance, though exhibiting similar colour reactions to aneurin, is not identical with it; on oxidation with potassium ferricyanide it gives a substance non-fluorescent in daylight, but blue fluorescent in ultra-violet light. The difference in fluorescence between thiochrome and synthetic thiazpurines suggests that the former contains a different ring system. Accordingly, the possibility that the formula of Makino and Imai might represent the vitamin has been explored by synthetic methods. These experiments are not yet complete, but a compound similar in structure to (II) has been prepared, which on oxidation with potassium ferricyanide yields a substance exhibiting an intense blue fluorescence comparable with that of thiochrome. We are thus of the opinion that aneurin has a structure of type (II).

Our results afford additional evidence in support of the formula (II: where $R_1 = CH_3$; $R_2 = H$) advanced by Williams as a result of his brilliant investigations. Final proof of the structure must rest with the complete synthesis of the vitamin itself.

F. BERGEL.
A. R. TODD.

Medical Chemistry Department,
University, Edinburgh.
June 29.

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[1] *J. Amer. Chem. Soc.*, **58**, 1063 (1936).
[2] *J Amer. Chem. Soc.*, **57**, 229 (1935).
[3] *Z. physiol. Chem.*, **239**, I (Feb 28, 1936).
[4] G Barger, F. Bergel and A. R Todd, B., **68**, 2257 (1935).

A Radioactive Isotope of Iron

IT was shown by Fermi and co-workers[1] that the activity induced in iron by neutron bombardment is due to an isotope of manganese. The isolation of an active iron isotope has not been reported. By means of the sensitive tube counter outfit[2] in this institute, it was found that active iron can be isolated from cobalt which has been irradiated with neutrons, whereas irradiated iron after removal of manganese was found to be inactive. Experiments were carried out with cobalt as metal, as oxide and as carbonate.

After activation, the substance was dissolved in nitric acid and a trace of ferric salt added to the solution. Iron was precipitated from acid solution by means of ammonium acetate, the hydroxide then dissolved again and precipitated once more in the same way, and finally the same process was repeated a third time. The final product (Fe_2O_3) showed an activity decaying with a period of very nearly 72 hours. As only a single cobalt isotope is present in detectable amounts, it can be deduced that this activity must be due to the isotope $^{59}_{26}$Fe. This result is in very good accordance with recent investigations on the isotopic constitution of iron[3], which have shown that the isotopes $^{57}_{26}$Fe and $^{58}_{26}$Fe are stable, being present in amounts of 2·8 and 0·5 per cent of the element. These data also explain why it has been impossible to detect the formation of an active iron isotope by irradiation of iron itself.

Attempts to isolate active zinc from irradiated gallium and active chromium from irradiated manganese gave negative results. The experimental method, however, only allows detection of active products with fairly long periods.

E. BUCH ANDERSEN.

Physical Institute,
University, Aarhus,
Denmark.
May 27.

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[1] Fermi and co-workers, *Proc Roy. Soc.*, A, **146**, 483 (1934).
[2] Buch Andersen, *Z. Phys.*, **98**, 597 (1936).
[3] de Gier and Zeeman, *Proc. Roy. Acad. Sci. Amsterdam*, **38**, 959 (1935).

Determination of van der Waals Forces

THE quantum theory, unlike classical theory, predicts a finite effective collision area for impact between gas atoms attracting with a mutual potential energy falling off more rapidly with distance than the inverse cube. It has been pointed out by Massey and Mohr[1] that this makes possible a new experimental method for investigating the magnitudes and nature of these interatomic forces, namely, by direct observation of free paths by molecular ray methods using sufficiently high resolving power. Further, they have given a formula for the effective collision area for any inverse power law of force, from which the results of such experiments could be interpreted.

Since then, Rosin and Rabi[2] have carried out experiments under the required conditions for collisions of rare gas atoms with alkali atoms. The values of the van der Waals energy constant C (such that the van der Waals potential energy of interaction of two atoms at distance r apart is $-C/r^6$) for alkali – rare gas interaction, derived from their results, are given in columns *a* of Table I. (In obtaining these results correction has been made for the random direction of motion of the scattering gas atoms, but not for the Maxwellian distribution of velocities.)

Table I

Values of $C \times 10^{60}$ (erg.cm.^{6}).

	He		Ne		A	
	a	*b*	*a*	*b*	*a*	*b*
Li	14 4	17	18·7	32	188	125
Na	17 8	(26)	40 4	(51)	192	(200)
K	31·7	35	50 5	68	356	260
Rb	25·4	(40)	49 0	(77)	249	(290)
Cs	29·5	44	56·7	87	235	325

These results are of special interest because they may be compared with values of C derived from the polarisabilities of the atoms by a formula due to Hellmann[3]. The polarisabilities of lithium, potassium and cæsium have been measured directly by molecular ray methods by Scheffers and Stark[4] and those of the rare gas atoms may be deduced from measurements of their refractivities[5]. Substituting these values in Hellmann's formula, we derive the values of the constant C given in columns *b* of Table I. The bracketed values have been derived by interpolation, as the polarisabilities of sodium and rubidium have not yet been determined.

It will be seen that the agreement of the two sets of values of C is quite good and suggests that the free path method will prove very convenient for the determination of van der Waals forces. Further experiments in this direction, particularly on mutual collisions between rare gas atoms, would therefore be most valuable. It might be mentioned in conclusion that the scope of the free path method is much wider than that of the older methods depending on gas viscosity and diffusion phenomena.

We would like to express our thanks to Miss R. Sullivan for assistance in some of the numerical calculations.

H. S. W. MASSEY.
R. A. BUCKINGHAM.

Queen's University,
Belfast.
June 2.

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[1] *Proc. Roy. Soc.*, A, **141**, 434 (1933) and **144**, 188 (1934).
[2] *Phys. Rev.*, **48**, 373 (1935).
[3] *Acta Phys. Chim U.S.S.R.*, **2**, 273 (1935).
[4] *Phys. Z*, **35**, 625 (1934)
[5] C. and M. Cuthbertson, *Proc. Roy. Soc.*, A., **84**, 13 (1911).

Bursts of Cosmic Radiation

BURSTS of cosmic radiation were observed in an ionisation vessel 14 cm. diameter and 27 cm. high, filled with carbon dioxide at 10 atmospheres pressure, and completely surrounded by 10 cm. of lead. The sizes of the bursts were estimated as ranging between 35 and 1,800 rays, while the average frequency was 0·88 per hour, with a maximum of four bursts occurring in any one hour.

The magnitude distribution of the bursts in a series of 2,640 observation hours could be represented by the expression

$$B = \frac{8{\cdot}3 \times 10^5}{R_2^{5/3} - R_1^{5/3}}$$

where B=number of bursts (per 2,640 hours) containing between R_1 and R_2 rays ($R_1 < R_2$).

This is of similar form to that suggested by C. G. and D. D. Montgomery to summarise the cascade theory of bursts[1].

The average rates of burst production for various barometric pressure groups were :

Barometer	Bursts/Hour
685–695 mm.	0·911 ± 0·019
695–700 mm.	0 840 ± 0·016
700–710 mm.	0·811 ± 0·019

The barometer effect thus amounts to approximately −0·75 per cent per mm., or about three times as great as that observed here for the bulk of the radiation.

The frequencies with which 0, 1, 2, 3, or 4 bursts respectively occurred per unit period of 57 minutes could be represented by the successive terms of the expansion of the binomial $(q+p)^n$. The values of q and p were found to depend upon the barometric pressure as shown in the following table :

Barometer	n	q	p	P	N
085–695 mm.	4	0·211	0·789	0·32	934
695–700 mm	4	0 205	0·795	0 58	1251
700–710 mm.	4	0·197	0·803	0·32	904

P = the probability that the deviations between the observed and calculated values of the frequency could be caused by random sampling variations (χ^2-test).
N = total number of 57 minute periods of observation.

These results would be explained if the burst-producing radiation falling on the apparatus in the unit time of 57 minutes comprised only a few rays, namely, $n=4$, each of which had a relatively high probability, q, of generating a burst. The assumption that the burst-producing radiation falling on the apparatus is composed of a large number of rays, each with a very small probability of producing a burst, would require that the distribution of the above mentioned frequencies be of the Poisson rather than the binomial type, and this was not supported by the observations.

An increase of barometric pressure brings about a decrease of q with n remaining constant, and this is in line with Swann's hypothesis[2].

A. R. HOGG.

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May 8.

[1] *Phys. Rev.*, 48, 786 (1935).
[2] *Phys. Rev.*, 46, 828 (1934).

Are Hymenoptera Tetraploid ?

A RECENT communication[1] has suggested that among Hymenoptera Symphyta males may be diploid, females tetraploid. It was further suggested that this characteristic might help to explain the phenomena of pre-conjugation as seen in *Apis* and *Cynips kollari*.

More light on the problem may be obtained by taking into consideration available genetic data. If the queen bee is a true tetraploid, one heterozygous for a given recessive factor might be designated *AAaa* and would be expected to produce impaternate diploid drones, an excessive number of which would show the dominant character (the exact ratio of dominants to recessives would rest upon the peculiarities of tetrad or octad formation). However, if the queen bee is diploid and heterozygous for a recessive factor, she would be designated *Aa* and would be expected to produce impaternate haploid drones, equal numbers of which would show the dominant or the recessive character.

Dzierzon, in 1854 (eleven years before Mendel's paper), stated that male offspring from a hybrid queen bee resembled one or the other parental race, the two types appearing in equal numbers. Newell[2] reports that hybrid queens resulting from crosses of yellow Italian and non-yellow Carniolan are themselves yellow and indistinguishable from the Italian parental stock, but "produce both Italian and Carniolan drones, produce them in equal numbers, and do not produce any other kind". A clearer demonstration of this genetic segregation is given by Michailoff[3]. A black-eyed bee, the mother of which was known to have produced white-eyed drones, herself produced a total of 811 white-eyed drones and 806 black-eyed. A black-eyed daughter of this queen, mated to a white-eyed drone, produced 191 white-eyed, 191 black-eyed females and 8 white-eyed, 11 black-eyed drones.

The same method of inheritance has been amply demonstrated by Whiting and his associates in the braconid, *Habrobracon*, for more than 100 mutant genes. Here females show 20 gonial chromosomes, males 10, and the possibility of a diploid–tetraploid condition is made improbable by the presence of one very small chromosome in the male, two in the female, as shown by Torvik-Greb[4] and verified by me. Moreover, recessive mutations in this species have so often been found in but a single male of a fraternity as to indicate that such mutations occurred shortly before maturation of the egg and were made visible by reason of the haploid condition of the offspring.

Also of interest in connexion with this problem is the fact that diploid males, which are occasionally produced in *Habrobracon* from fertilised eggs, show no synapsis of homologues during spermatogenesis and, behaving like haploid males, exhibit an abortive reduction division, resulting in diploid sperm.

Impaternate females likewise may appear in *Habrobracon*; these are diploid, and produce normal haploid sons. Recent cytological work indicates that these females come from unfertilised tetraploid eggs, and by inference, from tetraploid patches in the ovaries of their mothers. If the thelytokous mothers are heterozygous for any recessive factor, the impaternate daughters appear in the ratio of 3 dominants to 1 recessive[5], thus fitting the expectation for diploid progeny from tetraploid gonads.

Thus, although tetraploidy may be a characteristic of lower Hymenoptera, it is unlikely that this condition is normal among representative species of Apocrita. In all cases, genetic evidence would be desirable to back up the cytological findings, since by this means tetraploidy is readily demonstrable.

B. R. SPEICHER
(National Research Fellow in the
Biological Sciences).

Columbia University,
New York.

[1] F. Greenshields, NATURE, 137, 662 (1936).
[2] W. Newell, *Science*, 41, 218 (1915).
[3] A. Michailoff, *Z. I. A. V.*, 59, 190 (1931).
[4] M. Torvik-Greb, *Biol. Bull.*, 68, 25 (1935).
[5] K. Speicher, *Biol. Bull.*, 67, 277 (1934).

Bones of a Whale from the Wieringermeer, Zuider Zee

IN 1935, the hind part of a skull, two lower jaws and other bones of a juvenile whale were found in the soil of the Wieringermeer, a reclaimed part of the Zuider Zee. Dr. van Deinse and I came to the conclusion that these bones must have belonged to a young specimen of *Rhachianectes glaucus*. Close comparison of the bones with a skeleton of *R. glaucus* in the British Museum (Natural History) proved that our conclusion was a correct one. Mr. M. A. C. Hinton and Mr. F. C. Fraser are also convinced that our identification is right.

Nearly as interesting, however, is the fact that there are earlier records of this whale in Europe which seem to have been overlooked until now. As a matter of fact, the name *Rhachianectes glaucus* auct. must be changed to *Eschrichtius gibbosus* (Erxl.). Van Deinse and I propose to publish a detailed paper with full synonymy in the journal *Temminckia* in the beginning of 1937.

G. C. A. JUNGE.

Rijks Museum van
Natuurlijke Historie,
Leiden.

Immunological Detection of the *Y*-Chromosome in *Drosophila melanogaster*

THE general aim of this line of research is to detect hereditary substances in man and animals by means of immunological methods. We began with experiments on the *Y*-chromosome.

An intensely inbred stock of *Drosophila melanogaster* (Florida) was used. Rabbits were immunised, some by means of a gruel extract obtained from crushed male flies of this stock, and some by means of a similar extract obtained from the virgin females. Serum from the first group of rabbits was adsorbed by means of a gruel obtained from crushed virgin females; serum from the second group was similarly adsorbed by males. In both sera the complement fixation reaction was made by using, as antigens, extracts of gruel of both males and females.

The results are presented in Table I:

TABLE I.*

Material for immunisation	Material for adsorption	Results with ♂♂ antigen (number of experiments)						Results with ♀♀ antigen (number of experiments)					
		++++	+++	++	+	±	−	++++	+++	++	+	±	−
♂♂	♀♀	15	34	3	0	0	0	0	1	13	12	8	18
♀♀	♂♂	0	7	11	12	4	8	2	7	10	11	4	8

* The number of plusses indicates the degree of positive result of the complement fixation reaction, that is, of the absence of hæmolysis.

As evident from this table, the results are not free from defects, chief of which seems to be insufficient adsorption. Apparently the individual characteristics of the rabbits are also of importance, particularly in view of a certain percentage of comparatively weak positive reactions in the series of experiments in which the immunisation was made by means of male extract and the adsorption by means of female gruel, the male extract being used as an antigen.

In view of the possibility that the positive results of this latter series might be considered as due to antibodies formed not against the *Y*-chromosome but against products specific for the male plasm, another series of experiments was undertaken. Serum, derived by immunisation by means of *Drosophila* male extract and adsorbed by means of females of the same stock was, in addition, adsorbed by means of females of the type *XXY* (double adsorption being necessary because the latter females, taken from another stock, evidently differed genotypically from the first line).

The results of this series of experiments are presented in Table II:

TABLE II.

Material for immunisation	Material for adsorption	Results with antigen (number of experiments)						Results with antigen (number of experiments)					
		++++	+++	++	+	±	−	++++	+++	++	+	±	−
♂♂	♀♀ *XX* and ♀♀ *XXY*	0	0	2	2	3	2	0	0	0	0	8	6

Further experiments are in progress. Details as to technique and a detailed report on the results will be communicated elsewhere.

S. G. LEVIT.
S. G. GINSBURG.
V. S. KALININ.
R. G. FEINBERG.

Department of Genetics and the
Immuno-Biological Laboratory,
Maxim Gorky Medico-Genetical
Research Institute,
Moscow. May 28.

Projection Method for Demonstration of Chromosomes *in situ*

THE demonstration of chromosome preparations has suffered from two serious difficulties in the past. First, the solid form of the object has to be reconstructed from images at different focuses, and it is impossible to be sure that an inexperienced observer has been able to do this. Secondly, chromosome behaviour in general has to be reconstructed from the observation of a great many cells, and their separate demonstration to one student, let alone a large number, is out of the question.

In order to overcome these difficulties (for the summer course of this Institution) we have experimented with the projection of images of the chromosomes on a screen, such as is commonly used for lower magnifications. We find that with a 10 ampère arc lamp, a strong condenser, and a water-ammonia heat-absorbing tank, a sufficient beam of light can be passed through the horizontal microscope (with a ×90 oil immersion apochromatic objective, N.A. 1·3, and a ×5 compensating eyepiece) to give a bright image magnified 5,000 diameters on a screen four feet in diameter and at a distance from the microscope of nine feet. The beam of light between the condenser and the microscope is enclosed to prevent glare. We find that a plain white screen is more satisfactory for our purposes than ground glass, opal glass, silvered or beaded screens. The microscope can be turned on a swivel, and the demonstration interrupted to show ordinary lantern slides.

This apparatus gives equally satisfactory results with well-differentiated hæmatoxylin and gentian-violet staining, with sections of root-tips and with smears of testes and pollen mother-cells. The form and internal structure of the chromosomes—their coiling and chiasmata—and the positions of such bodies as chromomeres and centromeres, 2000 A. in diameter, can be shown throughout the nucleus at focuses varying in depth 20–30 μ. They can be seen by ten or fifteen persons at once with our present experimental apparatus.

The use of this method should enable students to understand chromosomes in a real, and not merely a verbal sense. The apparatus can be made from everyday laboratory equipment and could, we believe, be installed with advantage wherever this subject is taught.

C. D. DARLINGTON.
H. C. OSTERSTOCK.

John Innes Horticultural Institution,
London, S.W.19.
June 30.

An Early Magdalenian 'Raclette' Industry in the Lower Thames Valley

IN 1930, Dr. A. Cheynier described a newly-discovered industry of Early Magdalenian age, located at Badegoule in the valley of the Vézère, characterised by a large number of end- and side-scrapers made on flakes and showing vertical edge-trimming. He termed these specimens "raclettes"[1]. Mr. A. S. Barnes, who has made a special study of the Upper Palæolithic phases of the Dordogne, refers to this culture in a paper on the Magdalenian period of France, in which he records the close similarity between the edge-trimming on these 'raclettes' and on eoliths[2].

I have lately found, in Stone Court Valley, a 'floor' on the surface of the Lower Flood Plain gravel situated at the base of the Sunk Channel and overlain by an accumulation of alluvial beds and hill-wash. The Sunk Channel was cut in Late Pleistocene times through the gravels of the Upper Flood Plain, which are here overlain by some 10 feet of glacial material. The Stone Court Valley industry is similar to that described by Dr. Cheynier and consists of quantities of 'raclettes', a few carinated scrapers, points with a small notch on each side of the butt (lames à étranglement basilaire), hand-adzes, cores and plain flakes.

Mr. Barnes had already remarked that the retouches upon the Badegoule 'raclettes' recall on a small scale the high-angle chipping on eoliths ; but one of the most interesting features of the Stone Court Valley find is the recrudescence among the other artefacts of specimens analogous, both in sizes and forms, to the Harrisonian eoliths of the Kent Plateau.

The results of this investigation, which I am conducting through the generosity of the trustees of the Percy Sladen Memorial Fund and the kind permission of the management of the Associated Portland Cement Manufacturers, will be published in detail upon its completion.

J. P. T. BURCHELL.

30 Southwick Street,
W.2.

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[1] *Bull. Soc. Préhist. Française*, **27**, 483 (1930).
[2] *Proc Prehist. Soc. E Anglia*, **6**, pt. 4, 316.

Scientific Workers and War

THE article on "War, Science and Citizenship" in NATURE of May 9, and the letter on "Scientific Workers and War" published in the following week have expressed views no doubt widely held among readers of NATURE. Neither, however, gives any adequate suggestion as to how those scientific workers who hold such views can make them effective. Any steps depending on collective action through existing scientific organizations are obviously impracticable at the moment, for on the question of war, as on any other question of public policy, there are as wide differences of opinion among scientists as among the rest of the population. No existing organization of scientists, therefore, could at present make any pronouncement, apart from a purely platitudinous one, without serious loss of membership and of effectiveness in other directions.

On the other hand, an individual scientific worker who "first considers what ought to be done and then uses his influence to see that it is done" is acting simply as a private citizen and can do little to achieve that common action of scientists which is desired.

It seems to us, therefore, that the first requisite for any effective action along the lines indicated is the existence of an *ad hoc* organization of those scientific workers whose outlooks are sufficiently akin for an effective common policy to be possible. A policy arrived at by such an organization would not profess to be that of all scientific workers, but would doubtless carry great weight both among their colleagues and among many of the general public who are looking for a new lead. Furthermore, it might well result in existing scientific organizations, with their wider basis of membership, taking some kind of action. At the very least, it would call for a new standard of discussion among those who would oppose it.

A further difficulty must be faced. "To ally ourselves boldly with constructive political forces" as suggested, is not without its dangers. Opinions differ as to which political forces are the constructive ones. On matters where feelings run so high, any decisive action or expression of opinion is bound to cause offence in some quarters, and the offence is bound to be the greater the more original or effective such actions or opinions may be. Owing to their highly specialized training, many scientific workers have even more to fear than most people from the hostility of those who control their means of earning a livelihood. In these very questions to which we believe, with you, that professional scientists can make a distinctive contribution of real value to the community, we believe also that many of them—even in the remaining democratic countries—are kept silent by the certainty that an open expression of their opinions would seriously affect their careers or even bring them to a sudden end. This would certainly apply, for example, in many places to those holding some of the views mentioned in the Cambridge letter. It is with such considerations in mind that there has arisen among the staff and research workers of this University a group whose aim is to investigate the root causes of war and to find means of avoiding it. Isolated groups are, however, of little greater effect than isolated individuals, and we should welcome contacts with similar groups elsewhere in the hope of being able to arrive at a common programme.

E. BARROW, M.B.
J. DONEN, PH.D.
C. A. DU TOIT, PH.D.
B. GERSHILE, B.SC.
W. F. GRANT, B.SC.
W. S. S. LADELL, B.A.
L. A. J. LINCOLN, B.SC.
C. B. O. MOHR, PH.D.
C. J. MOLTENO, B.A.
E. O. PABST, M.SC.
G. F. PAPENFUSS, PH.D.
G. SACHS, M.B., F.R.C.S.
H. SANDON, PH.D.
N. SAPEIKA, B.A., M.B., CH.B.
J. G. TAYLOR, M.A.
E. M. THOMPSON, B.A.
J. WRIGHT, B.A., B.M., B.CH.
H. ZWARENSTEIN, PH.D.

University of Cape Town.
June 15.

Photo-Reduction of Fluorescent Substances by Ferrous Ions

DR. K. WEBER[1] has recently published a note on experiments which he connects with the results published previously by me[2]. There is, however, not much relation between his experiments and my investigations, as may be clear from the following remarks. Dr. Weber seems to be unaware of the fact that by the method which I described it is only possible to reduce fluorescent substances, and then only when they are in a suitable state to exhibit fluorescence. Indeed, his own failure to reduce dyestuffs such as neutral red and Nile blue, which he has reported recently[3], can be attributed mainly to the fact that these dyestuffs are non-fluorescent in aqueous solution.

It has been shown previously that, in principle, every fluorescent substance can be reduced by the influence of light in the presence of suitable reducing substances, for example, Fe^{++} ions, SO_3^{--} ions[4], HS^- ions[5], reversibly or irreversibly. Dyestuffs can always be easily reduced when they are fluorescent in aqueous solution, and Dr. Weber did not fail to confirm this. The reason simply is that the photo-reduction is identical with the elementary process of quenching of fluorescence. The dyestuff molecule in the excited state (F^*) which possesses an unoccupied electronic level (due to the excitation of one electron to a higher level) can take up an electron from a reducing (quenching) substance (into this level) according to the process :

$$F^* + Fe^{++} \rightarrow F^- + Fe^{+++};\quad F^- + H^+ \rightarrow FH \text{ (reduced dyestuff).}$$

In this way the excitation energy in effect increases the electron affinity of the dyestuff molecule (F). When there is no fluorescence, there are no excited dyestuff molecules of an appreciable life-time, and consequently no photo-reduction can take place.

The photo-reduction is not quite so simple in the case of chlorophyll and other fluorescent substances which give non-fluorescent aqueous solutions, and where it is necessary to use a suitable mixture of solvents (for example, aqueous methyl alcohol), in which the ferrous salt is sufficiently soluble and also the dyestuff (chlorophyll) is capable of fluorescence.

Further details are given in a paper[6] which has recently appeared, and an additional paper on the same subject will be published shortly.

JOSEPH WEISS.

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University College,
London, W.C.1.

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[1] K. Weber, NATURE, 137, 870 (1936).
[2] J. Weiss, NATURE, 136, 794 (1935).
[3] K. Weber, *Naturwiss.*, 23, 486 (1935).
[4] J. Weiss and H. Fishgold, NATURE, 137, 71 (1936).
[5] J. Weiss, *Naturwiss.*, 23, 610 (1935).
[6] J. Weiss and H. Fishgold, *Z. phys. Chem.*, B, 32, 135 (1936).

The Mysterious Number 137

THIS is stated in NATURE of May 23, p. 877, to be more accurately 137·2. Now 1371288 is the natural number similar to the mantissa of its logarithm. How will this fact interact with the formulæ of origin ?

FLINDERS PETRIE.

American School of Research,
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June 1.

Points from Foregoing Letters

To explain the elastic properties of viscid fluid threads, Sir Joseph Larmor imagines their molecules to be shaped like dumb-bells, interacting by forces between their ends, so that when two rows lie in parallel there is a position of equilibrium when the ends are opposite each other, and an elastic reaction comes into play which allows of a large range of reversible extension.

Crystalline pepsin is inactivated at a rate inversely proportional to the fifth power of the hydrogen ion concentration, between pH 6·2 and 6·45. This behaviour, Dr. J. Steinhardt considers, suggests the presence of an unstable pepsin ion, formed by the dissociation of five acidic groups with dissociation constants near $1{\cdot}7 \times 10^{-7}$.

From the reaction shown by regenerated tails of tadpoles and pieces of *Euplanaria* with sodium nitroprusside, N. S. R. Maloeuf concludes that the nitroprusside colour test is specific for the oxido-reduction enzyme glutathione, when applied to normal living tissues and when ammonium hydroxide is used as the alkali. Heat must not be applied, since it liberates free —SH radicals from protein, which then give a colour with the nitroprusside and invalidate the test both for glutathione and cystein.

F. Bergel and A. R. Todd discuss the possible structural formulæ of aneurin (vitamin B_1) and its oxidation product, thiochrome. Certain synthetic compounds show a fluorescence similar to that of thiochrome, and their known structure supports the formula suggested by Makino and Imai, and modified by Williams.

The formation of a radioactive isotope of iron by irradiation of cobalt with neutrons is reported by Prof. E. B. Andersen. The new isotope is probably iron of mass 59, and shows an activity decaying with a period of nearly 72 hours.

Dr. H. S. W. Massey and R. A. Buckingham calculate the values of the van der Waals' interatomic constant from observations by Rosin and Rabi on the collision of rare gas atoms (helium, neon and argon) with alkali atoms, observed by the molecular ray method. The authors compare the values with those derived from the polarizabilities of the atoms, and conclude that the free path method will prove convenient for the determination of van der Waals' forces.

An investigation by A. R. Hogg of bursts of cosmic radiation of estimated size 35–1800 rays suggests that the rays responsible for producing these bursts occur relatively infrequently, but that each ray has a fairly high probability of producing a burst. This probability varies with the barometric pressure.

Instances are quoted by B. R. Speicher to show that hybrid queen bees produce equal numbers of impaternate drones with dominant and with recessive characters. Hence he concludes that the impaternate drones in bees and wasps (sub-order Apocrita) are 'haploid', that is, they have the basic number of chromosome number in their nuclei, and are not 'diploid' as recently suggested in the case of male impaternate saw-flies (sub-order Symphyta).

The formation, in rabbits' serum, of 'antibodies' specific for the Y-chromosome of the male fruit-fly, after injection of a gruel of the insects, is indicated by experiments carried out by Dr. S. G. Levit, S. G. Ginsburg, V. S. Kalinin and R. G. Feinberg. An antibody when formed in the serum of living animals after the injection of an 'antigen' (in this case, extract of fruit-flies) 'fixes' the 'complement', a ferment which, in conjunction with an 'amboceptor', hinders the break-up of red blood cells and of bacteria.

A simple arrangement for the direct projection on a screen of microscopic slides showing the internal structure of chromosomes is described by Dr. C. D. Darlington and H. C. Osterstock.

J. P. T. Burchell reports the finding, in Stone Court Valley, of a 'floor' containing stone implements, including 'raclettes', at the base of the Sunk Channel, cut in Late Pleistocene times. The artefacts show features analogous to those observed among the 'eoliths' (earliest stone implements of tertiary age).

Research Items

Antiquities of the Jumna Valley

AN investigation by Prof. B. Sahni of mounds on the outskirts of the city of Khokra Kot, where their structure has been revealed by ravines cut through by rains, has produced a large number of relics, old bricks, pottery, etc. (*Current Science*, May 1936). A well-defined dark layer exposed in the side of a cliff at three feet below the surface, yielded hundreds of black terra-cotta disks, afterwards identified as moulds for coins. These, as is shown by a Brahmi inscription, must be assigned to the Yaudhiyas and dated at about 100 B.C. Some were found afterwards still to contain coins. The coins are of bronze. On the obverse is a humped bull, looking to the right, with head obliquely pointing to the observer. In front of it is the conventional sign for a tree enclosed within a railing. On the reverse is an elephant, also pointing to the right, in various postures of walking or running, with trunk upraised. In some, the tail is bifurcated. Above is the Brahmi letter *ga* and the *triratna* or *nandipada* symbol. The matrices were either baked over a slow fire of paddy or wheat and barley, or they were packed in them, when the molten metal was poured in. They show impressions of the paddy straw, and charred grains adhere to them in the form of a carbonized crust. A terra-cotta model of a humped bull probably came from the same level. Other relics belong to a distinctly lower, and probably earlier, level. A glazed pot of white paste bears on its inside a clear impression of a finely woven cloth. In this was an ink-like substance, which analysis has shown to consist of carbon (lamp-black) with mineral substances. A shell bead is carved out of the columella of a large gastropod. It is suggested on the ground of the resemblances of these objects in style to antiquities from Mohenjo-daro and Harappa, that there may be in the Jumna valley a tradition of a connexion with the Indus valley civilization, which systematic investigation on this site might confirm.

Antithyrotropic Activity

THE injection of extracts of anterior pituitary causes hyperplasia of the epithelium of the thyroid gland and general symptoms of hyperthyroidism. The effect on the thyroid is not maintained for long, and the symptoms of hyperthyroidism disappear, in spite of the continuance of the injections. Collip and Anderson showed that this disappearance of the effects is due to the appearance of inhibitory antithyrotropic substances in the blood. Rowlands and Parkes (*Proc. Roy. Soc.*, B, 120, 114; 1936) have studied the properties of this antihormone. Inhibition of the effect of thyrotropic extract on the weight of the thyroid of the immature guinea pig was used as a test of antithyrotropic activity, and a method of assay is described. Normal blood has no action. If thyrotropic extract is injected daily into rabbits, antithyrotropic activity begins to appear after four weeks and reaches a maximum in ten weeks. The results described are in complete agreement with the antihormone theory of Collip and his co-workers. It would be difficult to over-estimate the biological importance of this theory.

Northern Phytoplankton and its Production

DR. E. STUMANN NIELSEN has investigated the general plankton production conditions in the Faroe, Icelandic and East Greenlandic waters proper as well as dealing, although in less detail, with the whole of the northern region of the Gulf Stream and the bordering colder regions (*Meddelelser fra Kommissionen for Danmarks Fiskeri og Havundersøgelser*. Serie: Plankton. 3, No. 1; 1935). He gives the results during 1932–34, made chiefly with the Danish research ship *Dana*. All the plankton work was done in close co-operation with the hydrographic observations, and in 1934 the transparency of the water was also registered. The phytoplankton production is one of the most important links in the chain of factors leading to the production of great fish populations. On it depend the fisheries of all our seas either directly or indirectly. The conditions of production are of a very diverse character in the different seas around Iceland and the Faroe Islands, the factors that are of importance do not act in the same way everywhere, and it is only when they act together as a harmonious whole that the possibilities of production are optimal. Light and the quantity of nutritive salts are of supreme importance in restricting the plankton production in northern waters, but there depend many other factors which partly work into one another, such as stabilisation of the surface layers and the transparency of the water (including amount of detritus present); temperature and salinity having as a rule only a regulating effect. More exact studies into vertical movements of the volumes of water in the sea are advocated and also systematic investigation regarding the transparency of the sea throughout the year, together with detailed inquiries into the relation between the areas with large production of phytoplankton and those with great fish populations.

Researches on the Sucking Lice

THERE has recently come to hand Part 8 of "Contributions towards a Monograph of the Sucking Lice" by Dr. G. F. Ferris, and published by the Stanford University Press, California. This fascicle forms No. 8 of vol. 2, Stanford University Publications, Biological Series, 1935, and completes the monograph concerned. It deals especially with the lice of man and certain other primates. The author arrives at the conclusion that the genus *Pediculus* contains but three species. The question, so often debated, as to what constitutes a species is of particular interest in connexion with this genus, and the author defines his attitude as regards the problem as definitely as possible. Of the three species recognized, *P. humanus* L. is adopted as the name for the whole assemblage of Pediculi found on the races of man. It seems clear that it can also establish itself upon other primates which have been in contact with man. The validity of the author's conclusions remains to be tested by experimental work upon the various forms that are known to occur. The second species, *P. mjöbergi* Ferris, infests monkeys of the family Cebidæ, and *P. schäffi* Fahrenholz occurs on the chimpanzee. Of the genus *Phthirus*, in addition to *P. pubis* (L.), the existence of a second species, *P. gorillæ* Ewing, is doubtful, and adults are, as yet, undescribed. The fascicle concludes with an appendix relating to Anoplura dealt with in the earlier parts of the monograph, and an index.

Inhibitors of Tobacco Mosaic Virus

SEVERAL viruses produce local lesions upon the inoculated leaves of certain host plants, and this capacity has been used to test the effects of various inhibiting substances. It has not, however, always been possible to determine whether the inhibitor was acting upon the virus or the host, but Dr. J. Caldwell has evolved an interesting technique to separate these effects ("Factors affecting the Formation of Local Lesions by Tobacco Mosaic Virus", *Proc. Roy. Soc.*, B, **119**, 493–507, March 1936). The earlier part of the paper shows that if the inhibitor acts upon the virus, its effect should increase with decreasing virus concentration, and the reverse effect would indicate inhibitory action upon the host. Experiments with normal sera of horse and rabbit, with trypsin, and with silver nitrate, indicate that all these inhibitors act upon the virus. The mode of action is not yet quite clear, but should form a fascinating subject for future study.

Unity of Force and Matter

THE Masaryk Academy of Work has just published a thesis by Dr. J. Bašta entitled, "L'unité de la force et l'unité de la matière dans la conception physique uniforme du monde", in which the author sets out to show that, mathematically and physically, all matter is composed of what he terms 'proto-atoms'. Experiments are cited to indicate the possibility of reducing the various causes of pressure and acceleration, for example, cohesion, adhesion, chemical affinity, adsorption, vapour pressure, osmotic pressure, gravity, magnetic and electrical attraction and repulsion, etc., to a single force. This force is the cause of strain in static states and of acceleration under dynamic conditions. It is supposed that this simple force is the attraction of the smallest elementary particles of matter (proto-atoms). The range of action of these bodies is limited by the amplitude of their vibrations. The attraction is transmitted only by contact of one particle with its neighbour. All action at a distance is excluded. The primary sources of this elementary attraction are the proto-atoms. Atoms of the chemical elements and also the ultimate particles of cosmic ether represent different complexes of these ultimately simple proto-atoms which, it is postulated, are only able to exercise an influence on primary matter in their own material system or on other systems by their residual lines of force.

Oceanography and Meteorology of China Seas

Koninklijk Nederlandsch Meteorologisch Instituut publication No. 115, entitled "Oceanographic and Meteorological Observations in the China Seas and in the Western part of the North Pacific Ocean", is a large atlas in which are set out cartographically the extensive observations collected during many years by Dutch and other ships in East Asiatic waters in a similar form to that of the atlases of the Indian Ocean (Publication No. 104) and of the Atlantic Ocean (No. 110). The text is in Dutch, with an English translation, but the names on the maps are in English only. The work is in accordance with the recommendations of the Fourth Pacific Science Congress of 1929 at Batavia for active international co-operation to develop the practical and scientific aspects of oceanography and meteorology, and for this reason more observations from ships of other nationalities—especially those of Great Britain, the United States, France and Germany—have been used than in the case of the similar earlier Dutch publications. The result is an impressive mass of marine statistics set out in great detail and with admirable clearness, on charts roughly 18 in. × 18 in. It is a bulky publication, which when open occupies a space of 3 feet 6 inches by nearly 2 feet, but by adopting a large size for the charts excessively small lettering has been avoided. For the General Current Circulation 'one degree squares' are used. Each of these contains an arrow showing the average observed resultant current, and figures alongside giving the average speed in nautical miles per day and the number of observations, while the stability of the circulation is shown by the length and thickness of the arrow. Each month is dealt with separately; the information just described is shown on the left hand page at an opening, while on the right hand page the current roses for the same month are given on 'squares' of rather larger size—generally 5° of longitude by 3° of latitude. These roses follow a well-known standard form, the percentage frequency of a given direction of current being shown by a suitable length of line on the scale 1 mm. = 2 per cent, and various ranges of speed are represented by various thicknesses and shadings of line. On the same system of 'squares' the monthly data for the ordinary meteorological elements, wind, fog, precipitation, pressure, air and sea surface temperature are set out, and also the tracks of the more important temperate depressions (here designated continental depressions) and typhoons.

Iron Wire and Nerves

IN the study of complex problems, the construction of a simplified model may serve as an aid to comprehension. It is now eighteen years since R. S. Lillie first directed attention to the similarity between the properties of iron wire immersed in nitric acid and those of living nerves. During these years the phenomenon has been more closely studied, and many more points of similarity have been discovered. A review of the present situation has recently been published (*Biol. Rev.*, **11**, 181; 1936). When the iron wire is placed in nitric acid it is quickly covered with a film of oxide which protects it and makes it 'passive'. If this film is broken, the damaged area becomes anodal and local currents flow which break down a new area of the film, and this in turn 'stimulates' another area and an 'impulse' passes along the wire. When the impulse has passed, the damage is quickly repaired. The model resembles nerve in the fact that it can be stimulated by electric currents, and the laws governing the conditions necessary for excitation are similar. The 'chronaxie' of a certain model was about the same as that of heart muscle. After stimulation, the model shows an absolute refractory period followed by a relative refractory period. The temperature coefficients of the two processes are about the same. If the wire is enclosed in a tube the velocity of transmission is diminished. This is compared with the slow transmission in small nerve fibres. If a wire is enclosed in a series of short tubes, the impulse can jump straight from one node to the next and the impulse passes quicker than normally. This is compared with the nodes on the myelin sheath of certain quickly-conducting nerves. Under certain conditions, models may show rhythmical activity.

Centenary Celebrations of the University of London

THE hundredth anniversary of the University of London was celebrated during the week June 29–July 3 with a full programme of functions. The proceedings were inaugurated at an afternoon reception on Monday, June 29, in the Great Hall of the University at South Kensington. Here nearly two hundred representatives of universities and learned societies in every corner of the globe assembled to present addresses of congratulation and goodwill. The Chancellor, Lord Athlone, in welcoming the delegates, said that this great convention was a healthy reminder that learning recognized no national frontiers, that the whole band of great teachers, the whole band of eager students, were truly citizens of the wide world, and their influence for good was incalculable and illimitable. Honorary degrees were conferred on the following distinguished men, who were presented by the Public Orator: The Archbishop of Westminster, Dr. J. W. Mackail, Sir Charles Peers, Prof. G. M. Trevelyan, Mr. H. G. Wells, Senor Don Ramon Perez de Ayala (Doctors of Literature); Mr. S. A. Courtauld, Mr. P. M. Evans, Sir Joseph Larmor, Sir George Newman, Lord Snell, Lord Wright (Doctors of Law); Dr. R. Vaughan Williams (Doctor of Music); and Sir William Bragg and Prof. Max Planck (Doctors of Science). Degrees were also conferred *in absentia* on Dr. Emile Legouis (Doctor of Literature); Mr. Justice Cardozo (Doctor of Laws); Prof. Albert Einstein and Prof. Johan Hjort (Doctors of Science).

In the evening of the same day, a dinner was held at Grosvenor House. The Chancellor, who presided, read a message from His Majesty the King, Visitor of the University, conveying his sincere congratulations to the University on the occasion of its centenary, and alluding to the progress of the new buildings at Bloomsbury as marking the beginning of a new era as well as a new century in the life of the University. Sir Thomas Inskip, in proposing the toast of "The University", said that within the space of a hundred years the University had attained such a position that it was able in everything but antiquity and beauty of situation to challenge the supremacy of the two great Universities of Oxford and Cambridge, and had fully justified the foresight of those who founded it. Time would make it as venerable as its rivals, and the generosity of public and private benefactors would soon enable the University to have buildings as beautiful and as well placed as any in the land.

The Chancellor, in reply, commented on the happy spirit of co-operation and goodwill which to-day existed between the learned institutions of the world. The exchange of teachers and students and ideas was of the utmost significance, and the Universities of the world might well claim that they were making a contribution of high value and importance in the promotion of peace and understanding. He stressed also the importance of unity, though not necessarily uniformity, within the University itself, and remarked on the analogy which the constitution of the University, with its federation of semi-autonomous Schools, presented to the British Empire. The one was no less real than the other. "The respective spheres of University and College", he said, "are clearly defined in black and white but no written statute is of any avail apart from that spirit of goodwill, that desire to pull together, which is characteristic of London University". The toast of "The Guests" was proposed by the Vice-Chancellor, Mr. H. L. Eason, who said: "This great gathering is a token that the ideal that should underlie all Universities is not forgotten, namely, that academic learning should have no boundaries of space, nationality, religion or politics. Without this spirit, learning would have perished in the Middle Ages, and there never was a period in the world's history when the maintenance of complete academic freedom of thought was more urgently needed than to-day". Prof. Louis Cazamian, of the University of Paris, Mr. G. H. Wilson, vice-chancellor of the University of Cambridge, Prof. L. P. Eisenhart, of Princeton University and Sir James Barrett, Chancellor of the University of Melbourne, responded, and congratulated the University on the distinguished record of its first hundred years.

Tuesday, June 30, was devoted mainly to functions at the various Colleges, while in the evening the Worshipful Company of Drapers, old and generous friends of the University, gave a ball at the Drapers' Hall.

On Wednesday, July 1, the University's friendly relations with the City of London were once more demonstrated and reaffirmed. To the special service of thanksgiving at St. Paul's Cathedral came a vast congregation of members and friends of the University. The citizens of London gazed upon a striking and colourful scene as the processions in academic costume wound up Ludgate Hill. First the professors and readers entered the Cathedral. Then came the Lord Mayor, the Sheriffs and Corporation; and finally the Chancellor's procession, consisting of the delegates from sister universities and learned bodies, honorary graduates, the Court and Senate and the Chancellor. The service, which was broadcast, was impressive in its simplicity. The Archbishop of Canterbury, in an eloquent sermon, paid tribute to the high ideal which had animated the founders of the University one hundred years ago and which was still incorporated in the Statutes, "to hold forth to all classes and denominations without any distinction whatsoever an encouragement for pursuing a regular and liberal course of education". This ideal was now accepted as a commonplace of public policy, but in those days great courage was needed to assert it. The University had been a pioneer of the movement which had given universities to most of our large cities, and though unlike its younger sisters it had not been able, by reason of the vastness of London, to make such an impact on the life of the city, the presence of an institution which not only prepared students for profitable and useful careers but which also fostered the things of the mind and the spirit, the pursuit of knowledge and truth for their own sake, was of incalculable benefit to London. Throughout its development the University had lacked one thing—a body, so to speak, in which its soul might find a fitting home. This was now at last to be remedied, and at Bloomsbury there was arising a great building wherein for the first time the length and breadth and depth and height of the ideals for which the University stood would find a visible, noble, enduring embodiment and witness—a reminder to London that it had its own University in its midst.

After the service, the Lord Mayor and Corporation gave a luncheon in Guildhall. Lord Halifax, speaking as Chancellor of the University of Oxford, said that one of the greatest achievements of the nineteenth century was the assertion of the principle of an extended university education. This had inevitably given rise to a tendency to consider that the progress of the human race was automatic, provided that education could be sufficiently widely diffused. It was, however, being increasingly realized in these days that much knowledge might be a dangerous and destructive thing unless it was directed by something greater than itself. One had only to think of man's discovery of aeroplanes, of chemical laws and products and even of the internal combustion engine, to realize how dangerous they could be, unless guided and inspired by that which was greater than themselves—wisdom. Civilization must depend on training men to become masters rather than victims of their own inventions. No greater aim could be set before a university, and they could wish no better thing for London's university than that for the next critical century of its history it might continue to inculcate those principles to which in the past hundred years it had been so faithful.

The Chancellor, in reply, said that the first and perhaps the most difficult stage of the University's history was now past, and they might recall, with justifiable elation, the apprehension and dismay with which at the outset the project was greeted. All that the University had striven and was striving for would be consolidated in its new home, and there the University would pursue its course, going quietly and steadily forward; and when the next hundred years had passed there would be found the same spirit, the same high ideals, which animated the University of London to-day.

Lord Macmillan, chairman of the University Court, who proposed the toast of "The Lord Mayor and Corporation", referred to the friendly relationship between 'town and gown' which had always existed in London, and recalled episodes separated in time by more than a hundred years in which the City Corporation had shown its great interest in the cause of university education in London. The University, like the City, was engaged in commerce —not of commodities but of ideas—a commerce which knew no quotas, no embargoes, but where universal free trade existed. The best means for bringing about in the distraught world a renewal of friendship, mutual confidence and well-being, was by the promotion of those common bonds which scholarship and learning alone could furnish. The Lord Mayor, responding, said that the Corporation of London had always identified itself with the cause of education and had ever striven for that freedom of thought and action, in the wise and appreciative use of which the finest achievements of the human mind had become available for the benefit of mankind.

In the evening, His Majesty's Government held a reception at Lancaster House, where the guests were received by the Lord President of the Council and Miss MacDonald.

The proceedings were brought to a conclusion on Friday, July 3, with a brilliant reception given by the London County Council, the hospitality of which once more bore witness to the generosity and goodwill which characterizes its relationship with the University.

Throughout the week, hospitality was freely extended to the delegates by the Colleges and Schools of the University in the form of luncheons, garden parties, dinners and evening receptions, and all offered facilities for the visitors to see something of their work and activities.

A memorable occasion was thus worthily celebrated. The University, on the threshold of a new phase of its existence, may well be satisfied with the demonstrations of loyalty and friendship which the completion of its first hundred years has evoked, not only from those within its bounds but also from all those far and near who come into contact with its widespread activities.

The National Physical Laboratory

ANNUAL INSPECTION

ON July 1, the annual inspection of the work in progress at the National Physical Laboratory was made by the General Board and also by a large number of visitors representative of scientific, academic and commercial institutions throughout the country. The visitors were received in the High Voltage Laboratory by Sir William Bragg, president of the Royal Society and chairman of the Board, the Right Hon. Lord Rayleigh, chairman of the Executive Committee, and Sir Frank Smith, director of the Laboratory. Some three hundred exhibits illustrating the work performed in the eight departments of the Laboratory were on view; a brief summary of some of the more recent or interesting developments is given below.

In the Physics Department, the analogous problems of the transfer of heat from metal pipes and moisture from wet surfaces to a stream of air flowing over them have been investigated, and similar laws are found to hold for the two processes. The effect of inducing turbulence in the air-stream has also been studied. A simple falling plug method for determining the viscosities of liquid refrigerants has been devised. The apparatus is calibrated with liquids of known viscosity, and may easily be adapted to work under pressure and at low temperatures. The investigation of the changes of length of hygroscopic materials with humidity has continued and a demonstration was given of the application of such a material—gold beaters' skin—to the maintenance of constant humidity in a chamber. The thermal conductivity of a variety of materials used in building and refrigerating practice has been measured with the cold face at normal or low temperature. The thermal conductivity of metals at high temperatures is obtained by connecting the specimen in series with a rod of iron of known conductivity and measuring the temperature gradient through the latter.

Work on the application of X-ray methods to industrial problems has continued in the Radiology Division with the object of correlating the physical, electrical and magnetic properties of materials with their lattice structure. In this connexion, the effect of fatigue stresses on the structure of mild steel specimens has received a considerable amount of attention recently. For the checking of 'air-wall' ionization chambers designed to measure radium dosage in röntgen units, a 'free-air' ionization chamber approximately 10 ft. square in cross-section has been constructed and was exhibited. The experiments with this have shown that the results obtained with an 'air-wall' ionization chamber of suitable wall thickness are quite trustworthy. A single-stage electrometer-valve amplifier has been used for the rapid measurement of radium by the γ-ray method. The results obtained with it agree satisfactorily with those given by the standard apparatus.

A considerable amount of test work on sound-absorbing and other building materials has been carried out in the Acoustics Laboratory, and routine testing of the transmission of sound through walls and floors was demonstrated. The methods for the calibration of microphones in absolute measure have recently been extended, and standard instruments were shown, the calibration of which was known over the whole frequency range from 10 to 10,000 cycles per second. The standardizing apparatus and lagged chamber with which these calibrations were obtained were also on view.

In the accurate calibration of thermocouples it is necessary to maintain the furnace at a constant temperature for relatively long periods. A high degree of thermostatic control has been obtained by making the platinum heating element one arm of a Wheatstone's bridge which is arranged to be balanced at any desired resistance—and hence temperature—of this element. In this way it has been found possible to control the temperature at any point in a furnace to 0·01° C. at temperatures in the region of 1,000° C. A very close approach to a true black-body radiator has been realized by introducing a hollow nickel cylinder into a tubular furnace thermostatically controlled as above, and compensating for the axial temperature gradient in the nickel by additional heating elements at its ends.

In modern optical instruments, considerable attention has been paid to the attainment of greater light efficiency, and field brightness tests have assumed greater importance than hitherto. Photo-electric methods have now replaced the ocular methods previously used, and greater precision and rapidity in carrying out these tests have resulted.

The high precision obtained in frequency measurement in the Electrical Standards Division of the Electricity Department by the use of quartz ring and tuning fork oscillators has now been utilized so that the whole of the audio frequency range may be covered in small steps by frequencies which are known to within a few parts in 10^6. An oscillator of multivibrator type is tuned approximately to the frequency required, which must be a submultiple of 1,000, 20,000, 40,000 or 80,000, and is then held in step by an output of one of the above frequencies obtained from the primary standard. In this Division also the use of platinum as a material suitable for standard resistance coils has been investigated. The high temperature coefficient of this material necessitates a very accurate control of the temperature at which the coils are measured, but nevertheless with suitable precautions it has been found that results consistent to about 1 part in a million may be obtained. A very useful method of measuring dielectric properties at very high frequencies has recently been developed. It depends essentially upon the measurement of the width of the resonance curve of a tuned circuit which contains the specimen under test. Measurements over the frequency range 10^4–10^8 cycles per second have been made by this method.

The stroboscope method of frequency control in the Electrotechnics Division has been materially improved during the past year by the elimination of contacts on the standard tuning fork. A valve-maintained fork is now used, the output coil of which is connected to the grid of a thyratron. By this means a charged condenser is made to discharge through the thyratron and the primary of an induction coil once per fork cycle. Special neon lamps connected in the secondary circuit of the induction coil illuminate the stroboscope disc.

In the High Voltage Laboratory researches on the effect of transient voltages on insulation in general are proceeding, and the technique of high-speed cathode ray oscillography has been further improved. The testing of a lightning arrester connected across the end of the new overhead transmission line was demonstrated.

During the past year a new Photometry Building has been erected to accommodate the photometric work and the illumination research of the Electricity Department. In the design and equipment of the building special attention has been paid to the particular requirements of this work. In addition to rooms for routine photometry, preparation and maintenance of substandards, and experimental research, the building contains a wide room 145 feet long for work on all types of projection apparatus. By opening a roller shutter at one end of this room, the range over which this work is carried out can be extended when necessary to nearly 800 feet. Various problems in connexion with glare and its after-effects are being examined in the Division. To enable the results to be applied in practice, a knowledge is required of the rate of expansion of the natural eye-pupil during recovery from exposure to a high brightness. The subject is most conveniently studied by taking a cinematograph film of the eye during recovery, using for this purpose infra-red radiation, which does not affect the phenomenon under investigation.

A photo-electric daylight factor meter has been developed in the Division. The instrument consists in essence of two rectifier photo-cells in circuit with a microammeter. One is placed on the window-sill and receives light from a definite small solid angle of the sky. The other, which is compensated for light obliquity, is placed at the point where the daylight factor is to be measured. There is a variable resistance in parallel with the photo-cell on the window-sill. The mode of operation is to adjust this resistance until the microammeter reading remains the same, when it is connected in succession to the photo-cell resistance combination and to the photo-cell in the room. By means of a calibration curve, the daylight factor is given directly by the values of the resistance.

A photo-electric spectrophotometer, incorporating a thin film potassium photo-cell, has been designed for the rapid determination of the spectral transmission of coloured filters. A method has been devised for checking the linearity of the photo-cell characteristics at any desired wave-length.

In the Radio Department advantage has been taken of the fact that magnetron valves used for generating very short waves may, by the application of sufficiently intense magnetic fields, be made to operate at frequencies at which direct measurements of their input impedance are possible. In this way it has been found that electronic oscillations occur in such a valve near the condition of resonance. A portable direction-finding receiver for operation on wave-lengths between 8 metres and 10 metres was exhibited. The receiving loop is screened inside a solid copper tube and a push-pull input connexion to the first stage of the receiver is used to maintain electrical symmetry. A direct-reading frequency-measuring equipment has recently been constructed in this Department whereby the frequency of any radio oscillations between 1 and 70 megacycles may quickly be determined with an accuracy of 1 part in a million.

With the object of achieving greater stability in the frequency of transmitters, the work on design of condensers and inductances of low temperature coefficient of reactance has continued and a selection of such components was shown. An automatic monitoring system for the control of the frequency of a transmitter by a stabilized master-oscillator has been developed for use with the above. A novel exhibit in this Department was the outcome of co-operation with the Forest Products Research Laboratory. The apparatus was designed to detect the presence of destructive insects in timber, and consists of a sound-proof chest, a sensitive microphone and a high-gain amplifier. The microphone is placed in contact with the specimen of timber in the inner box of the chest, and any faint sounds created by destructive insect activity are received by the microphone and amplified to audible level.

Among the exhibits in the Metrology Department mention should be made of the interference apparatus for precise measurements of the refractive index of air. The method consists in the observation of Brewster's fringes in monochromatic light produced by two tubular invar étalons, one being permanently evacuated and the other containing dry air under the required conditions of test. The latter étalon is then evacuated, and from the change in the fringe system the value of μ-1 may be calculated. Measurements on photographic records of the fringe patterns made with the aid of a microphotometer enable a precision of 0·01 of a fringe interval to be obtained.

The new type of comparator for block gauges is now completed, and offers increased facilities for measuring the larger sizes of gauges to an accuracy of a millionth of an inch. The new pitch measuring machine for tapered screw gauges has also been completed. In addition to these exhibits, a large variety of machines used in the routine testing of engineers' gauges of every description was shown. An automatic pipette for the delivery of small and accurately known quantities of mercury was demonstrated in the Glass Testing Building.

Research in the Engineering Department on the structural changes associated with static and fatigue fracture of metals has been continued throughout the year: the X-ray method of attacking this problem has proved very valuable, since the primary cause of failure is associated with changes of a sub-microscopic nature in the crystalline structure. In connexion with researches in this Department on the wind pressures around buildings, the experiments on isolated models have now been extended so as to determine the effect of neighbouring structures. In order to obtain results which may be applied to structures in built-up areas, a model of the buildings lying in an area about half a mile square immediately to the north of the Thames Embankment has been constructed. This can be accommodated in the 14-ft. wind tunnel, and the actual test model is placed near the middle of this built-up area. Other aerodynamical problems under investigation are the characteristics of air streams loaded with granular matter, and the effect of roughness of pipes on air flow through them.

Wheel impact measurements have been continued throughout the year on a six-wheeled lorry under various types of loading, tyres and road surfaces. The equipment for carrying out similar tests on a private car has just been completed, and an economy in size and power consumption of the recording apparatus has been achieved. Typical records obtained in the course of this investigation were exhibited.

In the section devoted to lubrication research, refined measurements have been made of the change of shape at the crown of the bush when a plain bearing is run to seizure. The beneficial effects of rotation in both directions during the running-in of a bearing have also been demonstrated. The influence of temperature and rate of oscillation on the friction developed in an oscillating bearing is also under investigation, and the characteristics of various oils, in particular the extreme pressure lubricants recently developed, have been studied with the aid of two new machines in which the bearing surfaces are well defined. An investigation into the behaviour of bolted pipe flanges under high-pressure high-temperature steam is being carried out with the view of obtaining leak-proof joints in pipes operating under these conditions.

Among the researches in progress in the Metallurgy Department, that dealing with the alloys of magnesium promises to have important commercial results on account of the lightness combined with strength of some of these alloys. The technique of working such alloys is also being developed. Work on alloy steels for use at high temperatures is being continued, and corrosion tests on specimens exposed to high-pressure steam have been carried out. A method of determining thermal curves at high temperatures *in vacuo* was demonstrated in the high-frequency furnace room. The accessory apparatus made and used in the routine work of this Department was exemplified by a comprehensive display of refractory materials, including articles of sintered alumina and thoria for use at very high temperatures. A potentiometer was also demonstrated by means of which thermal curves of metals and alloys can be plotted automatically on a chronograph. The potentiometer dials are operated by an electric motor which is controlled, through a relay and photo-electric cells, by the light reflected from the galvanometer mirror.

An interesting exhibit in the Aerodynamics Department was an instructional film produced in this Department to show the flow of air around various models. The flow is made visible by producing a succession of hot spots in the air stream by means of spark discharges and observing them by the *Schlieren* method of illumination. The transitory and steady state conditions following the initiation of the air stream were illustrated with several models. By using a high-speed camera, it is possible by this method to analyze changes in the motion which are far too rapid to be seen by the eye.

The high speeds at which modern aircraft now operate have called for aerodynamical surfaces and shapes which offer as little drag as possible. This is not always compatible with the attainment of the requisite mechanical strength in the part concerned—notably in the case of monoplane wings, which need to be thickened at the root in order to be sufficiently strong. Tests have been carried out on such wings in order to determine the best conditions of compromise between drag and strength. The drag on aerofoils at high speeds where compressibility of the air becomes of importance has been measured directly on a balance and indirectly by measurements of the loss of momentum of the air stream at various points behind the model. The latter method is valuable since it may be applied to an actual machine in flight and hence allow of the separation of the scale effect and the compressibility effect in going from the model to the full-scale machine.

At the other end of the scale, the stability of aircraft at low speeds is receiving considerable attention, and the effect of slots and flaps and other landing devices is being studied. A demonstration was given of a model being tested in this way. The model is given a slow rolling motion, and measurements are made to determine whether such motion tends to be checked or accentuated. In order to verify a simple empirical formula which has recently been suggested for predicting flutter speed from the resonance frequency of a wing in still air, various types of wing have been under test in order to determine to what extent a numerical factor in the formula varies with the types of wing generally used.

In the Yarrow Tank of the William Froude Laboratory, experiments were being conducted on a self-propelled model cargo vessel, the rolling of which was measured continuously from an initial angle of heel. The tests are being made to differentiate between various types of keels and their position on the hull, and also to throw light on the effect of factors of design upon the extinction of rolling.

The effect of rate of revolution of twin-screw propellers on their propulsive efficiency has recently been studied. The results show that for any given pair of screws, there is an optimum speed of rotation at which this efficiency is a maximum. In addition to these exhibits, a variety of instruments for making tests on models and full-sized ships was exhibited.

South-Eastern Union of Scientific Societies

ANNUAL CONGRESS AT OXFORD

THE South-Eastern Union of Scientific Societies met for the first time in its history at Oxford on the occasion of its forty-first annual congress on June 30–July 4. Prof. G. D. Hale Carpenter, Hope professor of zoology at the University, occupied the presidential chair. The congress was held under the patronage of the Vice-Chancellor of Oxford, A. D. Lindsay, Master of Balliol College, and the Pro-Vice-Chancellor, the Warden of Wadham, welcomed the members at Rhodes House at its first meeting.

Prof. Hale Carpenter chose as the subject of his address "Charles Darwin and Entomology". The subject was, he said, of peculiar interest at Oxford, for his predecessor in the Hope professorship, Sir Edward Poulton, had made Oxford the centre for the study of the Darwin-Wallace theory of natural selection, as applied to the coloration and evolution of insects. This could only be explained on that theory. Sometimes it pays an insect to change its appearance according to whether it appears in a dry or a wet season. Poulton pointed out that a dry season is one of scarcity of food, and certain butterflies then remain inconspicuous, and of skulking habits, whereas in a wet season they are quite conspicuously coloured, and they can afford to allow some of the species to be eaten by reason of their numbers. Prof. Hale Carpenter referred to a species (*Charaxes zoolina*) from Africa which is conspicuous in the wet season, but in the dry season assumes a dead-leaf brown, and deliberately hides itself amongst clusters of dead leaves. Such cases afford support to Darwin's theory. It was customary for early entomologists to assume that coloration of the kind was due to the foresight of a beneficent Creator, and many statements were quoted from their writings to show this point of view, although Erasmus Darwin had some very pertinent remarks suggesting that variations in colours had some greater meaning than had then been discovered.

The clarification of the whole subject came when Darwin formulated his theory of natural selection and the preservation of favoured races in the struggle for life. This added zest to the study of entomology and revolutionized the older views. In spite of the rejection of the theory by some biologists nowadays, Prof. Hale Carpenter remarked, "No explanation has yet been put forward which covers the facts of the coloration of insects so well as does the theory of natural selection". Bates first gave a rational explanation of what he called mimetic analogy, now usually termed mimicry. Certain insects will mimic the outward form of others that are distasteful, and the enemy will avoid them, although not really distasteful. At the root of the matter lies the question of memory, and the assumption is that some of their enemies have recollections of distastefulness. "A variation which assumed a mimetic form has a better chance of surviving to reproduce its like by the laws of heredity, and an initial slight resemblance may be perfected into astonishingly detailed mimicry".

In his address to the Botanical Section, Mr. A. J. Wilmott spoke on the "Endemic Flora of Britain". He controverted the generally-accepted theory that the flora of Britain was exterminated in the Ice Age some ten thousand years ago. He held that at its height there were probably many nunataks where plants took refuge, apart from those parts of southern England which were never in their entirety and at one and the same time covered by ice. In addition, there were four interglacial periods during which there was amelioration of climate, when plants could obtain any foothold that they had lost during the severe periods of glaciation. Considerable migration from place to place was evident, during which there was possibly an "orgy of variation". It was mentioned that ten years' work on the compilation of a new flora of Sussex, commenced at the Hastings Congress in 1927, had now brought publication within view, and subscribers and contributions towards publication were needed.

In the Zoological Section, Lord Mansfield gave an address on "Bird-Ringing and Bird Migration". He said that a very small proportion of rings is ever returned, and an endeavour is to be made to reach the peasantry of various lands who never read pamphlets or newspapers, and thus know nothing of the value of the rings that they collect. Experiments he had made have shown that it is not only the desire to avoid cold climates that gives the impetus to migration. A canary and other birds when supplied with food have been seen feeding in the snow in Canada. Birds kept in an aviary have been found to wake up at night, whenever an electric light was turned on, and feed eagerly, birds' digestions being of a rapid nature. Food is what migrants have in view rather than the avoidance of cold. Reference was made to the endeavour now being carried out to induce the breeding of storks in England, and a report promised for next year's Congress. Mr. E. M. Nicholson spoke on the progress of the British Trust for Ornithology.

Of considerable interest and value is the report of the Insect Immigration Committee, conducted under the energetic guidance of Capt. T. Dannreuther. Observers all around the coast have been enlisted in this work, including by permission of Trinity House the occupants of lighthouses and lightships. The greater number of observations of the presence of certain butterflies and moths on land do not demonstrate migratory movements, and thus those made at sea or by the shore have the greater value. Actual movements in definite directions are greatly needed, and thus continuous watch by observers is asked for. In May 1933, undoubted immigrations were noted of *Vanessa atalanta*, which were seen arriving from over the sea on the south coast. These established themselves as far north as Thurso. After September they decreased rapidly in the north, but became more common in the south than at the height of summer. In 1935 the decline in the north was more gradual. *Cardui* (painted ladies) were scarce in 1933 in the Highlands, though common in southern Scotland, and it was noticeable that when they had disappeared, *V. atalanta* still remained common. Much work remains still to be done, and additional observers are needed in this fascinating work.

In the Geological Section, Dr. Dighton Thomas read a paper on "Geology and the Community", and showed how the science touches the common interests of all classes. Much money has been wasted in the past in the search for water, coal and oil, where a little geological knowledge would have avoided the waste. Municipalities are not even now alive to the necessity of taking expert advice about such matters.

Many excursions were made to places of scientific interest. Archæologists visited the Cotswold churches of Fairford, Bibury, Burford and Faringdon. Botanists and zoologists went to the Ruskin Reserve at Cothill, where marsh, fen and aquatic plants were found. Three rounds of visits were made to Oxford colleges, the Bodleian, the Sheldonian, and the Museum of the History of Science, where Dr. R. T. Gunther explained the treasures of the Old Ashmolean.

It was announced that the Congress in 1937 would be held at Hastings under the presidency of Prof. F. E. Weiss, formerly George Harrison professor of botany in the University of Manchester.

Educational Topics and Events

BIRMINGHAM.—At the annual degree congregation, honorary degrees were conferred on Mr. W. B. Grove, a well-known mycologist, and Mr. A. E. Hills, a Birmingham manufacturer to whose generosity the University owes the new chemistry building now being erected.

CAMBRIDGE.—T. R. B. Sanders, of Corpus Christi College, has been appointed University lecturer in engineering.

W. W. Brigden, of King's College, has been elected to the Marmaduke Sheild Scholarship in anatomy. Frank Smart Prizes have been awarded to G. Metcalfe, of Clare College (Botany), and E. T. Burtt, of King's College (zoology).

At Magdalene College, Dr. D. W. Babbage, research fellow of the College and University lecturer in mathematics, has been elected into an official fellowship.

EDINBURGH.—At a graduation ceremonial on July 3 the honorary degree of Doctor of Laws was conferred on the following, among others: Sir Thomas Hudson Beare, professor of engineering and dean of the Faculty of Science in the University; Sir William W. M'Kechnie, lately secretary to the Scottish Educational Department; Prof. Edward L. Thorndike, professor of education, Teachers' College, Columbia University, New York.

OXFORD.—Dr. J. H. C. Thompson, research fellow of Merton College, and formerly of New College, has been elected fellow of Wadham College and lecturer in mathematics—a new appointment.

ST. ANDREWS.—Mr. John N. Wright has been appointed to the chair of logic and metaphysics, vacated by Prof. G. F. Stout. Mr. Wright was appointed assistant to Prof. Stout in the United College in 1920, and in 1924 became lecturer in philosophy in University College, Dundee.

Mr. T. Malcolm Knox, fellow and tutor of Jesus College, Oxford, has been appointed to the chair of moral philosophy vacant by the death of Prof. David Morrison. From 1924 until 1931 he was secretary to Lord Leverhulme, but was appointed in 1931 to a lectureship in philosophy at Jesus College, Oxford. He was junior dean and librarian of his College, a member of the Sub-Faculty of Philosophy, and a member of the Oxford University Appointments Committee.

Science News a Century Ago

John Ericsson's Screw Propeller

ON July 13, 1836, six weeks after F. P. Smith patented his screw propeller, John Ericsson, the famous Swedish engineer, also secured a British patent for a screw propeller, but of a very different design. Ericsson's propeller consisted of two drums each carrying on its exterior helical blades; the blades of each drum being inclined in opposite directions, so that one screw was 'left-handed' and the other 'right-handed'. The drums were fitted tandem-fashion behind the rudder and the invention included an arrangement by which the drums were revolved in opposite directions. The object of the duplex arrangement was to avoid loss due to the rotary motion imparted to the water by a single screw.

Ericsson fitted his propeller to the *Francis B. Ogden* in 1837 and the *Robert F. Stockton* in 1838. In 1837 the *Francis B. Ogden* towed the Admiralty barge from Somerset House to Blackwall and back. Ericsson, however, received no encouragement and afterwards learnt that Sir William Symonds, Surveyor of the Navy, had remarked that "even if the propeller had the power of propelling a vessel it would be found altogether useless in practice, because the power being applied at the stern, it would be absolutely impossible to make the vessel steer."

Biot at the Collège de France

IN its column of "Miscellanea", the *Athenæum* of July 16, 1836, said: "The learned and scientific M. Biot has been delivering some very remarkable lectures at the Collège de France. He has proved, that, by means of polarized rays, it is possible to ascertain the chemical action which takes place between bodies held in solution in various liquids; an action which has not yet been discovered by less delicate means. This is a new branch of science, created as it were by this great natural philosopher, from which the most important and curious results may be expected."

Sir John Herschel and Mr. Somerville

WRITING to Mr. Somerville from "Feldhausen near Wynberg, C.G.H." on July 17, 1836, Sir John Herschel, referring to the honour which had been paid Mrs. Somerville, said, ". . . Though what she has performed may seem so natural and easy to herself, that she may blush to find it fame; all the rest of the world will agree with me that merit of that kind is felt and recognised at length in the high places of the earth. . . ."

"We are all," he continued, "going on very comfortably, and continue to like the Cape as a place of (temporary) residence as much or more than at first. The climate is so very delicious. . . The stars are most propitious, and astronomically speaking, I can now declare the climate to be most excellent. Night after night, for weeks and months, with hardly an interruption, of *perfect* astronomical weather, discs of stars reduced almost to points, and tranquilly gliding across the field of your telescope. It is really a treat, such as occurs once or perhaps twice a year in England—hardly more. I had almost forgotten that by a recent vote of the Astronomical Society I can now claim Mrs. Somerville as a *colleague*. Pray make my compliments to her in that capacity, and tell her that I hope to meet her there at some future session. . ."

Societies and Academies

Paris

Academy of Sciences, June 2 (*C.R.*, 202, 1826–1880).

L. E. DICKSON: Solution of Waring's problem.

JEAN CABANNES and AUGUSTE ROUSSET: Measurement of the factor of depolarization of the Raman lines in gases: nitrogen, oxygen, carbon dioxide.

GEZA KUNETZ: Some properties of characteristic functions.

ALFRED ROSENBLATT: The conformal representation of restricted domains limited by general curves.

A. TOUSSAINT and S. PIVKO: Free plane stream. The influence of the supporting wings on the aerodynamical characteristics.

GEORGES SABATHE: The origin and suppression of the discontinuity in the hydrodynamic resistance of the floats of flying boats.

VICTOR MAITRE: The colour of stars of the spectral types $A0$, $A2$. The hypotheses of a distance effect and an effect of absolute magnitude have been examined separately. From a study of 335 stars of types $A0$ and $A2$, the results can be better interpreted as due to an effect of absolute magnitude than as a distance effect. An examination of the B type stars will follow.

W. ARKADIEW: The magneto-dynamic relation between the viscous losses and the permeability in very weak fields.

THÉODORE V. IONESCU: Luminous discharges observed in the magnetic field at pressures below 10^{-4} mm. of mercury. Detailed description of the light effects observed under varying conditions of voltage and magnetic field. The theory of the phenomena is not discussed.

LÉON CAPDECOMME: The role of the parasite flux in measurements of reflective powers carried out with the aid of the microscope.

ANDRÉ MORETTE: The melting point of vanadium oxychloride and vanadium tetrachloride. The thermal analysis of the system chlorine – vanadium tetrachloride. The melting point of the tetrachloride is $-77^\circ \pm 2^\circ$ C. and of the oxychloride, $-28^\circ \pm 2^\circ$ C. The results of the thermal study of the system chlorine, vanadium tetrachloride are given graphically; they show no indication of the existence of a vanadium pentachloride.

RENÉ WURMSER and MME. SABINE FILITTI-WURMSER. The equilibrium between isopropyl alcohol and acetone in the presence of alcohol-dehydrase.

MME. MARIE FREYMANN and RENÉ FREYMANN: The infra-red absorption and Raman spectra of amides and anilides and the structure of these compounds. The conclusions lead to structures differing from the classical formulæ, and favour the hypothesis of chelation already suggested by several authors.

RAYMOND AMIOT: The adsorption of binary mixtures of acetic acid and of some alcohols in aqueous solution.

MAURICE ENGELDINGER: The study of a colloidal solution prepared starting with resorcinol – formol resins.

MME. LÉONE WALTER-LÉVY: Contribution to the study of the basic magnesium sulphates.

CHARLES DUFRAISSE and MARCEL GÉRARD: Dissociable organic oxides and anthracene structure. The properties of photo-oxyanthracene. From its chemical reactions, photo-oxyanthracene resembles anthrahydroquinone and oxanthrone, with which it is isomeric, but differs in its oxidizing power due to the peroxide function.

Georges Dupont and Raymond Dulou: The pyronenes.

A. P. Rollet: The polymorphism of potassium pentaborate, $K_2O.5B_2O_3$.

Philibert Russo: The Lias at the northern extremity of the Middle Atlas.

Josué-Heilmann Hoffet: The discovery of the Cretaceous in Indo-China.

Aimé Rudel: The flora, fauna and origin of the peperites of the Puy-de-Mur (Limagne d'Auvergne).

Marcel Gautier: The palæogeography of the Nemours (Algeria) region.

H. Grisollet: Study of the light diffused by particles in suspension in the air.

Ong Sian Gwan: The presence of sensitizing antispermatozoids in the blood of man and of woman.

Melbourne

Royal Society of Victoria, May 14.

Ann Nicholls: The mineralogy of the sand fractions of some Victorian soils. A microscopical study of the fine sand fractions of some Victorian soils has indicated that soils on the Jurassic rocks contain abundant orthoclase and plagioclase, suggesting that they are immature. Basaltic soils show quartz, zircon, tourmaline and sponge spicules, which must be due to the addition of foreign material by the wind. The amount of basaltic material present depends on the state of maturity of the soil, as determined by the age of the basalt flow and the slope on which the soil is developed.

R. T. Patton: A fossil *Casuarina* from near Bacchus Marsh, Victoria. Small teeth-like leaves, grooves on the branchlets and fruits are excellently preserved in beds which may be Miocene, as they overlie Oligocene lignites.

A. B. Edwards: Occurrence of almandine garnets in some Devonian igneous rocks of Victoria. Almandine is a characteristic mineral in those Upper Devonian rhyo-dacites of Victoria the magmas of which, at the time of their extrusion, had reached a state of 'silica saturation' in excess of the requirements of their ferromagnesian minerals and felspars. With further crystallization of the magma, the garnet became unstable owing to a dwindling ferromagnesian concentration, and broke down into more stable minerals, such as cordierite and biotite. Because of this, garnets are rare in granitic rocks, except in association with basic xenoliths. This process is not substantially affected by assimilation, so that the garnets appear to be pyrogenetic minerals of a 'discontinuous reaction' type.

Washington, D.C.

National Academy of Sciences, *Proc.*, 22, 249–326, May 15.

Edison Pettit: A second law of the motions of eruptive prominences. These prominences rise from the chromosphere and disappear at great heights during intervals of a few minutes or hours. They rise with uniform motion, modified at intervals by sudden increases as though receiving occasional impulses. From the records of thirty-eight such prominences, it is deduced that, when this sudden increase of velocity occurs, the new velocity is always a small multiple of that immediately preceding it.

C. D. La Rue: The effect of auxin on the abscission of petioles. When the leaf-blades of *Coleus* and *Ricinus* are removed, the petioles develop an absciss layer within a few days, and fall off. Several substances known to contain the growth hormone, applied in agar-agar or lanolin, delay formation of the abscission layer; the most effective is synthetic hetero-auxin in lanoline. Their effect is greater if the plant is kept in the dark.

Chester Stock: Perissodactyla of the Sespe Eocene, California.

F. Zwicky: Extra-terrestrial effects of cosmic rays. Such effects have not hitherto been investigated. It is estimated that the total intensity due to light, atomic and cosmic rays in space is greater than 10^{-3} ergs/cm.^{2} sec. Discussing in particular the long-period variable stars, which have comparatively low surface temperatures, it is suggested that the emission by these stars of the Balmer lines with high intensity may be due to the absorption of such interstellar energy. It is also possible that the mechanical behaviour of extended gas and dust clouds in interstellar space (sharp outlines observed) may be due to corpuscular rays.

C. M. Pomerat and M. X. Zarrow: The effect of temperature on the respiration of the earthworm. Respiratory measurements over the range 9°–27° C. on normal worms, and also on worms from which the supra- or subœsophageal ganglion had been removed, show that there is an increase in rate of gas exchange with rise of temperature, as in other animals the body temperature of which is variable.

H. G. du Buy: The change in the response of oat coleoptiles to growth regulators produced by aging. Response decreases with age at all concentrations of auxin, and the threshold concentration for curvature increases with age. The plants are sensitive to auxin only at a certain stage of development, the duration of which can be varied.

Robert M. Yerkes and James H. Elder: The sexual and reproductive cycles of chimpanzee. Data are given from daily observations of animals at the Yale Laboratories of Primate Biology, and include records of behaviour and reproductive outcome of more than five hundred controlled matings. The sexual cycle is approximately five weeks and the period of gestation eight months.

B. D. Burks: The nearctic Dirhinini and Epitranini (Hymenoptera, Chalcididæ). These parasitic flies exhibit great variations of structure. They are accordingly divided into five tribes, two of which are discussed and keys given.

G. A. Miller: Groups in which the squares of the operators generate a cyclic group.

Edward V. Huntington: Mathematical postulates for the logical operations of assertion, conjunction, negation and equality.

Sumner Byron Myers: Isometries of 2-dimensional Riemannian manifolds into themselves.

J. W. Alexander: On the connectivity ring of a bicompact space.

Edward Kasner and George Comenetz: Conformal geometry of horn angles.

T. Y. Thomas: On normal co-ordinates.

Marston Morse: Functional topology and abstract variational theory.

W. V. Quine: A theory of classes presupposing no canons of type.

Forthcoming Events

FIFTH CONGRESS OF UNIVERSITIES OF THE BRITISH EMPIRE, July 13–17.—To be held at Cambridge. The Right Hon. Stanley Baldwin: President.

July 15, at 10 a.m.—G. H. A. Wilson: "Some Problems which confront Universities".

July 15, at 11.—(1) Discussion on "Provisions in Great Britain for Postgraduate Studies for British and Overseas Students", to be opened by the Right Hon. Lord Macmillan. (2) Discussion on "Functions of Universities in the Training of Teachers", to be opened by Sir Percy Nunn.

July 16, at 10 a.m.—The Hon. H. J. Cody: "The Relation of Canadian Universities to National Life".

July 16, at 11.—(1) Discussion on "Careers for University Students", to be opened by O. V. Guy. (2) Discussion on "General as an Alternative to Specialised Honours Courses", to be opened by Sir Charles Grant Robertson.

July 17, at 10 a.m.—The Right Hon Oliver Stanley: "The Relation of Secondary Education to the Universities".

July 17, at 11.—(1) Discussion on "University Examination Methods", to be opened by Dr. A. W. Pickard-Cambridge. (2) Discussion on "Physical Education in the Universities", to be opened by Dr. Carleton Stanley.

WOMEN'S ENGINEERING SOCIETY, July 17–20.—Fourteenth Annual Conference to be held in the University of Leeds.

July 17, at 7.—Mrs. J. A. Mollison: Presidential Address.

BRITISH MEDICAL ASSOCIATION, July 17–25.—Annual Meeting to be held in Oxford.

Sir E. Farquhar Buzzard: President.

Official Publications Received

Great Britain and Ireland

Department of Scientific and Industrial Research. Catalogue of Types and Figured Specimens of Fossils in the Geological Survey Collections, now exhibited in the Royal Scottish Museum, Edinburgh. By Dr. E. M. Anderson. Pp. 77. (London: H.M. Stationery Office.) 1*s*. 6*d*. net. [196

University College of Wales, Aberystwyth: Welsh Plant Breeding Station. Investigations on the Improvement of Hill Grazings. 1: The Scope of the Work, by R. G. Stapledon; 2: The Introduction and Maintenance of Nutritious and Palatable Species and Strains, by M. T. Thomas; 3: The Buried Viable Seeds of Enclosed and Unenclosed Hill Land, by W. E. J. Milton. (Series H, No. 14, Seasons 1930–1935.) Pp. iii+86. (Aberystwyth: University College of Wales.) 3*s*. 6*d*. [19

Department of Scientific and Industrial Research. Forest Products Research Records, No 10: The Practice of Wood Bending. By W. C. Stevens. Pp. ii+9+2 plates. (London: H.M. Stationery Office.) 6*d*. net. [226

The British South Africa Company. Publication No. 4: Mazoe Citrus Experimental Station; Annual Report for 1934. Pp. xvi+133+5 plates. (London: British South Africa Co.; Mazoe: Citrus Experimental Station.) [236

First Annual Report of the Inland Water Survey Committee, 1935–36. Pp. 16. (London: H.M. Stationery Office.) 3*d*. net. [246

Imperial Economic Committee. Fruit Supplies in 1935, including Vegetables, Flowers and Bulbs; a Supplement to Weekly Fruit Intelligence Notes prepared in the Intelligence Branch of the Imperial Economic Committee. Pp. 100. (London: H.M. Stationery Office.) 2*s*. 6*d*. net. [246

Transactions of the Royal Society of Edinburgh. Vol. 58, Part 3, No. 27: The Development of the Legs, Wings and Halteres in Wild Type and some Mutant Strains of *Drosophila melanogaster*. By Dr. Charlotte Auerbach. Pp. 787–815+1 plate. 4*s*. Vol. 58, Part 3, No. 28: The Blood Vascular System of the Elasmobranch Fish *Squatina squatina* (Linné). By B. J. Marples. Pp. 817–840. 3*s*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.). [256

The Unseen Net: an Outline of the Plan to destroy British Liberties and to enthrone Political and Economic Plutocracy. Pp. 16. (London: Liberty Restoration League.) 3*d*. [256

Facilities available at University Institutions of Great Britain and Ireland: a Handbook of Information for Overseas Students. Pp. 63. (London: Universities Bureau of the British Empire) 1*s*. 6*d*. [266

Cambridge Observatory. Annual Report of the Observatory Syndicate, 1935 May 1—1936 April 30. Pp. 4. (Cambridge: The Observatory.) [296

Other Countries

Canada: Department of Mines: Mines Branch. Natural Bonded Moulding Sands of Canada. By Correll H. Freeman. (No. 767.) Pp. vi+144+11 plates. (Ottawa: Government Printer.) 25 cents. [156

Publications of the Dominion Astrophysical Observatory, Victoria, B.C. Vol. 6, No. 12: Re-Examination of 64 Orbits. By W. E. Harper. Pp. 207–260. Vol. 6, No. 16: The Orbit of the Spectroscopic Binary Boss 4217. By Andrew McKeller. Pp. 291–295. (Ottawa: King's Printer.) [156

Statens Meteorologisk-Hydrografiska Anstalt. Tillhör Årsbok 17, 1935: Årsberättelse for 1935. Pp. 21. Årsbok 15, 1933. iii. Vattenstånden vid Rikets kuster. Pp. 23. 2 00 kr. Årsbok 16, 1934. v. Hydrografiska mätningar i Sverige. Pp. 12. 3.00 kr. Årsbok 17, 1935. i. Månadsöversikt over väderlek och vattentillgång. Pp. 76. 2.50 kr. Årsbok 17, 1935. ii. Nederbörden i Sverige. Pp. 55. 2.50 kr. (Stockholm: Statens Meteorologisk-Hydrografiska Anstalt.) [156

Cawthron Institute, Nelson, New Zealand. Annual Report, 1935. Pp. 18. (Nelson: Cawthron Institute.) [176

Instytut Geofizyki i Meteorologji: Uniwersytetu Jana Kazimierza we Lwowie. Komunikaty, Tom 8, Nr. 93 do 109: Wyników prac Henryka Arctowskiego i jego współpracowników Natalji Chareckiej, Adama Kochańskiego, Kazimierza Korczaka, Henryka Orkisza, Jana Telli, Wacława Wiszniewskiego i Adama Zyśki. (Des résultats des recherches de Henryk Arctowski et de ses collaborateurs) Pp. iv+427. (Lwów: Instytut Geofizyki i Meteorologji.) [176

Svenska Linné-Sällskapets Årsskrift. Årgång 19, 1936. Pp. v+155. (Uppsala: Almquist and Wiksells Boktryckeri A.-B.) [186

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Science in the Public Press

THE desirability of promoting a more intelligent and more intelligible consideration of scientific work and thought in the public Press has often been urged in these columns; and there are signs of increased attention to this need both from newspaper editors and from scientific workers. This is due to several causes. The public expenditure upon scientific research is now large. Government departments which spend money on research, and scientific workers who are supported by public money, feel that the public should understand the value of the work it is supporting. This motive of social self-justification penetrates far more extensively than is generally realized. The Department of Scientific and Industrial Research and the University Grants Committee provide funds which assist a large fraction of all the scientific research at present done in Great Britain.

The circumstances of scientific research in this country have undergone a profound change during the last fifty years. In the nineteenth century, the leaders of research did not consider that social justification of their work was necessary. Providence had placed them in fortunate situations where they were able to indulge their personal intellectual tastes, and though their labours might be of practical value to humanity, or profitable to themselves, this was regarded as a happy accident. They considered that the receipt of a comfortable academic salary or private income did not lay any very pressing obligation on them to use their talents for the extension of scientific knowledge to the community. This attitude was derived from an earlier stage of civilization, when humanity was forced to admire those who could exact support without rendering any corresponding service.

The Greeks despised Archimedes' contributions to mechanics because manual skill in a slave State was disreputable. Until recently a large part of scientific research was done by persons enjoying academic endowments or private fortunes. As they were not directly dependent on the public, they did not see why they should explain what they were doing. In extreme cases, such as that of Henry Cavendish, they did not explain what they were doing even to their friends. A scientific worker in direct receipt of a subsidy cannot reasonably adopt this attitude.

The policy adopted by large industrial corporations of supporting research in order to invent valuable new processes has provided another motive for the extension of public interest in science. Many corporations systematically publish accounts of their researches, partly as a form of advertisement to show their progressive character. They are interested in securing as much public discussion as possible of the scientific principles connected with the goods they wish to sell. In the United States especially, a large amount of advertisement is designed to appeal to the scientific interests of consumers.

The rapid increase in the number of scientific inventions, such as radio, aeroplanes, synthetic plastics, and thousands of other modern objects, attracts the scientific curiosity of the public. In addition, there are the results of decades of the teaching of science in schools, and the spread of the conviction that science is the chief characteristic of the present age. It can scarcely be admitted, however, that the present age is scientific, though science may be prominent in it. Indeed, the development of science throws into greater contrast the unscientific nature of the greater part of modern life. Nothing could be more unscientific than the contemporary armaments race, and the existence of widespread poverty and malnutrition in a period of unparalleled development of the technique of production, and the study of the science of nutrition. An increasing number of citizens are looking to the public Press for explanations of these paradoxes.

It is not necessary to enumerate more reasons why the demand for news and information of science in the Press is increasing. The fact is known to every newspaper editor. Some are puzzled by it, and accept it merely on business grounds. Recent questionnaires on the popularity of different types of articles have shown that scientific articles are more popular than many editors with a literary training had believed.

While nearly everyone admits the increasing demand for news of science, there is general agreement that the demand is not being met satisfactorily. Scientific workers are irritated by inaccurate Press accounts of their activities, and the public is unable to hear of many matters it would like to know. Better methods of handling science in the Press are required. For various reasons the problem is difficult. The mere technical difficulty of explaining science in a style suitable for a newspaper, and yet not obnoxious to men of science, is considerable. The difficulty of popularization is generally underrated. Good popularization requires a breadth of culture in the writer which is not very common among scientific workers, or any section of the population. Few men of science are immediately capable of writing for the Press. In fact, it may be confidently asserted that it is more difficult to earn £300 per annum in writing satisfactory scientific articles for the Press than to earn an equal sum as a research worker. This is one of the explanations why so much newspaper matter relating to science is so bad.

The poor financial rewards of scientific journalism have repelled most able men from the work. The field has been left to a small group which contains an exceptionally large percentage of writers who, for one reason or another, do not fit in very well with the usual professions, where equivalent qualifications can usually command an income of £750 a year in an academic or industrial post. Until newspapers are prepared to pay such a salary for a full-time science editor, they will remain without a representative of science with standing equal to that of a literary editor. The problem is thus, to a large extent, economic.

The creation of a science news agency, like Science Service in the United States, seems to be a more immediately practicable, though less ideal, solution. But there are serious difficulties in creating such a service. The Press includes journals conducted on very different principles, and with very different points of view. The technique of writing for different types of journal varies greatly. Some writers are brilliantly successful with one type of journal, and are complete failures with others. Newspapers are very competitive. Editors in Great Britain always like to have some individuality or exclusiveness in their copy: they use matter from the Press agencies only when they are unable to get special material of their own. Thus a news service tends to start with the neutral characteristics of a stop-gap organization. But though there are difficulties confronting the establishment of a science news service, such a service is particularly necessary in the absence of adequate science reports in the Press, and will always have a useful function, for the same reasons which keep the various general Press agencies in vigorous existence.

Assuming that a science news service is desirable, the next point to decide is how it may best be organized. It would be wise to be clear from the beginning who should control the service. Should the predominance of the control be with science, or with the Press? Different answers might be given to this question in different countries and circumstances. There is little doubt that in Great Britain final control should at the beginning rest with representatives of science. The organizers of such a service should seek endowments from societies and individuals, and the control should be through a committee of eminent men of science. A staff of two or three scientific journalists, whose various styles will roughly suit the various types of journal, should be appointed. A sum of £25,000, or an endowment of £3,000 a year for ten years, might be sufficient for starting the organization under conditions that might lead to great and valuable success. The payment of fairly secure and satisfactory salaries would do much to attract able men to the staff of the service. Until this is done, the presentation of science in the public Press will not be improved, because the sort of ability necessary to solve the problems of the collection and presentation of science news will be much better paid in other fields of work.

Man and Forest in Prehistoric Europe

The Mesolithic Settlement of Northern Europe: a Study of the Food-Gathering Peoples of Northern Europe during the Early Post-Glacial Period. By Dr. J. G. D. Clark. Pp. xvi +284 +8 plates. (Cambridge: At the University Press, 1936.) 25*s.* net.

THE passing of the last Ice Age left northern Europe open to human settlement; but the environment which the settlers encountered was still slowly changing. They had to adjust their equipment to land movements (including the opening of the Channel and the submergence of the Dogger Bank), to the change from a cold 'Pre-Boreal' to a warm continental 'Boreal' climate and then to a moister 'Atlantic' phase, to spread of forests, first of birch and willow, then of pine, then of mixed oak woods, and to consequent alterations in the country's fauna. Of these changes and of the geological, botanical and zoological evidence from which they are reconstructed, Dr. Clark gives a clear account, illustrated with maps and documented with copious references. The successive phases provide not only the background as adjustments to which human cultures must be interpreted, but also the chronological framework in which they must be arranged. Indeed, accepting at least the method of de Geer's geochronology, Clark provisionally offers absolute dates for the climatic phases: 6800–5000 B.C. for the Boreal, 5000–2500 for the Atlantic.

The first colonists are known almost exclusively from their flint artefacts, among which tanged points are the most conspicuous, but Rust and Schwantes found also their 'harpoons' and other tools of reindeers' antler near Hamburg just in time for inclusion in this book. A little later, axe-like and adze-like tools of reindeer antler illustrate men's first efforts at coping with the Boreal forests that were invading the tundras and steppes. Clark accepts Schwantes' thesis that these so-called Lyngby axes of antler are the prototypes of the later north European flint axes, but admits the possibility of their derivation from some still unknown culture to the south-east—a possibility that cannot be excluded while Russia remains almost unexplored. The familiar Maglemose culture (this name, signifying Great Moss, is retained for the whole complex, Mullerup being used for the facies peculiar to Zealand) can then be treated as a further adjustment to the forest environment, though the author insists that its microliths are derived from the Tardenoisian, the spread of which round the fringe of the wooded plains is discussed in a special chapter.

Otherwise the principal novelties in the treatment of the well-known complex are the illustrations of the gravers, included among the relics from the type sites but ignored until Westerby noted them in 1927, and an accurate classification of the various bone points that constitute the best-known type-fossils of the complex. Independently of Bøe (whose work presumably appeared too late for mention), Clark exposes the inaccuracy of the conventional explanation of these as harpoons. He gives a very instructive map of the distribution of selected types from England to the Baltic States (but omitting the new Norwegian finds).

Clark's treatment convincingly establishes the underlying uniformity of culture prevailing throughout the region surveyed—a uniformity that really extends beyond it at least to the Urals. But the differentiation of local groups within this unity is no less interesting sociologically; for it must reflect the crystallization of distinct social units out of an ethnic continuum in Boreal times. It is graphically illustrated by the distribution of types 7 and 14 on Clark's map, and of the Vögtland club-heads and other types recently mapped by Germans. But still more striking is the rarity of axe-like tools in the forested plains east of the Baltic, suggested to the reviewer by a recent examination of Russian collections.

Regional differentiation is more emphasized in Atlantic times. Clark establishes very convincingly the continuity between the Maglemose and Ertebølle cultures in Denmark, and the contrast between the latter and its English and Scandinavian contemporaries. The differences between Maglemose and Ertebølle are due mainly to changed environment, between Ertebølle and say Lower Halstow to the isolation consequent upon land-sinking.

Its comprehensive bibliography, its tables of sites, of fauna and of flora, and its copious and beautifully executed figures and maps, make this book a standard work on the northern mesolithic. Its author's mastery of British as well as Baltic archæology should commend it even to the most insular local antiquary. As an objective record of human adaptation to changing environments and of the divergence of industrial traditions, it possesses a wider historical interest.

V. G. CHILDE.

Invisible Radiations of Organisms

Invisible Radiations of Organisms
By Prof. Otto Rahn. With an Introduction to the Physics of Radiation, by Sidney W. Barnes. (Protoplasma-Monographien, Vol. 9.) Pp. x+215. (Berlin: Gebrüder Borntraeger, 1936.) 13.20 gold marks.

HERE we behold mitogenetic radiation masquerading as the legitimate offspring of biochemistry and the quantum theory, and the unwary reader, finding 'muscle radiation' casually mentioned in a purely physical account of the photo-electric effect, may well suppose the scientific status of the two phenomena to be identical. On reaching p. 55 he may begin to suspect that in reality mitogenetic radiation was quite differently conceived; but up to this point the emission of such radiation by living cells, and even by simple systems undergoing chemical reaction, is treated as a predictable phenomenon related to chemiluminescence, and is described with the same confidence as the dispersion of light by a prism. Even the too remarkable phenomena of 'secondary radiation', involving emission of fluorescent radiation of shorter wave-length and higher intensity than the incident radiation, and its propagation, by successive phases of absorption and re-emission, through an absorbing medium, are made to appear almost as inevitable as Newton's laws of motion.

From p. 55 onwards, apart from a fair discussion of the physical detection of mitogenetic radiation, the book is biological, dealing largely with material which has already been adequately presented by Gurwitsch in his two monographs: the biological detection, phenomenology and significance of mitogenetic radiation. In addition to this, there are a few references to more recent work, accounts of experiments by the author and his collaborators, and some rather uncritical remarks about the alleged lethal effects of menstrual blood on yeast and bacteria.

A brief epilogue is devoted to the question of errors in the detection of mitogenetic radiation and to the attitude of those who remain unconvinced of its existence. Piously hoping for a *rapprochement* between believers and non-believers, Prof. Rahn does not seem to realize that his book is not likely to help in the attainment of that object. The critics ask only that a detailed re-examination of the original mitogenetic effect shall be undertaken by some of those who claim to be able to obtain positive results without difficulty; but Prof. Rahn and his Russian colleagues prefer to write redundant monographs on the ubiquity of mitogenetic radiation, to discuss it in relation to amphibian metamorphosis, parasitism, polyploidy in tomato plants, industrial fatigue, cancer and old age, and to invent queer chain reactions to hide its physico-chemical misbehaviour.

Properties of Iron

The Metal—Iron
By H. E. Cleaves and J. G. Thompson. (Alloys of Iron Research Monograph Series.) (Published for the Engineering Foundation.) Pp. xii+574. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 36*s*. net.

TO the valuable series of monographs on the alloys of iron, issued by the Engineering Foundation, there has now been added a volume dealing with the production and properties of the parent metal in a state approaching purity. Although iron is used in far larger quantities in industry than any other metal, and is not obtainable commercially in such a pure condition as several other metals, such as aluminium and zinc, our knowledge of its exact properties is still very imperfect. There are two main reasons for this fact. With its high melting point and great chemical activity, iron readily absorbs impurities when in the molten state, which are correspondingly difficult to remove, whilst its properties are exceptionally influenced by the presence of even very small quantities of foreign elements. The properties assigned to 'pure' iron in the text-books are mostly derived from commercial materials regarded as approximately pure, or by extrapolation from a series of samples with diminishing amounts of impurity. The results are in either case unsatisfactory.

The present work, by two members of the staff of the U.S. Bureau of Standards, covers the subject very thoroughly, and the volume is indispensable to the scientific metallurgist. The methods used in the laboratory and on the technical scale for the purification of iron are described, and the properties of the purified products reviewed, the treatment being critical throughout, with a useful short survey of the results at the end of each chapter. Electrolysis is commonly resorted to for purification, and this method successfully removes most of the impurities, except nickel and cobalt, but when the deposited metal is brought into a workable form by melting, new opportunities of contamination occur. Published analyses are not a satisfactory guide. As the authors point out, the formidable list of impurities recorded by some workers using refined analytical methods may not indicate that their metal was less pure than other samples, but may be merely evidence of more scrupulous analysis. The work was completed just too soon to include the careful work of Adcock and Bristow, who obtained an exceptionally pure product, using a chemical method followed by repeated fusion in hydrogen and *in vacuo* in vessels of pure alumina.

Much engineering research has been carried out on ingot iron, a low-carbon variety of mild steel which is always segregated, and contains many inclusions. In recent years, carbonyl iron, prepared by decomposing the vapour of iron carbonyl and sintering the product without fusion, has become available, and is the purest form of iron commercially produced at present ; but the cost is relatively high.

The chapters on the physical properties of iron, including the effects of small quantities of each of the impurities usually found in the metal, are most interesting. The allotropic changes occur in even the purest iron, and do not, as was at one time suggested, disappear on the removal of impurities. The magnetic properties are extremely sensitive to minute traces of foreign elements, but in a fashion which does not allow of extrapolation. The difficult subject of corrosion is discussed, the conclusion being drawn that the chemical composition is of less importance than external conditions. It is surprising, in view of the large amount of work included in this review, that the important researches of Bengough and his colleagues are not mentioned, and Bengough's name does not even appear in the excellent bibliography, arranged chronologically, and containing 1,081 references.

Pure iron is a very soft metal, and it is interesting to observe how small is the quantity of an added element which is necessary to give it appreciable hardness. It is this fact which gives to the metallography of iron a special importance, and the system iron–carbon, in particular, has attracted more workers than any other system of metallic alloys. In order to understand the properties of the alloys of iron, it is essential to know those of the pure metal, and the authors have rendered a service in making available a detailed and, on the whole, judicial survey of the whole of this difficult field of study.

C. H. D.

Science and Minerals in the U.S.S.R.

The Scientific Study of Soviet Mineral Resources
By A. E. Fersman. Edited by C. P. Dutt. Pp. 149 +15 plates. (New York : International Publishers, n.d.) n.p.

THE purpose of this book, as stated in the introduction, is to give a brief outline of the achievements of mineralogists and geochemists in Soviet Russia during the last five or six years, in which achievements Fersman himself has played a prominent part.

In its plans for economic development, the Government of the U.S.S.R. early realized the importance of utilizing the mineral resources of the State to the fullest possible extent, and ample provision was made for the investigation and development of these resources. Mineral survey parties, organized on scientific lines, directed their attention to promising areas, and were strengthened as required to carry forward the work of investigation.

One of the most productive of these exploratory parties was the one sent to the Khibin mountain area in the Kola Peninsula, within the Arctic Circle. Here, in an area occupied by nepheline syenites, extensive deposits of apatite were discovered, and as supplies of phosphate were required to meet the needs of Russian agriculture, steps to develop these deposits were taken without much delay in 1929. Within three or four years of the commencement of this undertaking, a carefully planned town had grown up around the apatite mines and quarries. The population of this town at present is about 40,000. The town has a central cinema seating 1,200 people, and has also a fine park.

Rivalling the remarkable mining enterprise at this locality, 2° within the Arctic Circle, is an equally remarkable agricultural enterprise, also organized on scientific lines. Peat bogs have been cultivated, and by using nepheline and apatite powder as a fertilizer, forage grasses are being grown. One farm has a herd of a thousand cows, in addition to vegetable gardens. From the greenhouses of these gardens, the population is supplied with fresh cucumbers and tomatoes. It is hard to believe that life at this locality is free from inconveniences, but these do not enter into Fersman's account. Whatever these may be, the enterprise is indeed a remarkable one. With a present annual output of two million tons of mineral, and a prospective output of seven million tons in 1937, things look promising in this wonderful arctic town.

Among other discoveries and developments mentioned all too briefly in this book are those of the potash deposits of Solikamsk in the Urals, and many other deposits the exploitation of which promises to have important effects not only in the U.S.S.R., but also in the world at large.

The book deserved to be edited, printed and published in better style; but even as it is, and in spite of its somewhat extravagant appreciation of the part played by Russian workers in the development of geochemistry, it will be welcomed as a useful account of tendencies of thought and practice among these U.S.S.R. workers, who are much to be congratulated on the vigorous efforts they are making to establish a stronger scientific foundation than has hitherto existed for the study of minerals and mineral resources.

Memoirs on Systematic Zoology

Temminckia:
a Journal of Systematic Zoology. Edited by Prof. Dr. H. Boschma. Vol. 1. Pp. v + 320 + 9 plates. (Leiden: E. J. Brill, 1936.) 13.50 fl.

THIS new periodical is designed to afford a means of publication for memoirs on systematic zoology. It is named in honour of C. J. Temminck (1778–1858), one of the most distinguished naturalists that Holland has produced and the first director of the great Rijksmuseum van Natuurlijke Historie in Leyden. Its scientific standing is assured by the fact that the editor is the present director of the museum, Dr. H. Boschma, while the name of the publisher, E. J. Brill, is a guarantee of typographical and technical excellence. Unlike most journals of the kind, it will appear only in bound volumes, of which one or two, each of some 320 pages, will appear annually.

The first volume, besides many text-figures, includes nine plates, of which one is in colour. Of the seven memoirs published in it, five are in English and two in German. Four of the authors are Dutch, one German, one Austrian and one American. All the memoirs except one deal mainly with the fauna of the Dutch East Indies.

The first paper, by Dr. G. C. A. Junge, is a faunistic one, dealing with the birds of Simalur and some other islands off the south-west coast of Sumatra. It includes field notes by the collectors on habits and distribution of the species dealt with. C. J. Keijzer writes at length on "Variability in East Indian Foraminifera" and concludes that the supposed trimorphism and polymorphism of certain species have no real existence, but are due to superficial observation of continuous series of variations superimposed on the well-known dimorphism. It is to be gathered from the paper, however, that the life-cycle of the Foraminifera is not so simple or so well-understood as might be supposed from the usual text-book accounts of it.

A revision of the flying lizards of the genus *Draco* by Willi Hennig is based on examination of the material in many museums, gives statistical analyses of measurements, and discusses the geographical relations of the various "Formenkreise".

A paper on the use of the generic names *Tethys* and *Aplysia* among the Mollusca is surely the most fully documented discussion on a point of nomenclature ever published, the list of references at the end extending to more than eighteen pages. The author, Dr. H. Engel, makes out a strong case for submission to the International Commission on Zoological Nomenclature for suspension of the rules in order that the traditional use of these two names may be retained.

Dr. Koumans describes, with statistical data, evidence for an increase in the number of scales during growth in a species of fish. As the number of scales has hitherto been regarded as a constant specific character, this conclusion will have important results for systematists. In the concluding two papers of the volume, F. Spaeth revises the Australasian beetles of the group Cryptonychini, and Austin H. Clark describes the unstalked crinoids of the *Snellius* expedition.

Every systematist knows that it is comparatively easy to find editors willing to accept short papers describing a few new species. Every such addition to the Systema Naturæ, however, demands some modification, although maybe very little, in the diagnoses of previously recognized species, and there comes a time when a revision of a whole group, a genus or a family, must be taken in hand if the system is not to fall into confusion. When an author is courageous enough to attempt such a revision for an extensive group, it is often hard to find a periodical in which it can be published, especially if it is to be adequately illustrated. It has not infrequently happened that such a revision has been laid aside for years after being completed in default of any means of giving it to the world. It is, therefore, a hopeful sign of reviving interest in systematic zoology that a journal should have been established in which important and lengthy memoirs of this kind may find a place.

W. T. CALMAN.

Indeterminism and Psychology

Déterminisme et variabilité dans le comportement des organismes

(Exposés de biométrie et de statistique biologique, 7.) Par Prof. W. J. Crozier. (Actualités scientifiques et industrielles, 261.) Pp. 57. (Paris: Hermann et Cie., 1935.) 15 francs.

THE physicists have gone on strike against determinism and have called on the psychologists to come out in sympathy, but the psychologists can see no logical connexion between the physical problem and the psychological problem. It appears that the physicist can never know the facts about a single electron and can only predict the behaviour of aggregates. An individual animal represents a large aggregate of electrons and other units, and the fact that the behaviour of the individual units cannot be predicted does not necessarily imply that the behaviour of the aggregate is not governed by laws as rigid as those which govern the behaviour of a similar mass of inanimate matter. The difficulties of prediction appear to be due to the complexity of the problem rather than to any fundamental obstacle to observation. The psychologist is presented with a glut of facts about each individual and can see no reason why he should not explain the processes which govern individual behaviour, but such knowledge is likely to play a less important part in the world than a knowledge of the behaviour of aggregates of animals. Prof. Crozier, of Harvard, who has devoted the last ten years to the study of the behaviour of aggregates of rats, has published the summary of his results now under notice.

The evidence may be illustrated by describing a typical experiment. A rat is placed on an inclined plane in the dark, and its movements are recorded by photographing the movements of a patch of luminous paint on the rat's back. The rat knows that a suitable reward awaits it at the top of the inclined plane, and it therefore runs uphill in a series of short straight dashes. The angle between the movements of the rat and a horizontal line in the inclined plane (θ) measures the accuracy of the rat's judgment, which must depend on sensations in the muscles of the rat's legs. When the results obtained from a large number of rats are averaged, their behaviour is found to be governed by laws. For example, the component of gravity in the direction of maximal slope will be proportional to sin α. As the slope increases, the accuracy of the rat's judgment increases in such a way that, like other similar curves depending on sensation, the curve connecting θ and log sin α is shaped like a prolonged *S*, being approximately straight in the middle range.

The curve obtained from a homozygous colony of rats is constant and typical of that colony. If two colonies interbreed, the factors on which the position of the curve depends are inherited according to Mendelian laws. The variability of the animals was estimated by calculating the standard deviation of the observed values of θ. Various conclusions are reached regarding the correlation between variability and slope. Different homozyous colonies of rats showed characteristic different degrees of variability, the inheritance of which has been studied.

Prof. Crozier discusses the philosophical implications of his results, which he considers to be opposed to the opinions of those physicists who would extend the principle of indeterminism to vital phenomena. On the other hand, he does not claim to be able to predict the behaviour of an individual rat any more than the physicist can predict the behaviour of an individual electron. He can, however, predict the behaviour of the average rat just as the physicist can predict the behaviour of the average electron. If methods such as those of Prof. Crozier can be extended to predict the behaviour of the average man, they may play an important part in deciding the destinies of nations.

(1) La radiation cosmique

Par P. M. S. Blackett. 1 : Aperçu général. Pp. 23+4 plates. 10 francs. 2 : La méthode de la chambre de C. T. R. Wilson (commandée par compteurs de Geiger-Müller). Pp. 25+3 plates. 8 francs. 3 : L'action du champ magnétique terrestre. Pp. 20+2 plates. 7 francs. 4 : La perte d'énergie par ionisation. Pp. 21+7 plates. 10 francs. (Actualités scientifiques et industrielles, 230–233.)

(2) Rayons cosmiques

Par B. Rossi. (Exposés de physique atomique expérimentale, 4 : Actualités scientifiques et industrielles, 248.) Pp. 48. 12 francs.

(Paris : Hermann et Cie., 1935.)

(1) THESE small books constitute the only connected account of cosmic rays which is available; and although the lectures on which they were based were delivered two years ago, the account given largely represents existing knowledge, and the problems stated remain mostly unsolved. The first part contains a general and historical account; the second deals with the technique and results of the counter-controlled Wilson chamber introduced by Prof. Blackett. This part contains the account of shower production. The third part is specially valuable. It provides a simplified treatment of the paths of electrified particles in the magnetic field of the earth, and the consequent effect of the field on the distribution of cosmic rays over the earth. The original papers in which this theory was developed by Størmer, Lemaître and Vallarta and others are difficult and in some cases inaccessible. The fourth part deals with the behaviour of very fast particles passing through matter. The details of the processes involved are still uncertain both in experiment and theory. They are at present the subject of intensive investigation, and some progress has been made, particularly in connexion with shower production.

(2) This brochure is more limited in scope than those by Prof. Blackett; it is concerned very largely with Prof. Rossi's own experiments on the cosmic rays, by the coincidence counter method. The experiments include analyses of the rays by absorption and by azimuthal distribution, a study of the effect of the earth's magnetic field, and a study of shower production.

Index Generalis

Année 16, 1936. Annuaire général des Universités et des Grandes Écoles, Académies, Archives, Bibliothèques, Instituts scientifiques, Jardins botaniques et zoologiques, Musées, Observatoires, Sociétés savantes. Publié sous la direction de Dr. R. de Montessus de Ballore. Pp. vii+2482. (Paris : Éditions Spes, 1936.) 225 francs.

THIS most recent edition of an extremely useful source of information concerning the universities, etc., of the world has the same format as its predecessors. All information has been obtained from official sources, thus marking the work as an authentic book of reference.

The first part of the volume gives details concerning the officers, professors and other teaching staff, laboratories and attached institutes of the universities of the world, though, unfortunately, those of the U.S.S.R. are again missing. This is through no fault of the editor of the "Index", who states that he has made repeated efforts to obtain the necessary information. This section occupies 1,213 pages of closely printed type. The next section, occupying 97 pages, supplies information concerning the personnel, publications, instruments, etc., of the astronomical observatories of the world. This is followed by 291 pages concerning libraries and archives. The next 139 pages deal with scientific institutes, such as museums, botanical and zoological gardens, biological laboratories, meteorological and other stations, etc. Societies and academies (with names of members of the more important) occupy the remainder of the text (190 pages). The general name index at the end contains about 95,000 names—a veritable mine for reference purposes; there is also a general geographical index whereby it is easy to trace institutions.

We know of no other single volume publication which brings together in this way so much information regarding the learned world.

The Kātkāris :

a Sociological Study of an Aboriginal Tribe of the Bombay Presidency. By A. N. Weling. Pp. vii+156+15 plates. (Bombay : The Bombay Book Depot, 1934.) n.p.

MR. WELING'S sociological study of the Kātkāris, a criminal tribe of the Bombay Presidency, who survive in considerable numbers in the hilly districts of the Deccan, has appeared at an opportune moment. Not only has there been a tendency to confuse them with the Kunbi, from whom indeed it is not easy to differentiate them, but also, like other aboriginal tribes of India, their institutions are subject to influences which tend progressively in the direction of modification. This process is likely to be intensified rather than arrested among tribes, who still possess something of the hunting culture and of the animistic and magical beliefs, which are of an abiding interest for the anthropologist.

Guide to Philosophy

By C. E. M. Joad. Pp. 592. (London : Victor Gollancz, Ltd., 1936.) 6*s*. net.

THIS is one of the books which will help considerably the case of philosophy as a subject of fundamental interest and importance. It is held in many quarters that without some knowledge of philosophy, the education of a citizen is far from being complete. Those who oppose this view will no longer be able to point to the lack of reliable and interesting books on this subject; for Mr. Joad provides them now with a practical answer in his "Guide to Philosophy". The subjects discussed in this lucid and attractive work are too numerous and too complex for even a brief review. It will suffice to say that the beginner and the specialist alike should derive both profit and enjoyment from its perusal. T. G.

Revision of Ordnance Plans from Air Photographs

By Colonel H. L. Crosthwait, C.I.E.

IN the Interim Report of the Departmental Committee on the Ordnance Survey, discussed in NATURE of May 2, p. 719, reference is made to the employment of air photographs as a means of speeding up the revision of the 25-in. Ordnance plans. It is proposed in this article to indicate in general terms how this can be done.

The area it is proposed to revise is divided up into rectangular blocks of about 10 miles side. The aircraft, carrying a camera* which automatically exposes a roll of photographic film at pre-arranged intervals, is flown to follow a straight course over the ground, and parallel strips are photographed so as to cover the area as shown in the diagrammatic illustration (Fig. 1). For this particular purpose a lens of 20-in. focal length is employed, from a height of about 8,000 feet, giving a scale of approximately 1/5,000. These photographs are afterwards enlarged without rectification to a scale of 25-in. to the mile or 1/2,500. During the flight, the exposure of successive photographs of a strip is so timed that they overlap each other in a forward direction by about 60 per cent, and the strips are arranged to have a lateral overlap of about 25 per cent. If the work is skilfully carried out, the whole area should be covered by strips of photographs without leaving any gaps. The chief object, among others, of giving the photographs an overlap of 60 per cent, is that adjacent photographs of the same strip may be viewed in a stereoscope, which gives an impression of the ground in relief, greatly facilitating the interpretation of objects which might otherwise be doubtful.

It will be noticed that each object is photographed at least twice. Only in the case of level ground where the exposure has been made with the axis of the camera pointing vertically downwards, and where the lens used covers the film without distortion, will the resulting photograph give an accurate map representation of the ground as seen from the air. In practice, the two conditions of a vertical axis and level ground are scarcely ever realised, while lenses are now made practically free from distortion within the limits they are required to cover. It becomes necessary, therefore, to subject the photographs to some form of rectification in order to counteract the effect of camera tilt, which should be kept as small as possible, and the deviation from the level of the ground. This can be done in several ways, but since we are only dealing with the application of air photographs to the revision of the 25-in. plans, we need only mention the method used for this particular purpose. There are few instances where there is not sufficient control on the old plan, in the form of unaltered detail, which can be recognised both on the plan and on the photograph. It is this control which is made use of in the epidiascope. Space will

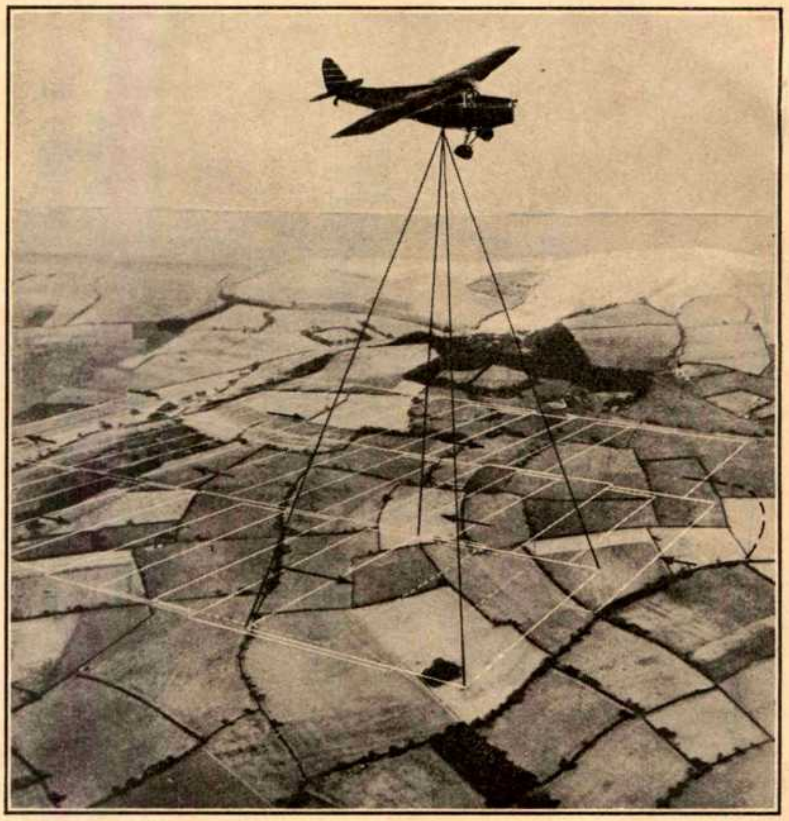

FIG. 1. Diagram illustrating how an aircraft covers the area to be photographed. By permission of Aerofilms, Ltd.

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* The camera used is known as the "Eagle", made by The Williamson Manufacturing Co.

not admit of a full detailed description of the method or instrument, but we can indicate, in general terms, how the revision is carried out with the epidiascope.

The enlargement, derived from the negative taken from the air, which is, as stated, approximately on a scale of 25-in., is carefully examined with the old plan, and new detail is inked up in red. In doing this the draughtsman is aided by the stereoscope, in which has been placed the pair of overlapping photographs relevant to the area under revision. He then selects suitably placed and well-defined points of detail appearing both on the photograph and the old plan, to form triangles covering the area, later to be fitted to the plan in the epidiascope.

The ideal triangle for rectification would be one which embraced an area on a uniform slope proceeding from the base of the triangle. With this object, points selected should be sited, if possible, on high ground and at the bottom of valleys. For this purpose the 6-in. contoured map can be consulted, assisted by the relief view of the area in the stereoscope. The Ordnance Survey employs a modified form of epidiascope* in which the movements have been simplified. It consists of a horizontally placed photo-board over which has been inverted an ordinary camera the back of which forms the plan-board. The photo-board is capable of being tilted about a horizontal and vertical axis. To it the photograph can be secured in any desired position under a sheet of plate-glass on which the two axes are marked. The photograph is set so that the base of the triangle to be revised coincides with the horizontal axis, with its mid-point at the intersection of the two axes. An image of the highly illuminated photograph is formed on the matted surface of a sheet of drawing celluloid, on which has been printed, in grey, an impression of the old plan, placed on the glass camera back or plan-board. The image of the base of the triangle being revised is made to coincide with the corresponding base on the print of the old plan, any small difference of scale being adjusted by a slight movement of the camera lens. The photo-board is then tilted so as to make the triangles fit one to the other. The new detail, which has already been inked up on the photograph, is then drawn in on the celluloid print of the old plan. The same process is repeated, triangle by triangle, until the whole area has been revised. This drawing forms the 'field trace', but

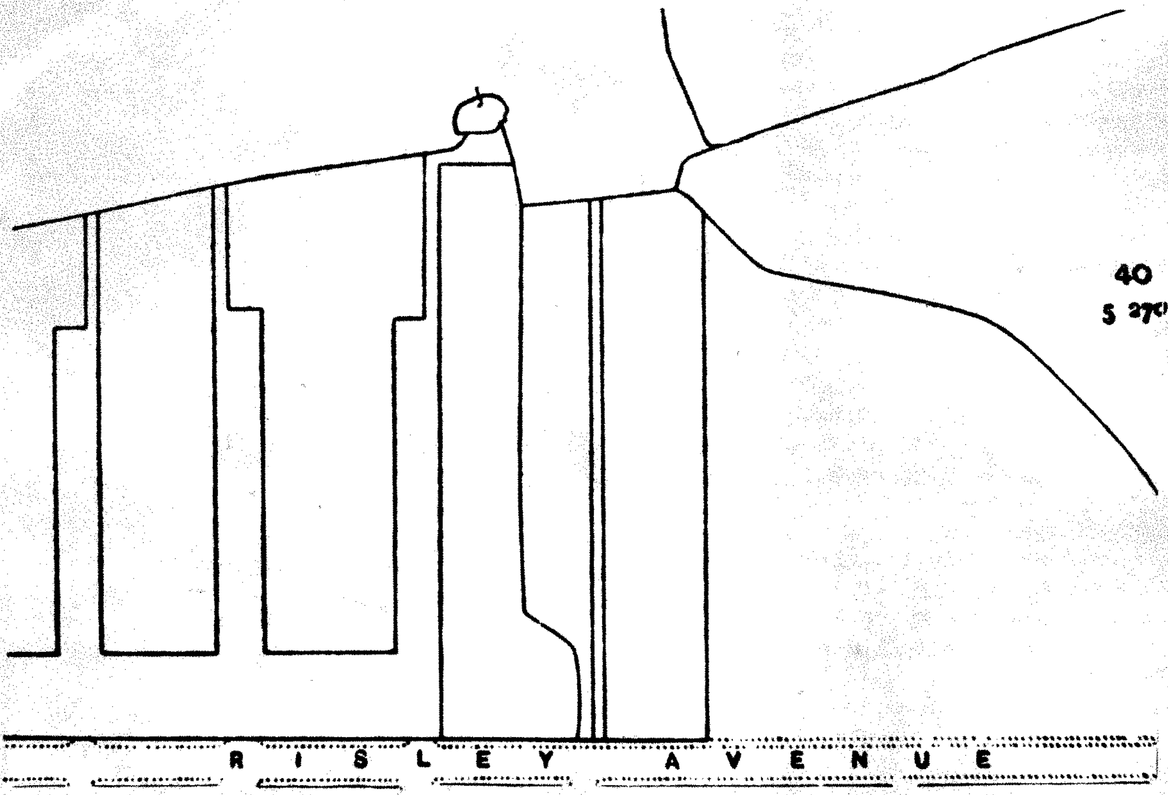

FIG. 2. Air survey of Tottenham. Reproduction of a section of a 25 in. Ordnance plan representing the area covered by the air photograph (Fig. 3). This plan was revised in 1913. Reproduced from the Ordnance Survey Map, with the sanction of the Controller of H.M. Stationery Office.

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* For a full description of the epidiascope made by Messrs. Barr and Stroud, see "Surveying from Air Photographs", by Capt. M. Hotine, R.E.

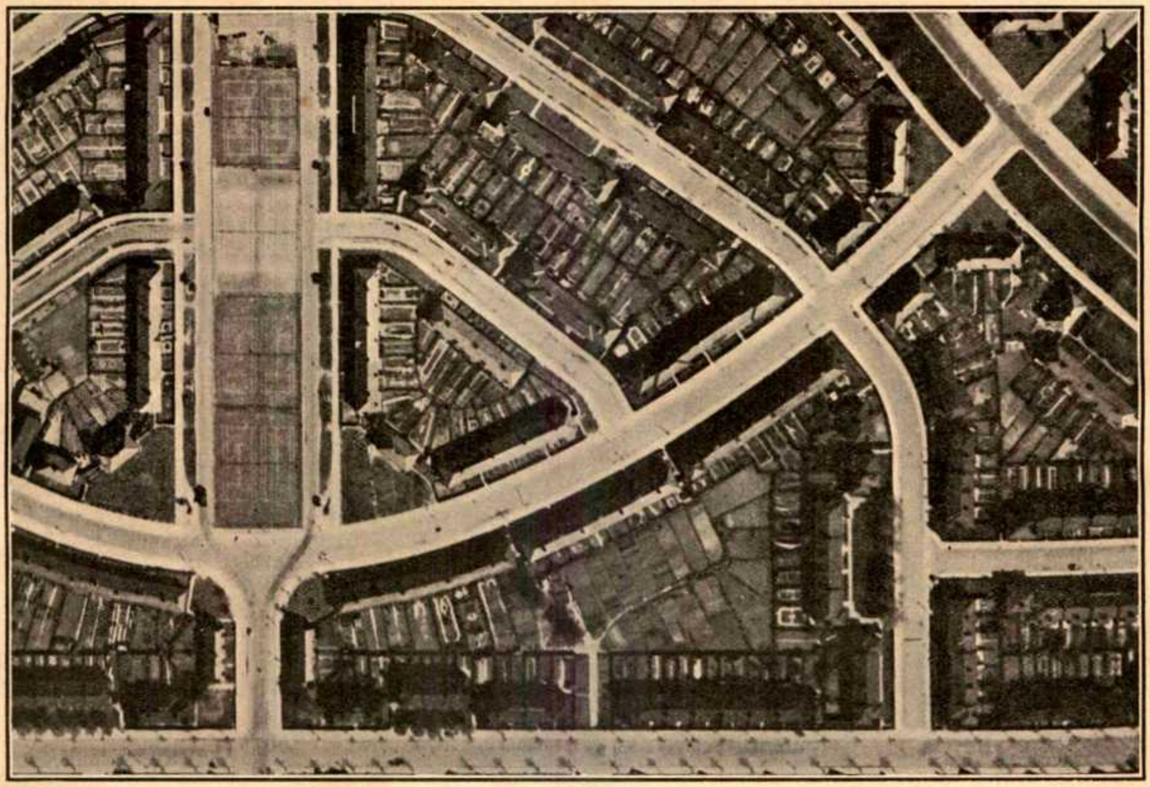

FIG. 3. Air survey of Tottenham. Vertical air photograph taken in June 1935 of same area as Fig. 2, scale 25 in. to a mile. By permission of Aerofilms, Ltd.

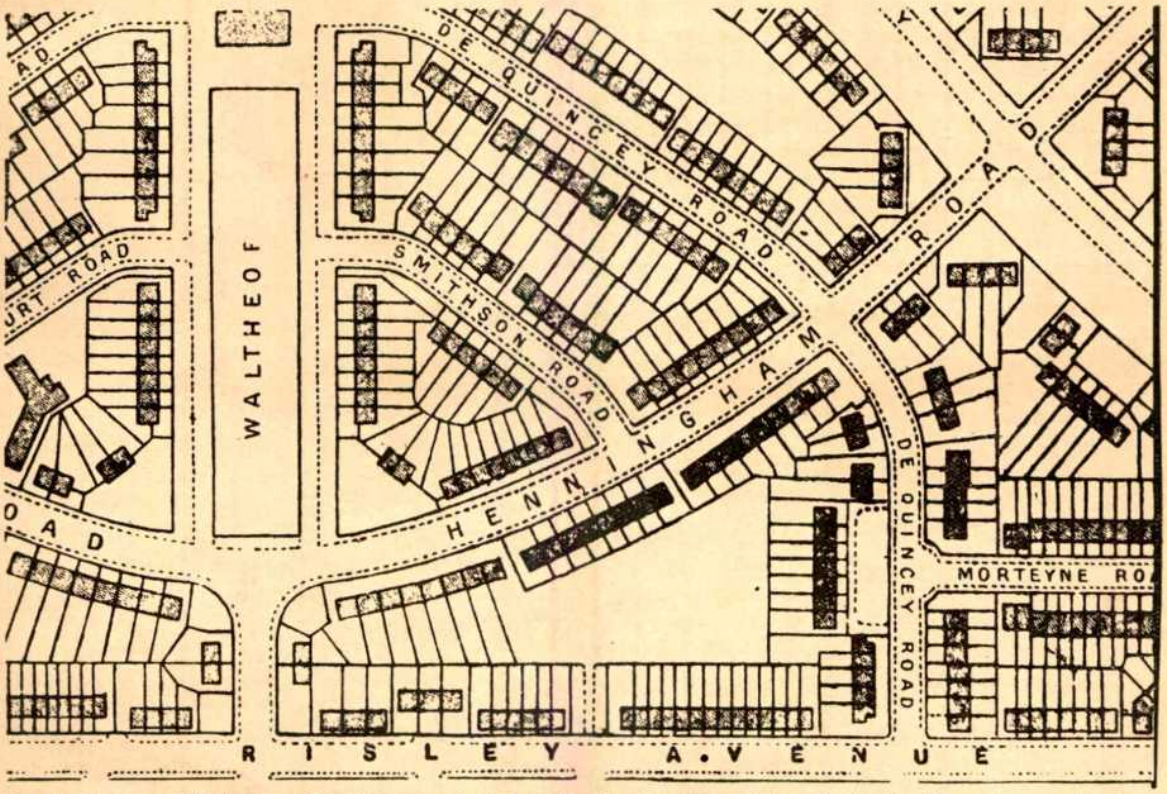

FIG. 4. Air survey of Tottenham. Resulting plan, scale 25 in. to the mile, plotted from photograph (Fig. 3). By permission of Aerofilms, Ltd.

since it is deficient in new names, boundaries and details such as wire fences, which fail to show up on the photograph, or which have been obscured by shadows, it is taken into the field for final revision. From it, when finally revised, the fair plan is drawn in the ordinary way. This, shortly described, without going into detail, is the process employed in revision from air photographs using the simplified epidiascope.

Owing to the small tilt of the photographs, which should not exceed some 2°, and the small area embraced by the triangles, the residual errors due to the theoretical inexactitude of the epidiascope design are so small as to be negligible. The advantage of the modified machine is that it is cheap to construct, a consideration of importance where a good many of them are required to deal expeditiously with a large number of photographs; also it is simple to operate.

Fig. 2 is a reproduction of a portion of an old plan; Fig. 3 a photograph of the same area as it now exists and Fig. 4 the resulting plan plotted from the air photograph.

Archæological Discoveries at Předmost

THE site in Moravia known to archæologists as Předmost actually is, or was, a small hill to the west of the little village of Předmosti, which lies about two kilometres north of Přerov, a junction on the Central European line between Warsaw and Vienna. The hill rose to a height of forty metres above the marshy plain, and was known locally as "Hradisko" (oppidum), evidently having served the inhabitants as a place of refuge in time of war. The substructure of the hill consisted of two limestone rocks joined by a saddle of yellow brick-earth, or loess. The complete quarrying away of one of these rocks many years ago has exposed the face of the loess, and at the base level of the rock in a band of darker deposit have been found relics of prehistoric man in such a quantity and of such a character as to justify the verdict that this is one of the most important palæolithic sites ever discovered.

The former inhabitants had evidently used the rock as an *abri*, or shelter, and had lived by hunting, mainly of the mammoth. Relics of this animal are almost innumerable. A thousand teeth and five milk-teeth have been found, and of the tusks, complete or broken, there are some hundreds. In the first series of explorations of the site, no less than twenty thousand implements of stone, bone and ivory were collected, while the carvings and engravings of ivory and bone are æsthetically and culturally of great interest and importance. The outstanding feature in the discoveries which have been made, however, is an assemblage of the skeletal remains of early man, in which twenty individuals were represented in a single find. The ethnic character of these individuals is no less interesting than the conditions in which they were found.

The first recorded discovery at Předmost was made so long ago as 1571, when "giants' bones" were discovered by John Blahoslav; but it was first recognised as a palæolithic station by Dr. J. Wankel in 1880 and 1881 as the result of an investigation which had begun in 1878. The great explorer of Předmost, however, was K. J. Maska, a schoolmaster, who first turned his attention to the site in 1882, and excavated it systematically and continuously in the ten years 1884–94. It was in this last year that he made his sensational discovery of human remains, when, as already mentioned, skeletons and parts of skeletons representing twenty individuals were found in a small space, an elliptical grave, measuring 4 metres long by 2·5 metres wide by 30 cm. deep. These remains were closely packed, side by side and one upon another, in a crouched position, the heads in most instances towards the north. They lay in the loess above undisturbed quaternary deposits, but separated from them by a calcareous layer 30–50 cm. in thickness. Above the skeletons was the complete skull of an Arctic fox, at the north-west edge was a fragment of the shoulder-blade of a mammoth, which had been graven by a flint tool, and at the south-west lay a complete mammoth shoulder-blade. Two lower jaws of the mammoth, found two metres away, may be related to the burial. Other finds adjacent were fragments of flint and jasper and carbonized bones. Stones to a thickness of 40 cm. had been piled above the interment. Nevertheless, gnawed human bones nearby, and the incomplete condition of some of the remains, suggest that these stones had not availed to keep away beasts of prey.

Unfortunately, no photographic record or drawing was made of the find; and discrepancies in detail have gained currency in accounts of the discovery. The finds associated with the skeletal remains and their position mentioned above are those recorded by Dr. J. Matiegka, to whom Maskra's material was entrusted.

This interment is evidently a communal grave, though whether it was the result of an epidemic or some other simultaneous catastrophe, or represents a succession of burials, thus accounting for the evident disturbance of the remains, there is nothing to show. There are sufficient close resemblances between individuals, some of them inherited, to warrant the conclusion that, if not all of one family as Maska thought, they were at least members of a single familial horde.

Maska's work was followed up by M. Kříž, a lawyer, who carried out excavations in 1894–96. The great collections formed by these two investigators have now been placed, with other valuable archæological and palæontological material brought together from different parts of the country, in the Provincial Museum of Moravia at Brno, where they are in the care of Prof. D. K. Absolon, curator of the Quaternary Collections.

Maska spent the remainder of his life at work on his material from Předmost; but his financial circumstances did not permit him to devote to it the time and attention it demanded. He died while his work was still incomplete in 1916, and Kříž died in the same year.

After the Great War, the interest aroused by the discoveries of early man in Moravia, evidently a 'gate of entry' for early migration into Central Europe, led to more systematic study. Chance favoured the resumption of investigation at Předmost. Further commercial exploitation of the remains of the hill for brick-making purposes opened up the loess deposits by trenches. Important discoveries followed and the Government intervened, taking over the site and entrusting its further investigation to Prof. Absolon, whose discoveries date from 1924.

With the aid of later investigation, it is now possible to obtain a truer perspective of the whole site. The occupation level appears as a darker horizontal band in the yellow clay at a depth of one to four metres and 20–70 cm. in thickness, its extent being estimated at 6,700–10,000 cubic metres. There are three main centres of accumulation, of which one is a domestic hearth with broken bones and implements of stone, the second a hearth of greater extent, which may have served for the preparation of food, with larger bones and finer implements, and a third of indeterminate purpose, consisting of a quantity of varied débris, without order and including bones of every kind, among them whole quarters, such as mammoth's feet, part of the backbone of a horse, etc. Some, however, show signs of arrangement, as for example a pile of thirteen mammoth tusks and four skulls placed side by side.

The vast wealth of objects which now form the collections from Předmost—implements of stone, bone and ivory, carvings and engravings on ivory and bone, personal ornaments of various materials and the like, the human skeletal remains, as well as the remains of the mammoth and other quaternary fauna—reveal the mode of life of the primitive hunter in quaternary Europe in a manner and to an extent which cannot be equalled on any other site, though with it is comparable the site of the horse hunters of Solutré. The development of its art is especially noteworthy. Certain objects, especially a remarkable figure of a mammoth in ivory, are characterized by a naturalism, comparable with the best produced by palæolithic man elsewhere. Here also are the characteristic corpulent figures, woman or divinity. In striking contrast is the work of another 'school', a school with a marked tendency to conventionalize, which culminates in a female figure engraved on a tusk, in lines which are entirely geometrical. It has been suggested that the two schools represent the influence of two distinct races, which met at this point.

The racial characters and affinities of Předmost man have been the subject of considerable discussion; but as such analyses have been based upon photographs and casts, certain features have been stressed unduly, and an authoritative and first-hand account of the remains has long been desired. Whereas many of the authorities concur in showing a tendency to attach too great a significance to the resemblances between Předmost man and Neanderthal man, it stands to the credit of Sir Arthur Keith's acumen and appreciation of the essential quality of the remains, that while recognizing the importance of the great size of the skull and the massive character of the attachments for the muscles, he has been emphatic in claiming an essentially 'modern' character for Předmost man; and further, while pointing out the marked difference between the sexes, he has not been prepared to go so far as those who hold that it is sufficient to justify the allocation of the woman to a different racial category.

The skeletal material available for discussion of the racial character of the people of Předmost, of which the crania, some represented by fragments only, have now been described, and their evidence analyzed, for the first time by Dr. J. Matiegka*, whose paper has only just recently become available, is regarded as representing twenty-six individuals. To this must be added a further discovery by Prof. Absolon in 1929. Of the material found by Maska, fifteen skeletons were fairly complete, while the remaining material was judged to belong to five individuals. Of the fifteen four were, comparatively speaking, well preserved. Eight of the twenty were adult, three being female, two adolescent, one male and one female, seven were children less than ten years of age, and three were infants of under one year.

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* Česká Akademie Věd a Umění (Académie Techèque des Sciences et des Arts). Trída 2: Anthropologica. Homo Předmostensis fosilní člověk z Předmostí na Moravě. 1: Lebky. (L'Homme fossile de Předmostí en Moravie. 1: Les crânes.) By Prof. Dr. J. Matiegka. Pp. 145+16 plates. (Praha: Česka Akademie Věd a Umění, 1934.)

Of the adults, the two best preserved were a male and female between the ages of thirty-five and forty years. They are regarded as type specimens of the race. The two well-preserved adolescents approximate closely to them, due allowance being made for the difference in age. The adult male, in particular, shows the close resemblance to Neanderthal man in a number of characters, notably the prominent supraorbital ridge, or torus, the low retreating frontal bone, and so forth. Indeed in its approach to early palæolithic man, this skull, Dr. Matiegka points out, is very near the border-line of the extreme lower range of 'modern' skulls. On the other hand, in certain features, such as for example the possession of a well-marked, if not prominent chin, and the absence of the characteristic prognathism, it is essentially modern.

All the individuals represented at Předmost, with one exception, are sufficiently homogeneous to be regarded as belonging to a single race. Dr. Matiegka stresses in particular their slender character, seen also in the long bones, their light weight, and in the bones of the skull their thinness, features in which they are distinguished from man of the earlier palæolithic period, and to be viewed in relation to size and capacity. In virtue of pronounced Neanderthaloid characters, Předmost man may be regarded as standing morphologically midway between Neanderthal man and modern man, but not in any genetic sense.

In all its dimensions the Předmost skull, both male and female, is within or well above the average of the modern European. The head length ranges from 189 mm. to 201 mm. male, and 185 mm. to 191·5 mm. female; breadth 139 mm. to 145 mm.; height 133–136 mm. In relation to the great size of the skull, the figure for height appears low, but actually it is above the modern average. The cephalic index varies from 70·15 to 77·63, being slightly higher in the women and children than in the men. The contour is ovoid. The cranial capacity is high, 1,578 c.c. male, 1,520 c.c. female, as against 1,475 c.c. male and 1,300 c.c. female in the modern European.

The development of the supraorbital ridge, assuming in certain skulls the character of a torus, appears also in the women and is even perceptible in the children. The sutures are simple; but in all the skulls there are Wormian bones.

The face is high, especially in the upper part, lower in the woman than in the man. The orbits are low, quadrangular and set slightly on the bias in both sexes. The nose is narrow and prominent in the men, broader in the women. The lower jaw is large, corresponding with the size of the skull, but notwithstanding its massive appearance, largely due to the disproportionate strength of the muscular attachments, it is slender in proportion to its size. The chin is slightly receding in relation to the alveolar projection, but there is a well-formed mental tubercle. The form of the jaw is modified by muscular pull. The teeth are well preserved. They are large. There is one apparent case of caries. At least two skulls have lost teeth during lifetime. The teeth are much worn down, the wear already beginning to appear in a boy of ten to twelve years. There is also evidence of a peculiar form of attrition of which the cause is obscure. It is more marked on the right side than on the left, and on that side in the upper jaw more than in the lower. It affects the first molar, the second showing it, if at all, only in a slight degree. It has been suggested that this is due to a custom of carrying a pebble in the mouth continuously, though for what reason is not apparent. In view of the cold climate and its continuous use, it could scarcely be for the purpose of alleviating thirst.

In considering the affinities of the crania of Předmost man with those of other forms of Quaternary man, too much importance must not be attached to the resemblances to Neanderthal man, which have been noted in the first-named. They do not warrant the conclusion at which some anthropologists have arrived that Předmost man represents the stage of transition in a series which extends from Neanderthal to modern man; nor are they the results of a cross between Neanderthal and Aurignacian man. They are due, it must now be held, to simple convergence.

Of the types of 'modern' man of Quaternary age to which the Předmost crania may be related, Grimaldi and Chancelade may be ruled out, notwithstanding affinities to the latter, which have been noted. Předmost stands with Brno I and Brno II, distinct from, but closely related to Oberkassel, with the female Oberkassel as a transitional form. In general terms, it is a simple variant of the Cro Magnon race.

This interpretation of the skeletal evidence is in sufficiently close agreement with the geological and archæological evidence. The fauna of the loess beds points to a rather cold climate of tundra type; while the culture of the settlement, which Maska thought to be Solutrean, is now regarded as developed Aurignacian, the Abbé Breuil would hold with strong Solutrean influence from Hungary, but which Prof. Absolon considers entirely Aurignacian, though of later date than Vistonice, the Moravian station which corresponds to the Upper Aurignacian of France.

News and Views

Native Policy in Africa

A MOTION by Mr. de Rothschild in Committee of the House of Commons on July 9 to reduce the Colonial Office vote initiated a debate on colonial administration with special reference to East Africa, and afforded Mr. Ormsby-Gore as Secretary of State for the Colonies an opportunity of making an important statement in reply, in which he touched upon a number of matters affecting native interests. As an earnest of a promised expansion in education when resources permit, he referred to the provision forthwith of a central institution in Uganda, which would extend facilities for higher education throughout East Africa. He also showed that he is fully aware of the necessity for considering the possibility of regulating the movements of emigrant labourers, to which attention has been directed recently, more especially by conditions in Nyasaland (see NATURE, June 6, p. 921). His most important pronouncement, however, was concerned with the difficult and controversial question of the allocation of land as between native and settler in Kenya. He announced that two orders arising out of the Morris-Carter Report are in contemplation. By one of these orders, some 48,000 square miles of territory will be reserved to the natives, this including the most thickly populated areas, in which 86 per cent of the natives are living; while in the second order, 16,000 square miles of the highland area will be assigned to non-natives, one quarter, however, being set aside for a permanent forest reserve. Before these become effective, however, Mr. Ormsby-Gore indicated that it would be necessary to deal with the question of the 'squatters', upon which he confessed frankly that he had not made up his mind. There are now, he pointed out, 150,000 natives in Kenya living on European farms under annual agreement. These hold from the farmer a house and land in return for 180 days labour per annum at a contract rate of pay. There are also other natives in the European area who are not squatters, but in course of time have acquired rights. Some of these have been dealt with already in accordance with the recommendation of the Morris-Carter report, and removed to an agreed location.

THE problem of the squatter is, indeed, difficult. Mr. Ormsby-Gore's dilemma, as he showed, is whether to permit a system to endure, which while it assures a certain amount of labour to the farmer, is open to abuse, as experience has shown, on both sides, or whether to require labour to be obtained from the reserves in conditions which would keep the native in touch with tribal institutions and discipline. In South Africa, where the squatting system has a long history, it is proposed under the new regulations for native lands that it should not further be permitted; while scientific study of native institutions and the effects of the impact of white civilization on native life and morale would favour the stricter regulation of conditions of employment and intercourse, which the restriction of labour to natives from the reserves would make possible. The present mobility of labour in Africa, as recent events have shown, makes it eminently desirable that there should be some uniformity in native policy; and this is, no doubt, one of the considerations which the statesmen of the Union of South Africa have in mind in their expressions of opposition to any interference with present conditions in the mandated territories of South-West Africa and Tanganyika. It was certainly contemplated by Mr. Pirow, the South African Minister of Defence, when, at Nairobi on his way back to South Africa (*The Times*, July 10), he urged the importance of a common policy for native affairs, defence and customs, in the three groups into which he classified British Africa, from Kenya to the Union. A further important step in this direction is also to be noted in the amendments to the constitution of Southern Rhodesia. According to the draft regulations in the White Paper (Cmd. 6218), issued on July 9, the native reserves in future will be vested in a Board of Trustees, and there is to be a Native Department with a Chief Native Commissioner at its head who "in view of his very important responsibilities, may not be removed without the Secretary of State's consent".

Proposed Tribute to Prof. A. L. Bowley

IT is intended to mark the retirement of Prof. A. L. Bowley from the chair of statistics in the University of London by a recognition in some degree commensurate with his distinguished services. Prof. Bowley has not only given to the London School of Economics, since its beginnings in 1895, years of brilliant and devoted teaching; he has at the same time made contributions to social welfare that have been recognized throughout the world, by universities, by learned societies and by Governments. His published writings have given him an eminence all his own, and his kindliness and geniality have endeared him to generations of students and to all who have had the good fortune to work with him. Over the signatures of Lord Kennet, Mr. J. M. Keynes, Prof. D. H. Macgregor, Prof. W. R. Scott and Sir Josiah Stamp, an appeal has been issued, since it is felt that past students and many others will welcome an opportunity to share in an expression of admiration for the work he has done. It is proposed that this tribute of esteem shall include a portrait of Prof. Bowley to be hung in the London School of Economics, and a scholarship or prize tenable in the University of London (at the London School of Economics) to assist a student pursuing undergraduate or postgraduate study in economic or social statistics. Sir William Beveridge has agreed to act as treasurer of the fund, and all subscriptions should be addressed to him at the London School of Economics, Houghton Street, Aldwych, W.C.2, England.

Anglo-German Stork Experiments

THE present experiments on the migration of the stork (*Ciconia alba*) being carried out in England in conjunction with German ornithologists is evidence of the wider possibilities of international co-operation in field ornithology than have hitherto obtained. Earlier in the spring, eleven storks' eggs from German nests were sent to England and placed in heron nests in Surrey by the Haselmere Educational Museum, as the stork is no longer a British nester, and it was hoped the experiment would indicate whether or not the English-born birds under heron foster-parents would follow the same migration route as German birds. However, only one egg hatched, and after a week the stork chick was accidentally crushed to death by the foster parent. It is hoped to repeat this experiment next spring. In June, a further experiment was made when twenty-three nestling storks from East Prussia were distributed to artificial nests in Scotland, Kent and Surrey where they were hand-fed, and it is hoped that if reared, these birds, which are ringed, will shed further light on migration, and how far inheritance plays a part in it.

MUCH work on the migration of storks has been carried out on the Continent in recent years. The early experiments at bird-ringing were made by Brugmann in Holland and Mortensen in Denmark last century with storks (NATURE, Sept. 30, 1933), and later research showed that birds nesting east of the River Elbe used an Asia Minor route to the Natal winter quarters and those nesting west of the river a route through Spain and Morocco. Three years ago, young storks born east of the Elbe were ringed and released west of the river, but soon found their way back. The small percentage of stork rings recovered in Africa has lately been shown to be due to the Egyptian natives treasuring them as tokens for fertility, a barren woman who obtained one having worn it and given birth to children, and hence the superstition spread. Skougaarde has reported a stork ringed in Jutland and believed to have lived between thirty and forty years.

Hadrian's Wall

EXCAVATION of the fort on the Roman Wall at Halton Chesters, near Newcastle-on-Tyne, by the University of Durham Excavation Committee, has made it possible to state definitely for the first time that the building of the wall was completed within a period of five years. A dedicatory tablet on the west gate of the fort has been found, it is stated in a report of the Committee (*The Times*, July 13), which bears the name of Platorius Nepos, the Governor of Britain in A.D. 122–126. As he also directed the first stages of building, the whole erection was completed within his term of office. The excavation has thrown much light not only on the methods of planning and construction of the fort but also on that of the wall itself. It is evident that the original plan was not always followed. For example, the original ditch fronting the wall runs straight through below the existing fort, one of six, which projects 200 ft. north of the wall. The east and west gates of the fort are carried down the entire depth of the filled-in ditch and are built on massive foundations. There is evidence of two considerable reconstructions or enlargements. After the Caledonian invasion, the Emperor Severus rebuilt the fort in about the year A.D. 205, erecting a monumental fore-hall in front of the administrative building. No hall so fine as this, it is stated, has as yet been discovered in Britain, where, in any event, they are rare. It is shown by the foundations to have been 160 ft. long by 30 ft. broad, with a central entrance spanning the north-to-south street. About a century later the fort was increased in size by an enlargement towards the west behind the shelter of the wall. This structure gave the fort the peculiar L-shaped plan which has long been a puzzle to archæologists.

Meteorology for Airmen in India

A COPY has been received of a new publication of the India Meteorological Department (M.O.A. Pamphlet 1936) entitled "Meteorological Organisation for Airmen". The purpose of this pamphlet is made clear in the introductory pages by the Director-General of Observatories, where the relevant part of the organization of the Department is described, together with the procedure to be adopted to obtain weather reports for the different parts of the area with which the Department is concerned ; this area extends from the south-eastern half of the Persian Gulf across the whole of Baluchistan, India and Burma. It is admitted that the existing organization for the supply of weather reports and forecasts for such a vast area falls short of the standards recommended by the International Convention for Air Navigation, particularly in the south of India, the reason being the size of the area in relation to the permitted financial expenditure on the organization, which is less than what it was formerly in spite of the increased demands of aviation, a fact that has necessitated various reductions, including the closing down of the important forecasting office at Quetta.

THE different areas covered by the forecasting centres in India are shown on a key map, which indicates also the centres themselves, the different airship bases, the pilot balloon stations from which information about the winds of the upper atmosphere can be obtained, and the aeronautical wireless stations. More precise information about these centres is given in extensive tables, which, together with further tables giving the various weather codes in use in India, occupy the greater part of the fifty-one pages of the pamphlet. Information of the kind provided is of course practically essential to airmen flying in a part of the world subject to very violent disturbances, ranging from tropical hurricanes to duststorms and tornados and other local phenomena that render aerial navigation dangerous to all classes of aircraft. A form is included, as a detachable page of the pamphlet, to be forwarded to the Director-General by anyone wishing to receive, free of charge, copies of all supplements and new editions as they are issued to cover the inevitable changes and growth of this meteorological service.

Yugoslav Cultural Progress

LITTLE notice is apt to be taken of the quiet constructive work or scientific developments that go on among the smaller nations. With this fact before it, the Society for Promoting Anglo-Saxon Culture in Yugoslavia has commenced the publication of an *Anglo-Yugoslav Review*, a quarterly to be devoted to the furtherance of the use of English among Yugoslavs and also to acquaint the British and American peoples with the educational, cultural and general progress of the South Slav nation. Its appearance coincides with the celebrations arranged for the eightieth birthday of Nicholas Tesla (born on July 10, 1856), which were held at the end of May. Tesla is a Yugoslav by birth, although most of his work and electrical discoveries on alternating and high-frequency currents were made at Paris and in America. A 15,000 horse-power plant of Tesla's conception was erected at Niagara in 1891 to supply power to Buffalo, 25 miles away—a remarkable feat at the time. Indeed, Tesla's fellow-countrymen claim that his work ranks him on a level with Volta, Watt and Faraday. Approximately half the review is devoted to the section on science and invention. Other sections deal with political, economic, sociological and miscellaneous matters, and among these is an account of recent archæological discoveries in Yugoslavia. Among the four British or American contributions is one by Mr. C. H. White, who discusses the cultural consequences when a nation's mineral resources are developed. The review is published in Belgrade, price 10*s*. per annum.

Transmission and Distribution of Electricity

IN a progress report by C. F. Bolton and R. H. Abell on the transmission and distribution of electricity (*J. Inst. Elec. Eng.*, April) there are several points of special interest. The British Grid uses a pressure of 132 kilovolts, but there is a large number of systems operating at 220 kv. in different parts of the world. In Sweden a hydro-electric power station operates over 200 miles at 220 kv. In France there is a line at this pressure which brings hydro-electric power to Paris. Great activity has been shown in electric development in Russia, and the Dnieper system operates at the same pressure. The Boulder Dam project on the Colorado River represents one of the outstanding engineering achievements of recent years. A part of the energy developed, 1·3 million kilowatts, will be transmitted 266 miles to Los Angeles by a 287·5 kv. transmission line. German engineers have constructed several of their 220 kv. lines so that they can be converted ultimately to work at 380 kv. A scheme using a transmission voltage of 400 kv. has been proposed for the establishment of a large water-power station in Norway for supplying power to Sweden, Denmark and Germany. The main transmission system is to be some 650 miles in length. It terminates at Hamburg, and will have intermediate stations at Göteborg and Copenhagen. The generating plant will have a capacity of nearly a million kilowatts (1·34 million horse-power). The British Grid scheme is now completed, and through it, the considerable water-power sources now available in Scotland are being exploited. The problem of 'system stability' arises when large blocks of power are transmitted over long distances. In Great Britain it is not of special significance.

Care of Old Trees

THE general public probably expresses more sentiment upon the beauty of large trees than upon any other aspect of horticulture. Yew trees may, under good conditions, live to the ripe age of a thousand years, and the oak can boast of very considerable longevity. Whilst the life of a tree must sometime come to an end, the artificial conditions of urban England often shorten its span, unless special care be taken. Mr. A. D. C. Le Sueur has recently shown (*J. Roy. Hort. Soc.*, 61, Pt. 4, 149–159, April 1936) what steps may safely be taken to check decay. Wounds should be cut to healthy wood, treated with a light creosote fungicide, and then rendered waterproof with bitumen. Branches should be cut close to the trunk. Cavity wounds usually contain wood already decayed, and should be cleaned drastically before filling with bitumen or concrete. Artificial support may be given with cables or rods, rather than by bands. Faulty soil conditions, such as lack of nutrients, water or air, or bad drainage, frequently retard good tree growth in public parks. The paper gives many details for the treatment of such backward trees, and provides innumerable instances of scientific practice of the greatest interest.

Earthquake Records at De Bilt, Holland

TWENTY-ONE years ago, the first number of the *Seismische Registrierungen in De Bilt* appeared under the editorship of Dr. E. van Everdingen. We have recently received the annual report No. 21 for the year 1933, still issued under the same capable direction. The seismological observatory of De Bilt lies about five miles north-east of Utrecht. In 1904, it contained a pair of Rebeur-Paschwitz pendulums and a Wiechert horizontal seismograph, and, in 1912, a pair of Galitzin horizontal seismographs were installed. In 1933, the same instruments were in action with the addition of a Galitzin vertical seismograph. The bulletin for 1933 contains the records of 450 earthquakes, and it is worthy of notice that, besides the usual details with regard to the times of the principal phases at De Bilt and the estimated positions of the epicentre, the editor should have been able to collect notices of nearly one-third of these earthquakes from the countries in which they were felt.

A Bibliography of Wheat

A BIBLIOGRAPHY of world literature on the genetics and breeding of wheat has been issued by the Institute of Plant Industry, U.S.S.R., and forms the first volume of a new series of publications on wheat (*Bull. App. Bot., Genet. and Plant Breeding*, Series VA, No. 1, pp. 136; 1935). In this work, the titles of articles or books appear in the language of the original contributions, and, where these have been reviewed, reference to the reviewing journal is given. The material is classified under various headings and, within each class, is arranged chronologically. An author index is included.

School Nature Study

THE July number of *School Nature Study* (31, No. 124), the official organ of the School Nature Study Union, contains several articles of interest. An ecological study of the plant life of the salt marshlands of south-west Sussex by A. D. French reveals four important zones, namely, the inner shore banks above high-water mark, beaches and sands above high-water mark, the interzonal region, and the marsh proper. The vegetation of these zones has been carefully examined and recorded. The animal life, too, afforded certain features of interest, and a list of birds is given. The birds of Costa Brava, Spain, have been studied by Margaret M. Hutchinson, and her observations are embodied in a short article (together with a list) in the same number. A. C. Evans, of the Rothamsted Experimental Station, contributes an article on insects and their food. The factors determining an insect's choice of plant food are examined, and the author reveals our great lack of knowledge on this problem, especially from the point of view of plants of economic value. The School Nature Study Union publishes a series of pamphlets dealing with subjects of interest to the biologist, about seventy of which are reprints from *School Nature Study*; five other Special Leaflets are also available. A list of the pamphlets may be obtained from Mr. E. G. Clarke, 7 Stanley Avenue, Wembley, Middlesex.

Library of Conchology

MR. SOHTSU G. KING, the Chinese conchologist and banker, has recently given his valuable collection on conchological literature to the Science Society of China Library, Shanghai. The collection was started some twenty years ago, while he was studying Chinese Mollusca with Prof. A. W. Grabau of the University of Peking. Under their joint authorship, a book entitled "Shells of Peitaiho" was published and is now in its second edition, besides many other scientific papers. The collection consists of many valuable and rare works and several complete sets of journals. It is no exaggeration to say that the collection is unique in the Far East and invaluable to students of zoology in general and conchology in particular. The Council of the Society has passed a resolution that a special room shall be used to house the collection and shall be labelled, "Sohtsu G. King Library of Conchology". The books have already been arranged, and a complete catalogue is in preparation and will be printed and circulated to research institutions and learned societies interested. In addition to the collection, Mr. King has also given an endowment, the income of which is to be used to provide the collection with the necessary periodical literature.

Records of the American Mercantile Marine

A CO-OPERATIVE project has just been launched by the Smithsonian Institution and the Works Progress Administration of the United States, having the two objects of preserving a set of standard measured drawings of American types of fishing vessels and merchant vessels, to be placed in the Watercraft Collection of the United States National Museum, and of providing work for unemployed naval architects, draughtsmen and boat builders. The work is to be known as the Historic American Merchant Marine Survey, and the information is to be gleaned from builder's models, original drawings and the actual vessels. It is to be hoped these efforts will lead to similar projects elsewhere.

London Health Services

THE Annual Report of the Ministry of Health for the year 1934–35 contains a special detailed review of the public health work carried out in London by the London County Council, the City Corporation and the Metropolitan Borough Councils. In view of the general interest of this review, it has now been issued as a separate publication, with a preface by Sir Kingsley Wood, the Minister of Health ("London Health Services". London: H.M. Stationery Office. 1*s*. net). The publication gives a useful survey of the division of functions among the various sanitary authorities in London, and describes the public health and poor law medical services, the food protection services, port sanitary administration, and welfare of the blind.

Rubber Latex

A REVISED edition of the book "Rubber Latex" by H. P. and W. H. Stevens has just been published by the Rubber Growers' Association, 19 Fenchurch Street, London, E.C.3, and a copy will be sent to any reader interested, on application. It deals in 224 pages with the properties, composition, coagulation, concentration, manipulation and compounding of latex and latex pastes, the vulcanisation of latex and latex products, and dipping and electro-deposition. The final chapter deals with a selected list of nearly a thousand recent British patents, and indicates the growing importance attached to the direct application of latex.

'Loose-Leaf Binders' for NATURE

MESSRS. EASIBIND, LTD., Pilot House, Mallow Street, London, E.C.1, have sent us a specimen 'binder' made to take twenty-six issues of NATURE, without advertisements. The first and last numbers are held by stout wires passing through the centre pages of the issues, and intermediate copies are carried on thin wires which go alternately into one of two parallel slots in a metal fitting at the top and bottom of the back of the 'binder'. By this device

(*Continued on p.* 119.)

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Direction Finding by Sound*

By Dr. W. S. Tucker, O.B.E., Director of Acoustical Research,
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It is a regrettable fact that some of our scientific activities have required the stimulus of war to initiate them and the fear of war to keep them alive. Not the least striking example of this impingement of military necessity on scientific research is afforded by the subject of direction finding by sound. During the Great War, sound provided the only means of locating the submarine that threatened our shipping, mining operations that threatened our entrenchments, the distant and invisible gun and the aeroplane flying behind cloud or in the darkness; and this search by sound provided four widely differing methods all requiring advanced scientific technique. The subject is so large that I am proposing to confine myself to the operation of finding the direction of sound transmitted through the air.

It is curious that, of air-borne sound, the War provided us with ideal sources—the gun and the aeroplane. The gun report is an almost perfect example of an impulsive sound—the anti-aircraft shell burst is even better. The aeroplane, so complex in the nature of its sound, has something so rich in its elements—high frequency, low frequency, impulsive, musical, non-musical—that it gives a fascinating mixture of qualities taxing the provision of many kinds of apparatus for investigating its properties.

The fear engendered by these characteristic sources—gun and aeroplane—has stimulated lines of scientific inquiry almost entirely dominated by military requirements, and such inquiries and the results of them have fallen into the category of secret investigations with all the handicaps of fettered scientific discussion. I will try, however, to strip my subject as much as possible of its war implications, and endeavour to show how fascinating the study of sound direction finding can become.

All living creatures equipped with listening faculties appear to have a capacity for obtaining the direction of sound, but this sense of direction is only provided by the functioning of two ears. When either a human being or an animal is deprived of hearing in one ear, sense of direction is very seriously impaired. What is called the binaural faculty has to be replaced by that of a single ear, in which reliance must be placed on variations of intensity due to the shadowing of the head. Even so small a creature as the cricket, using two ears, shows good directional perception, as has been shown by the direct flight of the female to the chirping male, and it has been shown that removal of the tympanum of one ear of the female deprives it of this capacity[1]. Some interesting experiments of Engelmann[2], working in the laboratories of Prof. D. Katz, illustrate the performance of a very intelligent sheepdog called "Asti", one of whose ears was bandaged. The dog then lost its remarkable powers of direction finding. Some residual sound in the bandaged ear appeared to give partial help, but, in addition to exhibiting false judgments, the dog's reaction time changed from about ¾ second to a mean of nearly 4 seconds[3].

What, then, is the function of the second ear? The answer appears to be perfectly easy when the sounds to be located are impulsive or of short duration. The ears owe their directive capacity to the fact that they are separated, and the distance between them is a determining factor. If the sound is directly in front, the sound arrives at the two ears simultaneously; if from the side, one ear receives the sound a very short time earlier than the other, the measure of that time being determined by the angle that direction makes with the median plane of the head, or with the line perpendicular to that joining the ears. From the known speed of travel of sound and the distance between the two ears, a time interval can be worked out for every direction, so that, if the brain recognises this time interval, a definite direction can be associated with it. A more accurate appreciation of direction can be given by turning the head until we face the sound, and this corresponds to the simultaneous arrival of the sound at the two ears. This time difference theory, enunciated by Hornbostel[3], has been supported by most modern exponents, and has been shown to be not inconsistent with the late Lord Rayleigh's theory of location by phase difference.

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* From the Friday evening discourse at the Royal Institution delivered on May 1. The author wishes to acknowledge with thanks his indebtedness to the Royal Engineer Board of the War Office for permission to refer to matters of military interest.

A very good example of direction finding by measuring time intervals is shown in sound ranging of guns[4]. Here the ears are replaced by microphones. Instead of the base length of only about 6 inches for the two human ears, the microphones were at the ends of a base from half-a-mile to three-quarters-of-a-mile long. The time intervals were therefore long and measurable by suitable timing apparatus, and from these any two microphones gave a direction, three gave two directions and an intersection, and therefore a location. Three more microphones were used in an installation, in the War, making six in all, giving five directions and a mean of locations which improved the accuracy of location very considerably.

The unit of measurable time difference was then about 1/100 sec., and recent advances in sound ranging have made it possible to measure to less than 1/1000 sec.; but the human mechanism of time recording is very much finer than this. Thus, experiments have shown that the pair of human ears with the interpretation of the brain can distinguish time intervals of 30/1,000,000 sec., and interpret them into a perceptible difference in direction. Animals can do even better than this. I am indebted to Prof. Katz for communicating to me some results obtained in his laboratories at the University of Rostock by Engelmann[5]. Engelmann's method of testing the faculties of animals exhibits great ingenuity. Two similar screens placed side by side served to hide a source of sound, and, on a hook behind the screen hiding the source, was placed a piece of sausage. A dog was trained to associate the correct choice of the screen with the reward of a piece of sausage. By adjustment of the screens both as regards distance from the dog and of their distance apart, the limitations of the dog in the correct identification of the screen gave a measure of the angular separation of the screens, and hence the capacity of the dog to separate directions of sound. The experiments were carried out with three dogs, the dog "Asti" giving the remarkable performance of a separation 2°9′, corresponding to a time interval of 14/1,000,000 sec. A smaller dog, "Fritz", gave even better results: a separation of 1°16′ and time interval of 7/1,000,000 sec.

Experiments with cats, in which the source of sound was the rustle of two white mice in a cage, gave, in one case, a separation of only 48′ and a time interval of 2·8/1,000,000 sec. Experiments with hens and chickens gave other figures showing how very sensitive to sound direction for certain sound these creatures are. Here the source of sound which served as a test for the hen was the 'cheep' of the chick, and the chicken was tested on the cluck of the mother hen.

The following table shows the relative capacities of the various creatures as regards accuracy of direction finding; man is obviously outclassed.

Subject	Base-length between ears	Accuracy of direction finding	Distinguishable time intervals between the ears
			(10^{-6} sec.)
Man	14 cm	4°18′	30
Dog:			
"Asti"	18 cm.	2° 9′	14
"Fritz"	9 cm.	1°26′	7
Cat	7 cm.	48′	2·8
Hen	3 cm.	2° 9′	3 3
Chicken	1·5 cm.	2° 9′	1·6

I have emphasized so far the time difference explanation of this phenomenon of directional listening; but it may be objected that the direction finding of a continuous sound like an aeroplane cannot be so accounted for, since we would appear to have no discrete pulses on which we can observe such time difference. I have already referred to the quality of aircraft sounds and have mentioned its partly impulsive character. However much help may be derived from what is called the phase difference between the waves of incoming sound, our experience with troops has taught us that it is these flutterings and pulses which appear to be given out irregularly that make direction finding easy. Even when the source of sound is entirely musical, atmospheric irregularities make the sound appear to fluctuate, and it is the time interval between the arrivals of these discrete fluctuations or flutterings which give the binaural sensation so prominently.

Now it must be admitted that this faculty of direction finding by sound grew naturally, both in men and animals, from the necessity of locating sounds nearly in the horizontal plane. With the advent of the aeroplane, we are faced with the necessity of listening to overhead sounds also, and here our listening mechanism shows a lack which it is probable Nature will never contrive to redress. When listening to the overhead sound, rotation of the head does not alter that time difference between the arrivals of the sound at the two ears upon which we depend for acquiring sense of direction, and this disability, although greatest in the overhead position, still persists, though in a gradually lessening degree, as the angle of elevation of the aeroplane is reduced. To get accuracies in the overhead position comparable with that of horizontal listening, the listener must make the axis of his body horizontal, that is, he must lie down with his length parallel to the course of the aeroplane before making use of his ears for direction finding. His head is then placed as well for locating the overhead sound as previously, when the body was erect, it was placed for locating sounds on the ground.

It may be that this uncertainty in placing an aeroplane which is overhead is responsible for the feeling experienced during the War that the bombing aeroplane seemed to spend an undue amount of time exactly over us, an impression, no doubt, which added to the terror of this overhead menace.

In the design of an efficient sound locator there is one obvious improvement to aid directional listening, namely, the artificial separation of the two ears. If we can, so to speak, pull the ears out of the head and separate them, we can increase for any given direction that time difference upon which a sense of direction depends. This pulling out of the ears can be done artificially by means of tubes placed in the ears with their open ends widely separated. If, further, the terminations of these tubes can be some type of sound collector, such as a horn, the improved directional properties can be supplemented by a magnification of the sound.

This was the fundamental principle which led to the design of the first British sound-locator, produced by the Anti-Aircraft Experimental Section of the Munitions Inventions Department under Prof. A. V. Hill. Four wooden horns were used on altazimuth mounting. The operation of direction finding involves two pairs of ears and two pairs of trumpets. The azimuth listener uses the horizontal pair which rotates about a vertical axis, while the altitude pair rotates about a horizontal axis. In operation, all the trumpets in a frame move together so that their mouths always point in the same direction.

It must be noted also that the azimuth listener must be on the correct bearing before the altitude listener can function correctly. This second pair of trumpets takes the place of hypothetical ears mounted on the crown of the head and under the chin, and the corresponding directional listening operation would be analogous to the nodding of the head after it has been swung round to face the sound.

In 1923, the Acoustical Section of the Air Defence Experimental Establishment had the problem of producing a portable sound locator which could be packed in a case after dismantling. The base length of 4 ft. 6 in. was used, but the horns were made smaller than in the early British pattern and, being metal-lined, withstood damage, for a fine crack in a wooden horn of the early type kills its magnifying properties. The performance of this locator after training was adequate for the slow moving and heavy bombing aircraft of ten years ago, but, owing to the high speed of modern aircraft, it is gradually losing its usefulness.

This magnification produced by horns is helpful because it reduces the reaction time of the listener ; hence he gets on the correct bearing more quickly than if he were dealing with faint sounds. The horns, however, have another property which helps the listener. As they are rotated into the true direction, the intensity increases, and the listener will naturally turn the horn so that the sound is loudest. High-pitched sounds are more strongly magnified than the low-pitched sounds. The intensity variation as the horn rotates is also greater for the high-pitched sounds. We do not hear the aeroplane through the horns exactly as we hear it with the unaided ear, and, as we rotate them, the quality of sound changes, being richest when the horns face the sound.

We get, then, three factors affecting our correct estimate of direction—the binaural sense which depends on time difference, giving us the sense of sound straight ahead when facing it, the intensity of the sound which becomes greater, and the quality of the sound which becomes richer and more closely resembles that of the aeroplane as heard by the unaided ear.

Of recent years, several well-known armament firms have produced sound locators in which great diversity of design has been exhibited. Sound collectors have been either of the horn type or have employed concave reflectors with special devices for conveying the sound to the ears. A modern example of the horn type is that produced by Sperry in the United States. Another type, produced by the firm of Barbier, Benard and Turenne, provides collectors each one of which is composed of a number of horns connected at their narrow ends. The Sautter Harlé locator, also produced in France, is of the reflector type, and so also is one produced by the firm of Goerz of Vienna, in which many striking acoustical features are introduced.

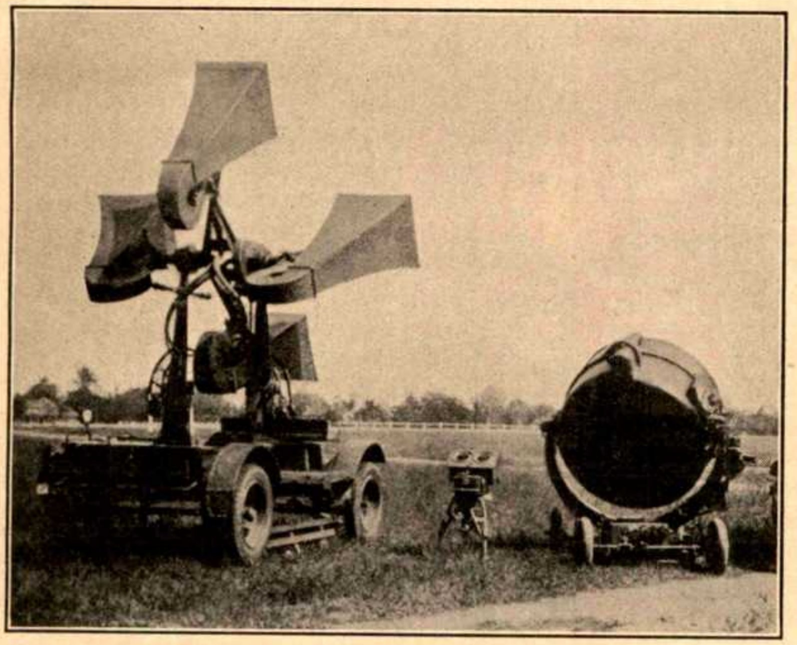

FIG. 1. THE SPERRY SOUND LOCATOR.

The Sperry sound locator (Fig. 1) consists of large exponential horns, that is horns with curved sides in which the cross-section diminishes in logarithmic relation with distance from the mouth. As such they accord with the latest scientific principles and, in fact, lend themselves to calculation both as regards frequency response and frequency range. They are 16 ft. long and give a base length of 7 ft. The listeners are, as it were, clamped to the horns by caps carrying earpads through which sound has access to the ear. They give an impressive magnification, but, unfortunately, are extremely resonant and, in even light winds, provide a disturbing background which hampers listening. This difficulty is overcome by a prolonged period of training. A feature of the trumpet which is liable to be overlooked is the danger to the listener of local gun sounds in which the gun blast is greatly concentrated. These Sperry locators, in the hands of trained troops, give a good performance.

By the way of comparison, the latest British sound-locator is shown (Fig. 2). Collectors which are paraboloid reflectors have been evolved as the result of researches in which the acoustical properties are accurately known. As in the best of the Continental locators, the instrument is trailer-mounted and the listeners adjust the positions of the locator and themselves by hand-wheel control. The instrument is highly directional, is free from trumpet resonance and can be used in moderately noisy surroundings.

In general, a condition of absolute silence is imposed in the neighbourhood of these locators while they are in operation, but with the new English locator it is quite possible to do effective work when onlookers are talking near it, so long as they keep away from the direction of listening.

Reviewing all these types of locator, it is interesting to note that, working on independent lines, the mouths of the collectors, which is an important feature of selective directional listening, and the length of the base between collectors, which determines accuracy of location, have achieved about equal dimensions throughout, but it must be confessed that some of the designs do not accord with the simplicity of the functions which they have to carry out.

Efforts of various countries have been concentrated hitherto on the production of sound locators in which the ear is the ultimate criterion. Directive listening is known to require training, and a certain proportion of military and civil personnel are quite incapable of being trained. The British locator has proved itself to be a very rapid training instrument, but with all possible improvements, some listeners are physically incapable of good performance.

More recently, however, attention has been directed to the production of electrical locators in which it is hoped that difficulties of training will, to some extent, be eliminated.

It is only during the last year that microphones in Great Britain have been produced for all-round listening which can be matched as accurately as the ears are matched. The sensitivity of the microphones themselves is inadequate, and they must have amplifiers similar to wireless amplifiers, but of special design. These again must be matched, or they will, of themselves, introduce time errors or, better expressed, phase changes. Also, the power of discrimination of wanted from unwanted sounds, used automatically by the ears of the listener, must find its analogy in some electrical device, and recently we have been able to produce electrical filters which help to cut out the sounds which form an undesired background.

Finally, we should naturally replace the stethoscopes by telephones, which again must be matched, but that leads us back again to the ear with all its inherent difficulties. There is, however, an alternative to the ear in the cathode ray oscillograph, which may be used in a manner suggested by Dr. E. T. Paris. We have two receptors, so to speak, in the two pairs of parallel plates in the oscillograph, and the two microphone circuits may be connected to these so that each microphone effect can be recorded as a corresponding movement of the spot on the screen. Fig. 3 shows diagrammatically the four plates of the oscillograph, in which plates *aa* correspond to microphone *A* and plates *bb* to microphone *B*. The displacements *aa* and *bb* on the screen shown below correspond to their separate movements. These movements which are, of course, oscillatory, give by persistence of vision a straight line for each microphone, but when the two microphones are connected up, we get the well-known Lissajou figure, which would be another straight line equally inclined to the first two if these two microphone responses are in phase. When out of phase, the effect depends on the nature of the sound. If the sound is a pure musical tone, represented by a sine wave form, the intervening out-of-phase conditions are represented by ellipses. If, however, the source of sound is as complex as that of an aircraft, and is built up of many frequencies, the pattern only becomes simple, that is, the straight line above referred to, if all the constituents are in phase, namely, when the microphones are equidistant from the source.

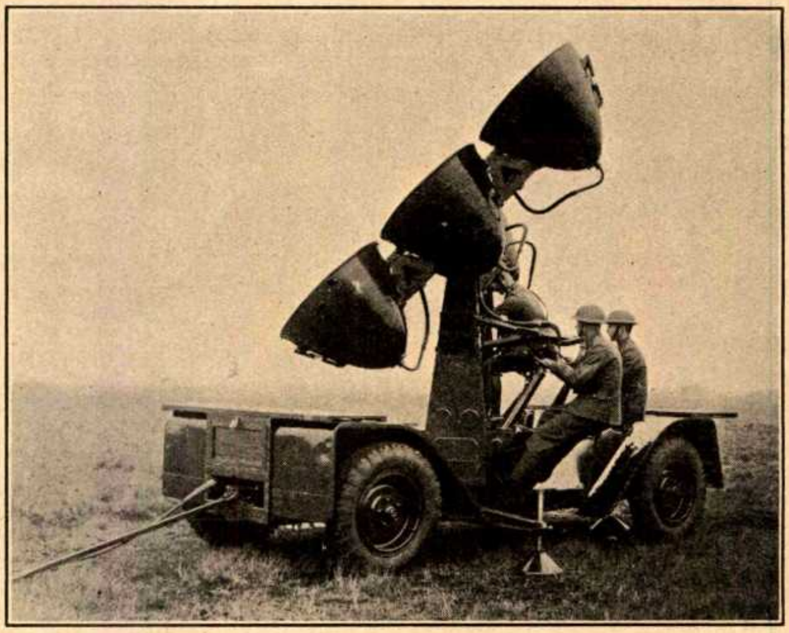

FIG. 2. MODERN BRITISH SOUND LOCATOR.

Gusty winds make directional listening very difficult; for the critical time difference on which direction finding depends becomes variable. The cathode ray oscillograph gives a perfect picture of this disability. The straight line then becomes blurred, and if the sound intensities change, as they do in the two receivers, at unequal rates, the resultant line oscillates. The aural and visual perceptions give an exact parallel. Similarly, other sources of sound, or, it may be reflections of the same source, confuse both aural and visual effects equally. This method of visual indication by the cathode ray oscillograph gives immediate evidence of listening disabilities.

I have so far dealt with sound direction finders in which the two ears or their equivalents in microphones are necessary. There are, however, direction finders in which use is made of single collectors which can rotate to face the sound and so find a maximum of intensity. Although these direction finders are of considerable interest, they fail to give the accuracy shown by the binaural instruments, and, furthermore, present difficulties in recovering the direction of the sound when it is lost.

I will only give one example of this type, which is of interest in so far as it is entirely devoted to peace operations, and deals with the direction finding of fog horns and ships' sirens at sea. The need of supplementing the human ear has been recognized by many navigators, especially as meteorological conditions sometimes baffle the listeners. Situations may also arise when the nearness of the foghorn involves hasty and definite action. The invention of Messrs. W. and T. G. Hodgkinson is directed to the supply of accurate bearings (to half a point of the compass).

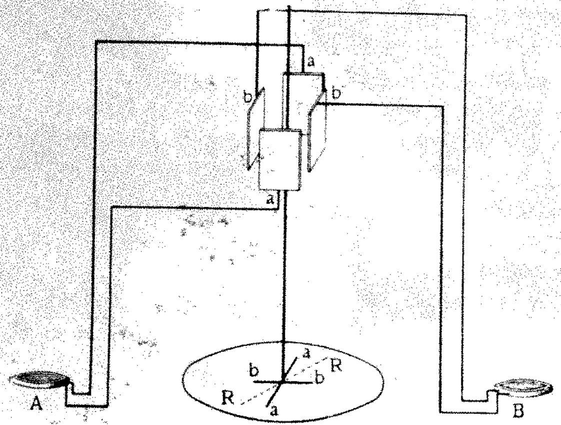

FIG. 3. DIAGRAM OF CATHODE RAY OSCILLOGRAPH.

The devices tried out were of two types. The first and simpler form of direction finder consisted of a paraboloidal receiver mounted in a drum rotatable about a vertical axis. The axis of the paraboloid was horizontal and coincided with a diameter of the drum. At the focus of the paraboloid a contact microphone was mounted, and the mouth of the paraboloid was protected from wind by a perforated screen. Microphone adjustments were such that the noises of the ship on which it was erected and disturbances from wind produced little effect, but it would respond to horns and sirens up to ranges of three miles. The axis of the drum carried a commutator, and brushes were arranged so that, for sixteen positions of the drum, currents generated by sound in the microphone could light a lamp through the agency of a relay. Sixteen of these lamps were arranged in a dial to give the points of the compass against which any sound disturbance could be anticipated. For near foghorns, a group of lights might be shown on a definite arc, the centre of which would give the bearing. This instrument was used for a period on the Mersey pilot-service and on the Holyhead–Dublin mail service. A later pattern, where a much larger drum was used, avoided the operation of rotating the drum, the same effect being achieved by using a number of radial paraboloid receivers, each with its own light indicator. This was installed on S.S. *Victorian* of the Allan Line on the Liverpool–Montreal service. The instrument, though successful, was not brought into general use.

It may be suggested that considerable gain might be achieved by using very large receivers. This development, however, has not been pursued because it has been discovered that appreciable increase in acoustical range has not been comparable—a result which can be attributed to the very high attenuation of sound in the atmosphere. The application of the inverse square law is not helpful in estimating range extension, since, at greater distances than normal listening, the attenuation losses are high in comparison with those due to spherical divergence. Very large receivers have been tried and have resulted in very disappointing performance at long ranges. Thus, large exponential horns which admittedly magnify very impressively, will add only a few miles to the audible range. A gain in accuracy of direction finding may be achieved, but, even so, the accuracy obtained by a single large receiver working on a maximum of intensity cannot compete with that derived by employing the binaural effect, using pairs of receivers of more modest dimensions.

It is obvious that no description of sound direction finding would be adequate without reference to two sources of error. The first one, which applies to the location of all sources of sound, whether fixed or moving, is due to the physical nature of the atmosphere. The effect of wind in creating difficulties of listening range is, of course, familiar, and I do not wish to dwell on this. Meteorological acoustics is a science of itself and might easily occupy the whole of this discourse. It is my purpose rather to indicate in a few words how wind and temperature may affect the direction of listening. We may regard the velocity of sound in still air at uniform temperature as a physical constant, but air is very rarely still and never at a fixed temperature as we ascend. We must increase or decrease the velocity of sound according as the wind is with or against the direction of travel, and according as the temperature increases or decreases. The effect of the variation is to produce refraction, to a greater or less degree, and the effects of these variations have been worked out precisely from mathematical considerations[5]. The following simple illustrations indicate in what manner meteorological conditions affect directional listening. If we consider the wind to increase with height in the direction of listening, the sound ray comes down more steeply. If opposite to the direction of listening, the sound ray is bent so that it comes in at a smaller angle. For example, in a south-west wind so prevalent in England, an aeroplane would be heard in a south-west direction at a higher angle than the true, or, if with the same wind we listen to an aeroplane in the north-east, we should be hearing it at a lower angle. The reason is that wind from the south-west increases as we ascend in nearly all cases.

The effect of the temperature is such that, if no wind had to be allowed for, the aeroplane would always be heard at a lower angle of elevation than it actually is. The reason is that the temperature during the day is nearly always lower as we ascend, and, in consequence, the velocity decreases. The effect is the same as if we were listening against the wind, as described above. At night, however, the reverse effect frequently occurs, because the ground cools by radiation and the temperature of the air above it is higher. At night therefore it frequently happens that we hear an aeroplane at a greater angle of elevation. These effects are quite large, as much as 10° for very low angles of elevation, but when the aeroplane approaches the overhead position, these errors become negligible. An illustration is shown in Fig. 4, where the directions of sound rays given out by an aeroplane at 7,000 ft. are mapped out. This acoustical distribution of rays can be worked out if we know how wind and temperature change as we ascend. Here, the sound rays spread in such a way as to give a region in which no sound is heard, hence no direction can be defined; but above and below it there are errors in direction as shown. Provision for such corrections will eventually be made, for, if sound is to be employed for controlling gun fire, great accuracy will be essential in obtaining direction.

The survey of the atmosphere as regards wind and temperature has been accessory to a large research (now being carried out by P. Rothwell) on the refraction of sound in the atmosphere.

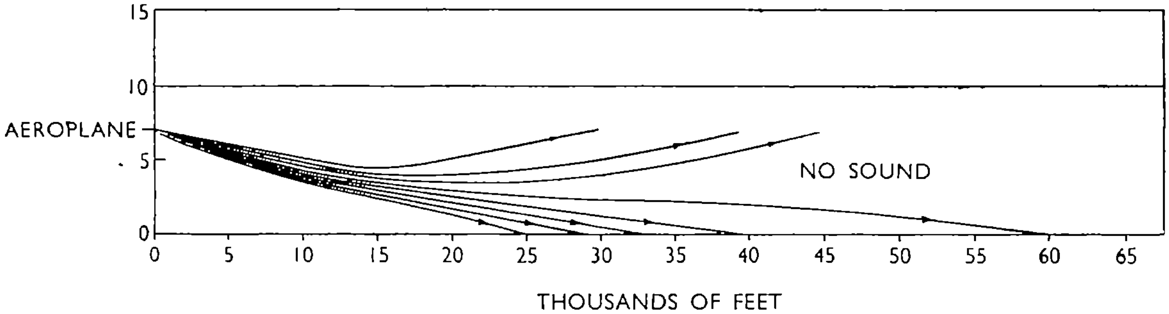

FIG. 4. DIRECTIONS OF SOUND RAYS FROM AN AEROPLANE AT 7,000 FT.

A more serious error in sound direction finding occurs if the source of sound is moving. The small velocity of sound relative to that of light is responsible for an error called the 'lag of sound', and it can be defined as the angle between the line of sight and the direction of listening. Taking an aeroplane as the moving source, while the sound which it gives out is approaching the listener, the aeroplane has travelled on its course, so that the listening direction will always be behind the visual one. The lag of sound varies according to the direction in which we are listening. If the aeroplane is coming straight towards us or receding from us, there is no correction; but if it is flying across our field of vision, such as it would be if vertically overhead, the lag of sound is a maximum. The angle thus becomes approximately $\varphi = \nu/V$ where V is the speed of sound and ν the airspeed of the target, but a wind correction must be incorporated with this if the wind varies between the aeroplane and the ground. No correction is necessary if there is no wind. How large the correction may be is indicated in the accompanying table, which gives the angular lag of listening direction for an aircraft flying overhead. Against this correction, a year is quoted, corresponding roughly to the speeds of aircraft prevalent at that time.

	Air speed : miles per hour	Angular error overhead position
1918	60	4·6°
1926	120	9·1°
1934	180	13 8°
1936	240	18 4°
1940?	300	23 0°

The corrections would suggest a very serious disability in sound locating, but this disability may easily be exaggerated, for, if we know the airspeed of the aircraft and the direction in which it is travelling, corrections may be applied with considerable precision. The various sound locators have devices attached to them which insert the lag of sound corrections and, in some cases, corrections for wind and temperature refraction.

We must, of course, remember that acoustical direction finding cannot compete with the precisions of visual observations, but it is not too much to say that, on fixed sources of sound, an error of ½° can be assured with the modern instruments, and with an aeroplane flying at reasonable heights, all sound locator manufacturers quote 2° accuracy. The distance away of the target is, of course, a determining factor, as with low-flying targets having a high angular velocity, difficulties of following, both physical and psychological, make the operation of direction finding difficult. By careful training, a listening team of two listeners per locator can achieve an accuracy of 1° for a reasonable proportion of the time during which the aircraft is within hearing and at heights above 5,000 ft.

Is sound as an aid to defence likely to be completely outclassed because of its low velocity ? We are apt, with the sensational reports of greater and greater speeds of aircraft, to exaggerate the heavy handicaps from which sound suffers. In direction finding, it is true that a large correction may be involved, but, if it is an accurate one, the result may still be adequate for the purpose for which sound locators were designed. We are by no means approaching yet the stage described in the well-known petrol advertisement, and we have one consolation in the fact that very high-speed aircraft produce much stronger sounds than those flying at lower speeds, so that what we lose in time through high speed we gain in range of audibility.

It is not desired, however, to close on the note of war. We are endowed with a directional listening faculty, the study of which has been seriously neglected. We scarcely appreciated that we had this faculty until sound locators were designed and time differences exaggerated, so that an almost uncanny throwing of our perception of sound from one ear to the other was observed only by a slight rotation of such instruments.

We have claimed the impulsive character of the aircraft sound as a valuable asset in sound direction finding, and we have been able to explain the phenomenon of direction listening on the time difference theory of Hornbostel. It has, however, been the subject of psychological researches to try if sense of direction is lost when the sounds are pure tones. Banister[6] has by suitable laboratory equipment tested certain observers on pure tones and has come to the conclusion that tones of frequency ranging from 133 cycles to 1,705 cycles can give a binaural effect and that discrete impulses are not essential. Our own experience is that lower frequency pure tones are very difficult to locate.

Banister has attempted to reconcile these results with Hornbostel's theory of time differences and has produced a theory which may explain why such an operation is possible. The crests of the sound wave, so to speak, can fulfil the function of discrete pulses, if certain assumptions are made on the mechanism of the ear.

These and other experiments on the theories of hearing should benefit by the attention now being devoted to sound direction finding, and it is hoped that instruments devised specifically to defend us against war dangers will thus give an impetus to work of purely scientific value.

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[1] J. Regen, *Sitz. Akad. Wiss. Wien*, Math.-Naturwiss. Kl., (1), 132, 81 (1924).

[2] Engelmann, "Untersuchungen über die Schall-lokalisation bei Thieren". (J. A. Barth, Leipzig.)

[3] E. M. von Hornbostel. "The Time Theory of Sound-Localization". Physical Society Discussion on Audition, June 19, 1931.

[4] "Dictionary of Applied Physics", vol. 4, p. 738.

[5] E. A Milne. "Sound Waves in the Atmosphere". *Phil. Mag.*, 42, 100 (1921). Tucker. "Some Problems of Modern Meteorology. No. 11 Meteorological Acoustics". *Quart. J. Roy. Met. Soc.*, 59, No. 250, July, 1933.

[6] H. Banister. "The Basis of Sound-Localization". Physical Society Discussion on Audition, June 19, 1931.

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the bulkiness of the 'stitched' edges of a pile of loose issues is to some extent minimized. The 'binder' has an attractive dark green imitation leather finish, it is easy to manipulate, and is a convenient means of keeping loose issues together pending binding up a volume, or even permanently. The price of the binder is 3*s.* 6*d.* (4*s.* including postage).

Civil List Pensions

AMONG the Civil List pensions granted on March 12 and recently announced in a White Paper (H.M. Stationery Office, 139, price 1*d.*) are the following pensions for services to science: Miss A. M. Buckton, in recognition of her services to literature and of the services rendered by her father, the late Mr. George B. Buckton, to entomology, £60; Mrs. S. I. Cunningham, in recognition of the services rendered by her husband, the late Mr. J. T. Cunningham, to zoology, £90; Miss R. M. Fleming, in recognition of her services to anthropology and geography, £80; Mrs. C. D. Hodgkinson, in recognition of the services rendered by her husband, the late Prof. W. R. Hodgkinson, to chemistry, £90; Mrs. B. Kaye, in recognition of the services rendered by her husband, the late Mr. W. J. Kaye, to the study of archæology, £60.

Grants for Cancer Research

AT the recent quarterly meeting of the Grand Council of the British Empire Cancer Campaign, grants totalling £5,296 were approved; £1,187 to Dr. A. Pollard, working at the Courtauld Institute of Biochemistry at the Middlesex Hospital, on a special scheme of biochemical research inaugurated by the Scientific Advisory Committee; £150 to Dr. F. G. Spear, working at the Strangeways Research Laboratory, Cambridge, for the purchase of a low-voltage equipment apparatus, and £700 for the purchase of a 200 k.v. 10 m.a. Greinacher set; £300 for six months for work being carried out under the direction of Mr. F. C. Pybus through the North of England Council of the Campaign; £1,256 for fifteen months to Dr. Alexander Haddow, who is transferring from his research appointment in Edinburgh to continue special research work at The Royal Cancer Hospital (Free); £320 to Mr. Nevill Willmer, working at the Physiological Laboratory, Cambridge, for technical assistance and purchase of apparatus; and £150 for six months to Dr. Alice Leigh-Smith, working under the direction of Dr. Thomas Lumsden at the London Hospital.

The Structure of Aneurin and Thiochrome

MESSRS. F. BERGEL and A. R. TODD point out that in their letter under this title in NATURE of July 11 (p. 76), formulæ I and II are printed with HCl apparently attached to carbon atom 5′ of the thiazole nucleus; actually the HCl should be represented merely as attached to the molecule as a whole, since it cannot be allocated with certainty to any particular nitrogen atom; it cannot, of course, be attached to a carbon atom. In formula III a single bond should be inserted between C_5 of the pyrimidine ring and the thiazole nitrogen.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A lecturer in biology in The Polytechnic, Regent Street, London, W.1—The Director of Education (July 20).

A lecturer in mechanical engineering in the Burnley Municipal College—The Director of Education, Education Offices, Burnley (July 20).

An assistant in the Mechanical Engineering Department and an assistant in the Electrical Engineering and Physics Department of the Coventry Technical College—The Director of Education, Council House, Coventry (July 22).

Mechanical engineers for the Supply Board Technical Establishment under the Director of Ordnance Factories—The Under-Secretary of State (C.5), War Office, London, S.W.1 (July 24).

Four instructors in motor engineering in the South-East Essex Technical College—The Clerk to the Governors, Five Elms Council School, Wood Lane, Dagenham (July 24).

A lecturer in mathematics, and three lecturers in engineering, in the Acton Technical College, High Street, Acton, 3—The Principal (July 24).

A lecturer and deputy director of the Department of Anatomy in the St. Thomas's Hospital Medical School, London, S.E.1—The Dean (July 24).

An assistant lecturer in physics in the University of Manchester—The Registrar (July 29).

A lecturer (Grade IIb) in electrical engineering in the University of Birmingham—The Secretary (July 29).

Junior scientific officers in the Directorate of Scientific Research of the Air Ministry—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (July 31).

A head of the Department of Mechanical Engineering in the Bradford Technical College—The Principal (July 31).

A civilian scientific officer in the Admiralty Scientific Pool—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (July 31) (quote C.E. 3709/36).

A demonstrator in chemistry in the University of Aberdeen—The Secretary (August 8).

A temporary assistant lecturer in chemistry in the University of Manchester—The Registrar (August 8).

Two part-time demonstrators in inorganic chemistry in the University of Leeds—The Registrar (August 15).

A lecturer in fuel technology in the University of Sheffield—The Registrar (August 15).

A lecturer in metal mining in the University of Birmingham—The Secretary (August 15).

A University reader in physiology in the London Hospital Medical College—The Academic Registrar, University of London, S.W.7 (September 11).

A part-time lecturer in science in St. Paul's Training College, Selly Park, Birmingham—The Principal.

A part-time demonstrator in mathematics in University College, Southampton—The Registrar.

An assistant lecturer in geography in University College, Hull—The Registrar.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 128.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Atomic Masses of Uranium and Thorium

WITH ions from a spark between a thorium or uranium electrode and a tin electrode, it was found that easily resolved doublets are given by the mass-spectrograph, formed by the doubly charged thorium ions with the tin isotope at 116 in one case, and in the case of uranium with the isotope at 119 (Fig. 1). The mass difference is found to be 0·120 ± 0·003 for thorium (the average of six doublets of nearly equal intensity), and 0·131 ± 0·003 in the case of uranium (average of the values for the five best doublets). The packing fraction for the tin isotopes has been determined by Dr. Aston[1] as 7·3 ± 1. Using this value, the atomic mass of thorium (oxygen = 16·000) is 232·070 and that of uranium 238·088.

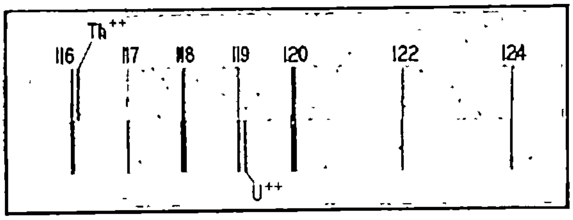

FIG. 1. Ions from electrons of tin and thorium (above) and tin and uranium (below).

Doubly charged ions of the faint isotope of uranium[2] at 235 appeared on four photographs, unsymmetrically spaced between the tin lines at 117 and 118. Its mass was found to be 235·084 ± 0·01. The proportion of this isotope is 0·4 per cent, according to the actino-uranium theory. Reduced to the chemical scale, the atomic weights become 232·024 for thorium and 238·028 for the mean of the two uranium isotopes, as compared with the usually accepted values 232·12 and 238·14. The discrepancy of approximately one tenth of a unit is too large to be ascribed to an error in the masses of the tin isotopes.

From their analysis of the transformations induced by neutron bombardment of uranium, O. Hahn, L. Meitner and F. Strassmann[3] have recently concluded that a uranium isotope of mass 235 exists with a half-life of only 24 minutes. It is transformed by β-ray emission into eka-rhenium ($N = 93$) of the same mass, which is probably a long-lived product. As the uranium and pitch-blende samples used in the present experiments were of unknown origin, analyses of the uranium ions from purified samples of uranium salts were made to make sure that the faint component is an isotope of uranium and not by any chance eka-rhenium. Pure uranyl nitrate crystals were heated and packed in a nickel tube. With this electrode the isotope at 235 was observed apparently in the same ratio as with the other electrodes. No precipitate was obtained by hydrogen sulphide, showing the absence of an appreciable amount of eka-rhenium. The uranium was next freed from other elements by precipitating it as sodium uranyl acetate. This salt when heated and used as the electrode also gave the isotope at 235 just as before. Since this long-lived isotope at 235 thus belongs to uranium, the short-lived isotope formed by neutron bombardment must be isomeric with it, the two having the same mass and charge but differing in nuclear properties.

A. J. DEMPSTER.

University of Chicago.
June 12.

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[1] F. W. Aston, *Proc. Roy. Soc.*, A, **115**, 506 (1927).
[2] A. J. Dempster, NATURE, **136**, 180 (1935).
[3] O. Hahn, L. Meitner, F. Strassmann, *Ber. deut. chem. Gesell.*, **69**, 913 (1936).

Unimolecular Elimination and the Significance of the Electrical Conduction, Racemization and Halogen Replacement of Organic Halides in Solution

THERE are a number of cases in which the development of electrical conductivity in sulphur dioxide solution has been held to indicate the electrolytic dissociation of an alkyl halide. One of the best known examples is that of *tert.*-butyl iodide[1]. We find, however, that *tert.*-butyl chloride absorbs bromine quantitatively in sulphur dioxide, the products being *iso*butylene dibromide and hydrogen chloride. This suggests a rather rapidly established equilibrium,

$$\mathrm{Me_3CCl \rightleftarrows Me_2C : CH_2 + HCl},$$

in which, however, the left-hand components have the smaller free energy. α-Phenylethyl chloride also is said to give a conducting solution in sulphur dioxide: we find that the pure chloride in the pure solvent does not conduct, but that when there is conduction, styrene and hydrogen chloride are present:

$$\mathrm{CHPhMeCl \rightleftarrows CHPh : CH_2 + HCl}.$$

Under conditions of purity in which the chloride does not conduct, hydrogen chloride itself has negligible conductivity in small concentration, but even in these circumstances the addition of bromine leads to a quantitative yield of styrene dibromide.

Observations of the unimolecular racemization of optically active alkyl halides have also been held to measure their rates of electrolytic dissociation or at least their ionization. α-Phenylethyl chloride has been shown to racemize in sulphur dioxide at a rate which is unaffected by added chloride ions[2]. A similar but more rapid racemization has been observed with formic acid as solvent[3]. In formic acid also styrene and hydrogen chloride are formed; we find, moreover, that the rate of racemization is substantially accounted for by the rate of formation of hydrogen chloride. In sulphur dioxide a direct comparison of rates is scarcely possible owing to the one-sidedness of the equilibrium.

The unimolecular replacement in sulphur dioxide[4],

$$\mathrm{CHPhMeCl} + \mathrm{I}^- = \mathrm{CHPhMeI} + \mathrm{Cl}^-,$$

is open to the same explanation, since styrene adds hydrogen iodide, which would be formed from the added iodide ions and the liberated hydrogen chloride. Several supposed rearrangements can be similarly re-interpreted.

We are thus able to group all these conductometric, polarimetric, kinetic and other observations under our general mechanism (customarily labelled *E*1) for unimolecular elimination reactions :

$$\left.\begin{array}{lll} >\mathrm{CH.CR_2.X} & \xrightarrow[\text{slow}]{} & >\mathrm{CH.}\overset{+}{\mathrm{C}}\mathrm{R_2} + \overset{-}{\mathrm{X}} \\ >\mathrm{CH.}\overset{+}{\mathrm{C}}\mathrm{R_2} & \xrightarrow[\text{fast}]{} & >\mathrm{C:CR_2} + \overset{+}{\mathrm{H}} \end{array}\right\} \quad . \ . \ (E1)$$

This mechanism assumes that the rate-determining stage is the ionization of the halide, and to this extent we support the inference drawn by previous investigators[2,3] to the effect that ionization is fundamentally involved. In our mechanism the instability of an alkyl cation containing a potential proton is made responsible for the production of olefin.

Experimental particulars and more extended applications of the *E*1 mechanism will be published in the *Journal of the Chemical Society*.

E. D. HUGHES.
C. K. INGOLD.
A. D. SCOTT.

University College,
London.
July 1.

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[1] Walden, *Ber.*, 35, 2029 (1902).
[2] Bergmann und Polanyi, *Naturwiss.*, 21, 378 (1933).
[3] Bodendorf und Bohme, *Annalen*, 516, 1 (1935).
[4] Ogg and Polanyi, *Trans. Faraday Soc.*, 31, 617 (1935).

Equilibria in Salt Systems with Deuterium Water

IN connexion with the letters of Bell[1], of Partington and Stratton[2] and with editorial notes[3], it is of interest to note the degree of activity in this field. As is justly stated in the second letter cited above, "measurements of dissociation pressures of salt hydrates are somewhat difficult". By way of illustration, whereas Perpérot and Schacherl[4] report a value for the dissociation pressure equilibrium at 25° of cupric sulphate penta- and tri-deuterates which is 36 per cent lower than the corresponding value for the ordinary hydrates, two of us in 1934 had found this pressure difference to be only 8 per cent. We shall therefore welcome the promised results of Partington and Stratton. We have studied pressure equilibria in this and other univariant salt deuterate systems with and without the liquid phase (saturated solution) present, over a range of temperature.

The solubility relations of salts in deuterium water seem to have received less attention[5]. A few results may perhaps be of interest. If, following "International Critical Tables", concentration is stated in terms of moles of anhydrous solute per 1,000 gm. (55·51 moles H_2O) in the case of ordinary water, for purposes of comparison we may state the number of moles of solute per 1111·7 gm. (55·51 moles D_2O) in the case of deuterium water. For potassium chloride on this basis, we find the solubility in deuterium water lower than that in ordinary water by about 7 per cent at 30°, 3·6 per cent at 100°, and 1·5 per cent at 180°.

In speaking of the solubility of deuterates and hydrates, we refer to solubilities in deuterium water and in ordinary water respectively. Cupric sulphate pentadeuterate is, at 10°, nearly 12 per cent less soluble than pentahydrate; but the difference in solubility falls to about 1·5 per cent near 96°, which is close to the transition temperatures of both salts to their tri-aquo forms. Strontium chloride hexahydrate passes to dihydrate at 61·3°, and the hexadeuterate to dideuterate about 56·5°. The graph of solubility of hexadeuterate against temperature lies lower in concentration than that of the hexahydrate at lower temperatures but crosses the hexahydrate curve about 10°; the dideuterate solubility curve crosses the hexahydrate curve about 60° and the dihydrate curve about 115°, both deuterate curves showing a faster change of solubility with temperature than the corresponding hydrate curves.

F. T. MILES.
R. W. SHEARMAN.
ALAN W. C. MENZIES.

Princeton University,
June 5.

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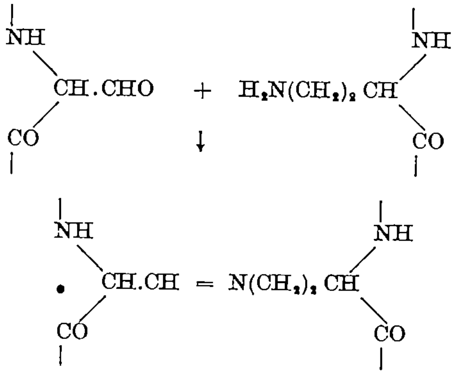
[1] NATURE, 137, 534 (1936).
[2] NATURE, 137, 707 (1936).
[3] NATURE, 137, 698 (1936).
[4] *J. Phys. et le Rad.*, vii, 6, 439 (1935).
[5] But cf. Taylor, Caley and Eyring, *J. Amer. Chem. Soc.*, 55, 4334 (1933).

Cross-Linkage Formation in Keratins

THE depilation of hides and skins prior to tannage[1], and the permanent setting of stretched hair and wool[2] are both important industrial processes considered to be governed by the development of resistant cross-linkages between the peptide chains of keratins. Speakman[2] has suggested that when stretched wool fibres are set in steam, the cross-linkages developed consist of –S–NH– groupings formed subsequent to the hydrolysis ($\mathrm{R.S.S.R.} \rightleftharpoons \mathrm{R.SH} + \mathrm{HOS.R}$) of the cystine disulphide cross-linkages; but it is admitted that other resistant linkages must be formed when cross-linking is attended by loss of sulphur.

A possible chemical mechanism, hitherto overlooked, for the production of such resistant linkages may arise by the auto-oxidation-reduction of the sulphenic acid side-chains produced by the hydrolysis of the cystine disulphide cross-linkages. Such decomposition of the sulphenic acid side-chains would yield hydrogen sulphide, and aldehyde groups ($>\mathrm{CH.CH_2.SOH} \rightarrow >\mathrm{CH.CHO} + \mathrm{H_2S}$) capable of linking-up with the amino-groups of adjacent peptide chains, for example, those of lysine.



That the sulphenic acid radical can decompose in this manner is indicated by the production, with the liberation of hydrogen sulphide, of glyoxylic acid from dithiodiglycollic acid, and of phenylglyoxylic acid from dithiodiphenylglyoxylic acid[3]. Keratin is also known to evolve hydrogen sulphide under the action of steam, and to lose 50 per cent of its sulphur when treated with sodium hydroxide[4].

On the assumption that the cystine disulphide cross-linkages must be severed before hair can be removed rapidly from hides, the above hypothesis explains why fresh lime liquors are not efficient depilators, unless they contain reducing agents, for example, sodium sulphide. These substances reduce the sulphenic acid side-chains to cysteine side-chains and thus prevent the generation of aldehyde groups. The unexpected ability of aliphatic primary amines[5] (especially methylamine) to facilitate depilation by fresh lime liquors (free from reducing agents) may also be due to the prevention of cross-linking, since these amines could condense with, and mask, the aldehyde groups arising by the sulphenic acid decomposition.

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[1] Marriott, *J. Int. Soc. Leather Trades Chemists*, 12, 216 (1928).
[2] Speakman, NATURE, 132, 930 (1933).
[3] Schöberl, *Annalen*, 507, 111 (1934); *Ber.*, 67B, 1545 (1934).
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Association and Dissociation Reactions of Thyroglobulin

FROM their ultracentrifugal studies on thyroglobulin, Heidelberger and Pedersen[1] found that solutions of this protein within its *p*H stability region[2] are fairly homogeneous (Fig. 1). The sedimentation picture shows, in addition to a predominating component consisting of molecules having a molecular weight of about 700,000, a small amount of heavier and lighter molecules with poorly defined sedimentation boundaries. These molecules were assumed to have been formed respectively by the dissociation and association of the molecules comprising the predominating component. It was noticed that on dilution the number of lower molecular weight molecules increased.

In the study of the stability of thyroglobulin being carried out by means of the ultracentrifuge, I have been able to confirm the previous work. I find, however, that this protein dissociates in dilute solutions provided a number of other conditions are fulfilled. Furthermore, I find that the same factors are concerned in the association of thyroglobulin into molecules of higher molecular weight. Finally, I conclude that the number and size of molecules present in a given solution of thyroglobulin may be defined by the following set of variables: protein concentration, salt concentration, temperature, dielectric constant, *p*H and the time the solution has been standing under a given set of conditions.

Those conditions which favour the dissociation of thyroglobulin are as follows: low protein concentration, low salt concentration, elevated temperature, high dielectric constant (glycine and urea were added to the thyroglobulin solutions in this set of experiments), a *p*H displaced from the isoelectric point (only values on the alkaline side, but still within its *p*H stability region, have been studied). These are the same conditions which favour the ionization of the protein.

On the other hand, those conditions which favour the association of thyroglobulin are the opposite or the same as those which minimize the ionization of the protein.

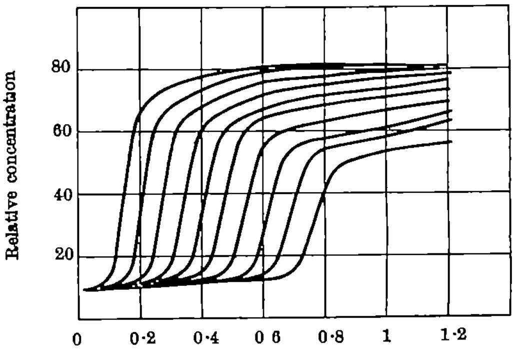

FIG. 1. Sedimentation diagram of thyroglobulin prepared essentially to reference 3.

When placed under the proper combination of conditions, thyroglobulin dissociates with a slow and measurable rate into a series of components of lower molecular weight having well-defined sedimentation boundaries (Fig. 2). I have been able to reverse the reaction, resynthesising the original molecule from the dissociated fragments. Moreover, under the proper conditions, thyroglobulin will associate in due course into higher molecular weight components having definite sedimentation boundaries.

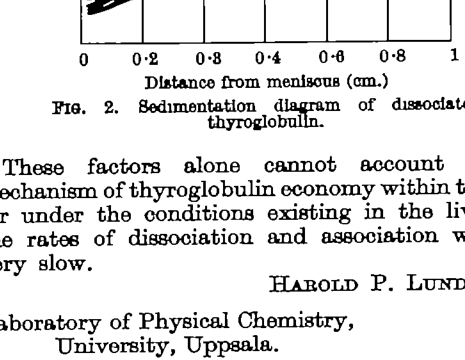

FIG. 2. Sedimentation diagram of dissociated thyroglobulin.

These factors alone cannot account for the mechanism of thyroglobulin economy within the body, for under the conditions existing in the living cell the rates of dissociation and association would be very slow.

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Raman Spectrum of Cyclopropane

THE Raman spectrum of cyclopropane is of great interest in view of the fact that it is the simplest of the cyclic hydrocarbons, and also from the point of view of the structure of the cyclopropane molecule. I have investigated this substance both in the liquid and vapour states and have obtained the following results:

Liquid	$\Delta\nu$ (cm.$^{-1}$)	736*	863	1185	1434	1503*	2852*	2952*	3010	3028	3080
	Int.	0*bd*	8*b*	15	2*b*	0*s*	½	1	10	10	6*bd*
	ϱ	*D*	*D*	*P*	*D*	*P*	*P*	*P*	*P*	*P*	*D*
Vapour	$\Delta\nu$ (cm.$^{-1}$)		863	1185					3010	3028	
	Int.		0*b*	2*s*					1*s*	2*s*	

b = broad; *d* = diffuse; *s* = sharp; *P* = polarised ($\varrho \ll 6/7$)
D = depolarised ($\varrho \approx 6/7$).

The frequencies marked with an asterisk in the case of the liquid have not been noticed by the previous investigators[1,2] and are reported here for the first time. The strongly polarised Raman line at 1185 cm.$^{-1}$ and the depolarised Raman line at 863 cm.$^{-1}$ presumably represent the totally symmetric and the deformation vibrations respectively of the triangular carbon ring which forms the nucleus of the cyclopropane molecule. However, for an equilateral triangular model, the doubly degenerate deformation frequency is forbidden in the Raman effect according to Placzek's selection rules. The fact that the Raman line at 863 cm.$^{-1}$ persists even in the vapour state clearly shows that its appearance in the liquid spectrum cannot be due to the influence of the neighbouring molecules. The influence of the hydrogen atoms on the vibrations of the carbon ring might be a possible explanation for the appearance of this line. The matter, however, requires mathematical investigation.

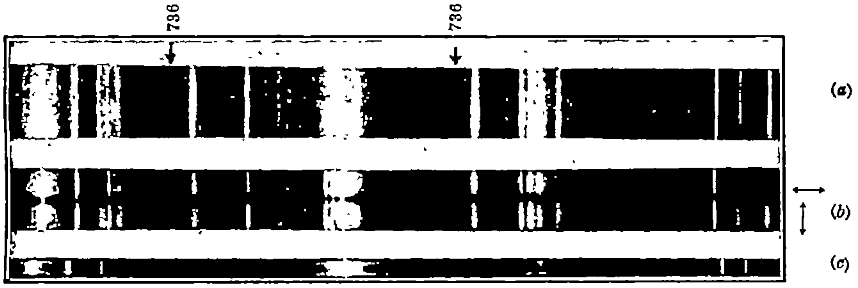

FIG. 1. Raman spectrum of cyclopropane; *a*, liquid; *b*, liquid (polarisation); *c*, vapour.

A striking difference between the liquid and the vapour spectra is noticed when we compare the Raman lines at 3010 cm.$^{-1}$ and 3028 cm.$^{-1}$. In the liquid picture, these two lines are of equal intensity or perhaps $\Delta\nu = 3010$ cm.$^{-1}$ is slightly more intense than $\Delta\nu = 3028$ cm.$^{-1}$. The intensity of either of these is less than that of the Raman line at 1185 cm.$^{-1}$. In the vapour picture $\Delta\nu = 3010$ cm.$^{-1}$ is found to have become considerably weaker, while $\Delta\nu = 3028$ cm.$^{-1}$ has gained in intensity and is almost as strong as Raman line 1185 cm.$^{-1}$ Such a strong difference between the relative intensities of the Raman lines between vapour and liquid in the case of a non-polar molecule is remarkable, and evidently requires further elucidation.

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Electronic Specific Heat in Palladium

KEESOM and Clark[1] have shown that the atomic heat of nickel at low temperatures contains a linear term 0·0019 T, which is many times bigger than the contribution from the free electrons to be expected from the Sommerfeld theory. Mott[2] has suggested that this term is due to the unfilled quantum states (positive holes) in the d-shell of nickel, and that a similar term should occur for the other transition metals, whether ferromagnetic or paramagnetic.

In order to test this theory and to make more quantitative data available on the subject, the specific heat of palladium was determined, palladium being chosen on account of its similarity to nickel and its high paramagnetism, which according to Mott should imply a large electronic specific heat. Though the electronic component in these transition metals is larger than usual, it is nevertheless small in absolute magnitude. But since it varies proportionally with the temperature, whereas the specific heat due to the lattice vibrations varies near the absolute zero with the cube of the temperature, the two become comparable in magnitude at sufficiently low temperatures[3]. Experiments were therefore carried out in the liquid helium region.

The specific heat of a block of metallic palladium (weighing 25 gm.) kindly put at our disposal by Prof. Mott was measured between 2·5° K. and 22° K. in a vacuum calorimeter enclosed in a helium liquefier using the Simon expansion method. The sample was contained in a small copper calorimeter on which were wound heating and thermometer coils of eureka wire, thermal contact between the calorimeter and the palladium being effected by the use of helium gas at a low pressure.

The results showed that the atomic heat of palladium in the region 2·5°–22° K. could be expressed in the form

$$C = 0{\cdot}0000224\ T^3 + 0{\cdot}0031\ T \text{ cal./degree.}$$

The first term represents the component due to the lattice vibrations and corresponds to a Debye characteristic temperature of $\theta = 275°$, while the second term represents the specific heat of the free electrons or positive holes. At 2·5° K. the linear term is about twenty times as great as the T^3 term, while the two terms become of equal magnitude at about 12° K. The value of the electronic specific heat is, as predicted by Mott, much higher than for normal metals, and is even greater than that of nickel. The above result is considered from the theoretical point of view in a book on metals by N. F. Mott and H. Jones, to appear shortly.

I should like to thank Prof. F. Simon and Dr. N. Kürti for their advice and assistance in carrying out this determination.

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Transparency of Sodium and Potassium Films in the Schumann Region

THE remarkable transparency of alkali metal films reported by R. W. Wood[1] is of considerable interest, on one hand in relation to the theory of electrons in metals and on the other in relation to spectroscopic technique, for these films are unique as filters[2].

We have recently succeeded in depositing transparent films of sodium and potassium on fluorite cooled to liquid air temperature before the slit of a vacuum spectrograph. Photographs of the spectrum of the transmitted light establish that not only does sodium transmit from 2100 A. to 1860 A., as observed by Wood, but also that it transmits through the entire Schumann region to 1250 A. (limit of fluorite). Experiments made with different film thicknesses indicate that there is some absorption in the neighbourhood of 1250–1400 A., and it seems reasonable to anticipate that the transparency of sodium does not extend very far beyond 10 volts. For potassium films (which transmit wave-lengths less than 3150 A.) there is no observable transmission beyond 1400 A., while there is evidence of weak absorption extending to between 1700 A. and 1800 A. Examples of the spectra are shown in Fig. 1.

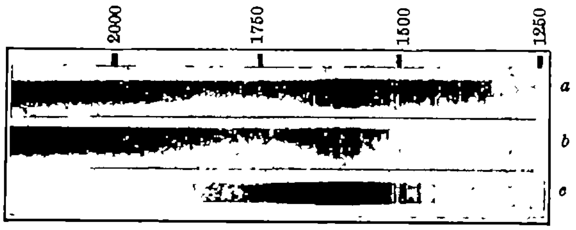

FIG. 1. Transmission of fluorite (*a*) without metal film, (*b*) with potassium film, (*c*) with sodium film.

A sodium film on fluorite is therefore an ideal filter to remove all visible and ultra-violet light of wave-length greater than 2100 A. and to pass the entire Schumann region. A full account of our experiments will be published later, but it is appropriate now to indicate the conflict of the experimental results with the existing theory of the optical properties of metals[3]. According to Wilson's formulæ,

(i) for body-centred cubic lattices the absorption bands overlap and there is no transparency;

(ii) there is a *sharp* rise in the absorption at the low frequency end of an absorption band and slow decrease at the high frequency end.

Both of these conclusions are at variance with the experiments, so the theory cannot be applied in its present form to describe the optical properties of the alkali metals, which ought to afford the most favourable case for the quasi-free-electron model.

One of us (D. G. H.) is indebted to the National Research Council of Canada for scholarships to carry out this work.

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High Potassium Diet and the Survival of Adrenalectomized Rats

WHILE investigating the factors influencing the length of survival of rats after adrenalectomy, we found[1] that rats receiving liberal quantities of bread as a supplement to their usual diet lived many times longer than the controls fed on the stock ration alone. That this was only partly due to the high sodium chloride content of the bread (8 per cent by dry weight) seemed evident from the still markedly prolonged survival of rats receiving bread with a sodium chloride content as low as the stock diet, namely, 1 per cent. This diet, containing cereals, meat, molasses and vitamins (Purina Dog Chow), was taken well by unoperated animals. After adrenalectomy, however, the rats soon manifested an almost complete anorexia for the Purina, but those with access to bread in addition ate this well almost until the time of death. Consequently, these animals ingested more sodium chloride and a greater number of calories than the rats on Purina alone—facts favouring survival.

In explanation of the preference shown by the rats for bread, we suggested that this being a low residue food did not impair the characteristically diminished appetite of the adrenalectomized rat as did the high residue Purina. The fact that bread is a high carbohydrate food we emphasized as important in view of the well-known breakdown in carbohydrate metabolism in adrenal insufficiency.

Recent work of Zwemer and Truszkowski[2] and also Allers, Nilson and Kendall[3] appears to be of importance in the interpretation of our results. These workers have shown that a high potassium intake is detrimental to the life of adrenalectomized animals. In view of this finding, we have analyzed our diet and found the potassium content of the Purina to be 0·46 grams per cent, while that of the make of bread chiefly used was but 0·135 grams per cent. This result indicates that the low potassium content of the bread may have been a factor favouring survival in our rats so fed. Experiments are in progress to determine the relative importance of these factors.

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[1] R. A. Cleghorn, S. M. M. Cleghorn, M. G. Forster and G. A. McVicar, *J. Physiol.*, 86, 229 (1936).
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Humidity and Insect Metabolism

ENTOMOLOGISTS have suggested that certain insects may show a greater rate of metabolism in dry air than in moist at the same temperature. They believe that such increased metabolism should cause a greater production of metabolic water, to compensate for evaporation from the insect's body, and maintain a constant ratio of water to dry matter at different atmospheric humidities. This increase in metabolic rate is assumed to occur in resting insects which are not moving actively. Buxton[1] obtained results which indicated that, at 23° C., the mealworm used up its reserves more rapidly in dry air than in moist, and kept the ratio of water to dry matter constant. As the body composition of mealworms is so variable, and as these results were obtained from rather small numbers, it appeared advisable to make further experiments before finally accepting a conclusion of such general physiological importance.

Numerous experiments were made, in which large numbers of individual mealworms were subjected to various humidities at temperatures ranging from 8° to 37° C.[3] Analyses after intervals of from 14 to 35 days showed that the rate at which the reserves were utilized was governed by temperature alone. For example, batches of these insects consumed reserves equal to 19 per cent of their dry weight in 35 days, when exposed to humidities of either 0 or 60 per cent at 24° C. I also made daily estimations of the amount of carbon dioxide produced by mealworms at different temperatures and humidities, and found that the rate of respiration appeared to be governed by temperature alone, and unaffected by changing humidity.

Experiments with other insects, including bed-bugs[4], clothes-moths[5] and adult[6] and pupal[2] tsetse flies all show that with them the rate of metabolism is governed by temperature, and unaffected by changes in humidity.

In the light of present knowledge, it is difficult to see how an increase in the rate of metabolism *could* help an insect to withstand desiccating conditions. True, it would produce more water of metabolism, but this would mean an increase in the rate of respiration (to obtain the extra oxygen) and consequently the spiracles would be opened more frequently. This would allow more water to be evaporated[7]. For every molecule of metabolic water produced, at least one molecule of oxygen must be taken in, and under dry conditions more water is lost by the evaporation which accompanies respiration than is gained by metabolism. This has been shown by analyzing insects which have been subjected to low humidities, and by the fact that many insects are more susceptible to desiccation at high temperatures (where metabolism *is* actually increased) than at low temperatures.

With an actively moving insect, an unfavourably low humidity may perhaps cause great activity, and a consequent increase in the metabolic rate; but this will hinder, rather than help in withstanding desiccation. With resting insects such as fasting mealworms, a lowering of the humidity does not increase the rate of metabolism; if the metabolic rate were increased, it would not be of any advantage.

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Organizers in Mammalian Development

EMBRYONIC organizers, discovered in the Amphibia by Spemann[1], have since been found also in birds (Waddington[2]) and fish (Luther, Oppenheimer[3]). It seems probable that embryonic determination is brought about in the same way in all groups of vertebrates, and rather similar conditions have been found in some invertebrates. Previous work on mammalian embryos has, however, produced very little definite evidence in support of this suggestion. The occurrence of identical twins shows that regulation is possible in very early stages (see Nicholas[4]), while several authors have described apparently mosaic development of parts isolated from early somite, or later, stages.

The only available fact concerning the actual process of determination in mammalian embryos is that the ectoderm of the rabbit embryo in the primitive streak stage can be induced, by a chick organizer, to form neural tissue (Waddington[5], working with the tissue culture technique[6]). Attempts to obtain inductions by transplanting pieces of the rabbit primitive streak into other rabbit embryos have so far been unsuccessful, although the grafts differentiate into neural tissue and (probably somitic) mesoderm; small amounts of neural tissue have been found in grafts which did not include the anterior end of the primitive streak, the rabbit behaving in this respect exactly as does the chick.

Grafts may also be made from the rabbit into the chick, and the grafted tissues differentiate (Waddington and Waterman[6]). Until recently, no inductions were observed in these grafts, but this long-expected result has now occurred; in a specimen, No. 36—9ORC, the anterior part of the embryonic axis of a two somite rabbit has induced a small but definite neural plate in the host chick. This shows that the rabbit contains an organization centre, and, taken with the fact mentioned above that the rabbit ectoderm is competent to react to a chick organizer, scarcely leaves room for doubt that the determination of the mammalian embryo during normal development is in fact produced by an organization centre.

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and Department of
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Cambridge. June 30.

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Metabolism of Cartilage

THE recent letter of Bywaters[1] on this subject prompts us to describe some observations made independently in the course of a study of normal mammalian tissues showing an anærobic type of metabolism. Following our investigation of the metabolism of the medulla of kidney[2], a tissue recognized as having a poor capillary supply, we were led to study cartilage because this is an entirely non-vascularized tissue, and here we found the same association of anærobic type of metabolism and poor oxygen supply as in medulla of kidney.

Our experiments were done with thinly sliced rib cartilage of the rat, suspended in a bicarbonate-saline medium. Concentration of glucose: 0·2 per cent.

Material	Respiration	Ærobic glycolysis	Anærobic glycolysis
	Q_{O_2}	$Q_G^{O_2}$	$Q_G^{N_2}$
Costal cartilage			
Specimen I	− 0·68	+ 1·22	+ 1·36
Specimen II	− 0 22	+ 1·27	+ 1·85
Xiphisternum	—	—	+ 0·90

These figures are much higher than those obtained by Bywaters for the rabbit; in particular, the respiration though small is easily measurable. Comparing the ratios of respiration, ærobic and anærobic glycolysis, we find roughly the same relationship for medulla of kidney, cartilage and tumours.

Approximate ratio	$Q_{O_2} : Q_G^{O_2} : Q_G^{N_2}$
Medulla of kidney	1 : 2 : 4
Cartilage	1 : 3 : 4
Tumours	1 : 2 : 4

Thus cartilage gives further support to the view previously expressed[2] that the metabolic type depends on the relationship between oxygen supply and energy requirements of the tissue.

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North of England Council of the
British Empire Cancer Campaign,
Royal Victoria Infirmary,
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Optical Polarization Ellipsoids of the Hydrogen Halide Gases

ESTIMATES of polarization and related constants of the four hydrogen halides[1] appear to reveal certain peculiar, though simple relations. If α is the mean optical polarizability of a halide HX, b_1, b_2 respectively that along and perpendicular to the internuclear axis of symmetry S, r_e the equilibrium internuclear distance of HX, and $\alpha(X)$ the polarisability of the negative ion X^-, I find that (1) $\alpha = 1{\cdot}242 r_e^3$ [2,3] and, further, if (2) $b_1 \propto r_e^3$, then since $3\alpha = b_1 + 2b_2$, (2a) $b_2 \propto r_e^3$, (2b) $b_1 \propto b_2$, and (2c) $b_1 = \alpha(X)$ (Born and Heisenberg[4]).

Stuart[5], arguing from the positive sign of the constant occurring in the electro-optical Kerr effect of hydrogen chloride, found that the direction of greatest polarisability b_1 coincided with the axis S, along which the permanent dipole also lies. If we take[1] $\alpha(\text{HCl}) = 2{\cdot}56$, and[5] $(b_1 - b_2)_{\text{HCl}} = 0{\cdot}77 \times 10^{-24}$ c.c., it follows that b_1, b_2 are $3{\cdot}07$ and $2{\cdot}30 \times 10^{-24}$ c.c. respectively. Using the above assumption (2), the corresponding values for the other halides may be calculated, as in the following scheme.

HX	b_1, b_2, $\frac{1}{3}(b_1+2b_2)$ (in c.c. $\times 10^{24}$)			α(HX) (expt.[1])	α(X) [4]	r_e
HF	0·96	0·72	0·82	0·80	0·99	0·864A.
HCl	3·07	2·30	2·56	2·56	3·05	1·272
HBr	4·19	3·14	3·49	3·49	4·17	1·411
HI	6·24	4·68	5·20	5·18	6·28	1·612

The anisotropy δ is connected with the depolarization factor Δ (ratio of light intensity scattered parallel and at right angles to direction of incident beam) for gas molecules having an axis of symmetry, as follows :

$$\delta^2 = \frac{5\ \Delta}{6 - 7\ \Delta} = \left(\frac{b_1 - b_2}{b_1 + 2b_2}\right)^2 = \frac{1}{9}\left(\frac{b_1 - b_2}{\alpha}\right)^2,$$

so that we have $\delta^2 = 0{\cdot}01007$, $\delta = 0{\cdot}1004$ and $\Delta = 0{\cdot}0119$ for each of the four cases. (Stuart[5] found $\Delta(\text{HCl}) = 0{\cdot}0125$, giving $b_1 = 3{\cdot}01$, $b_2 = 2{\cdot}24 \times 10^{-24}$ c.c.)

If we may take $\delta = 0{\cdot}1$, we have $10(b_1 - b_2) = b_1 + 2b_2$, whence $b_2/b_1 = 0{\cdot}75$, $b_1 = 1{\cdot}2\alpha = 1{\cdot}490 r_e^3$, $b_2 = 0{\cdot}9\alpha = 1{\cdot}117 r_e^3$, and $b_1 - b_2 = 0{\cdot}3\alpha$.

On the present basis of argument, therefore, I conclude that (1) the four hydrogen halides have equal optical anisotropies, (2) the optical polarization ellipsoids constitute similar solid figures, (3) b_2 is approximately equal to 75 per cent of b_1, and (4) b_1 of HX is equal to the polarizability of the halogen ion X^-, a somewhat surprising result. Dispersion of refractive index is neglected in making the estimates.

Further work on the depolarization and Kerr effects of the hydrogen halides other than hydrogen chloride is desirable to confirm these predictions.

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June 3.

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[5] H. A. Stuart, *Z. Phys.*, 55, 358 (1929).

Focal Depth of the Hawke's Bay Earthquake of February 2–3, 1931

IN the seismological report of the Hawke's Bay earthquake of February 2–3, 1931[1], an attempt was made to arrive at a value for the focal depth of the shock. The method used was similar to that developed by Jeffreys[2] for near earthquakes in western Europe, depending on the apparent delay of the surface wave *Pg*. In the Hawke's Bay earthquake, a phase agreeing reasonably well in velocity with *Pg* was observed on the seismograms at Arapuni, Takaka and Wellington, and the mean apparent delay led to a focal depth of 13 miles (21 km.). On account of the confused nature of the Wellington and Arapuni records, and the lack of precise time on most of the records, it was considered that a definite value for the depth could not be obtained, but that it probably lay between 10 miles and 15 miles (16–24 km.). In the original interpretation of the Takaka record, the first phase recorded after *Pn* was considered to be *P**, and the interval between *Pn* and *Pg* was 28 seconds.

In a recent paper[3], C. G. Dahm, of Saint Louis, U.S.A., had occasion to discuss the focal depth of the Hawke's Bay earthquake, using data from the Takaka seismogram. He found an interval of 7·5 sec. between what he considered to be the phases *Pn* and $\overline{P}$, and states that this agrees with a focal depth of 10 km. (6 miles). Dahm points out that the Takaka data are not conclusive, and after some further considerations, finally arrives at a focal depth of the order of 10–12 km. (6–8 miles).

Having rightly directed attention to the difference between his own value for the depth and that given in the Hawke's Bay earthquake report, Dahm criticises this report, considering that the methods used appear to be based on doubtful assumptions. In view of this criticism, I re-examined the original Takaka seismogram. On both horizontal components the first movement (presumably *Pn*) is very small and emergent, and the interval before the arrival of the second phase was found to be 8 sec. on the E–W component, and 11 sec. on the N–S component. This discrepancy of 3 sec. may be due to the arrival of *Pn* not having been recorded on the E–W component. On the vertical component, *Pn* is very small, but the interval to the next phase was observed to be about 10 sec. The mean interval between *Pn* and the next phase at Takaka therefore appears to have been of the order of 10 sec. No phase could be found to correspond with an interval of 7·5 sec., as read by Dahm, and if it is assumed that the second phase is *P*, then a focal depth somewhat greater than 10 km. is indicated. This would tend to diminish the discrepancy between Dahm's determination of the focal depth, and that given in the Hawke's Bay earthquake report.

It should be mentioned that the re-examination of the Takaka seismogram did not appear to warrant any serious alterations to the original interpretation from which the focal depth of 10–15 miles (16–24 km.) was determined. Further, although Jeffreys' theory regarding the waves in near earthquakes has been somewhat modified in a more recent paper[4], the apparent delay of the *Pg* wave would still lead to a determination of focal depth.

From the foregoing statements, it is considered that Dahm's interpretation of the Takaka seismogram is open to question, and that his criticism of the Hawke's Bay earthquake report is not justified.

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April 24.

[1] C. E. Adams, M. A. F. Barnett and R. C. Hayes, Seismological Report of the Hawke's Bay Earthquake of 1931, February 2–3. Dominion Observatory Bulletin 85.

[2] H. Jeffreys, "The Earth". 2nd Edition.

[3] Cornelius G. Dahm, "The Velocity of *P* waves in the Earth Calculated from the Macelwane *P* curve, 1933", *Bull. Seis. Soc. America*, 26, 1 (1936).

[4] H. Jeffreys, "A Rediscussion of Some Near Earthquakes", *Geophys. Supp., Mon. Not. Roy. Ast. Soc.*, 3, No. 3, March 1933.

Continuous Spectra of Certain Types of Stars and Nebulæ

MR. W. M. H. GREAVES[1] has made certain objections to my tentative explanation of secondary maxima in the continuous spectra of novæ, etc.[2], because the observations of Nova Herculis 1934 made by various observers do not fully agree.

I should like to point out that a close inspection of the curves given by Beileke and Hachenberg[3] discloses, however, the presence of a secondary maximum in most curves at practically the same wave-length as observed by Barbier, Chalonge and Vasy[4] and reproduced in my note. The results of the unpublished Greenwich observations are, of course, unknown here.

However, leaving aside the Nova Herculis 1934 spectrum, we find, in the spectra of several former novæ, the presence of secondary maxima upon which I based my theory of two different types of continuous emission spectra in novæ, etc., superimposed on each other. Whether or not one of these emissions is continuous electron radiation is an open question. I only wish to direct attention to this type of emission, the existence of which does not seem to be generally realized. This type of spectra is quite different from the Planck black body radiation on which most astrophysical theories are based. I believe that the continuous electron emission will help in explaining several phenomena observed which have not been accounted for so far.

WILLI M. COHN.

Berkeley, California.
May 26.

[1] W. M. H. Greaves, NATURE, 137, 405 (1936).

[2] W. M. Cohn, NATURE, 137, 150 (1936).

[3] F. Beileke and O. Hachenberg, *Z. Astrophys.*, 10, 366 (1935).

[4] D. Barbier, D. Chalonge, É. Vasy, *C.R.*, 201, 128 (1935).

The Teaching of Science in Schools

AN account of a conference on general science opened by the president of the Royal Society appeared in NATURE of April 11, p. 626. This association of prominent men of science with secondary education is very desirable. I write to suggest that the present is a very critical time for science teaching in schools, and that men of science may now be able to give help in a more effective way than by presiding at meetings and conferences.

Such help has been given in the past. In 1918 a committee of which Sir J. J. Thomson was chairman issued a report on the teaching of science and made many valuable suggestions. A few of these have been carried out, but only a few; in the meantime, conditions have altered, and the whole question needs reconsideration. The recent conference represents a belated attempt to implement recommendation No. 17 of that report:

"That the science work for pupils under 16 should include, besides physics and chemistry, some study of plant and animal life."

To do this in the limited time at the teacher's disposal presents difficulties, but this recommendation must necessarily be read in conjunction with recommendation No. 8:

"That in all secondary schools for boys the time given to science should not be less than 4 periods in the first year of the course from 12 to 16, and not less than 6 periods in the three ensuing years."

This was published nearly twenty years ago, when the great necessity was to obtain for science some sort of recognition in our educational system. It would be expected that what was recommended then would be axiomatic now. Surprising as it may appear, the very body which was partly responsible for this recent conference expressed the intention of trying to formulate a generalized course in chemistry, physics and biology to occupy only 4 periods a week; that is, 3 hours or a little less.

If this proposal comes into being, we shall be back again in pre-scientific times. If I read the recommendation of the Thomson committee aright, it did not maintain that the 6 periods a week was an adequate time, but merely that it was as much as many schools under present conditions could be expected to give. A considerable number of schools have now approximately that time. There is a danger that the publicity which has been given to a particular sub-committee may lead to reduction of this inadequate minimum of time which many science teachers already have.

The whole problem of the school time-table is now in hopeless confusion. No attempt is being made, for example, to correlate the mathematics and the science in the manner suggested by the Thomson committee. Teachers of mathematics and science scrupulously respect each others' territory. The dominant influence is that of a group of headmasters who wish to keep the classical bias of the time-table, and this is probably the origin of the proposal to formulate a scheme for 4 periods a week, a proposal which was originally suggested by the Secondary Schools Examination Council. The time is ripe for another committee, similar to the old Thomson committee, to reconsider the whole question in the light of the conditions of the present day.

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Teddington.

Estimation of Vitamin A

WITH further reference to our letter under this title in NATURE of March 7, p. 402, we have been in touch with Dr. E. M. Nelson, chief of the Vitamin Division, United States Department of Agriculture, Food and Drug Administration, Washington, concerning the ambiguous position of the U.S. Pharmacopœia Reference Cod Liver Oil. Our query was, Are we sure that the "Reference Oil" now in use is identical with the original product ? In reply to our question he has given us permission to publish the following facts, which undoubtedly throw some light on a rather difficult situation :

"There has been only one lot of this reference oil prepared and the samples that have been issued were all bottled at the same time from this lot. Since the potency of 3000 units of vitamin A and 95 units of vitamin D were assigned to this oil, assays have been made at intervals by six laboratories for both its vitamin A and vitamin D content. There has been no indication that the oil has changed in vitamin potency. As soon as the oil was obtained samples were sent to Dr. Charles E. Bills of Mead Johnson and Co., for spectrophotometric determination of vitamin A. He has made several such examinations since that time. His last report was made to the U.S. Pharmacopœia Vitamin Committee on March 24, at which time he stated that as far as can be determined spectrophotometrically the oil has not changed in vitamin A potency."

JOHN F. WARD.
R. T. M. HAINES.

Crookes Laboratories,
London, N.W.10.
June 12.

Points from Foregoing Letters

THE atomic masses of doubly charged thorium 232, and of uranium 238, have been determined by Prof. A. J. Dempster with the mass-spectrograph, by comparison with the isotopes 116 and 119 of tin (having the same mass-charge ratio). The presence of 0·4 per cent of a stable uranium isotope of mass 235 was also found, and since a radioactive uranium isotope of mass 235 and of half-life 24 hours is already known, Prof. Dempster concludes that the two isotopes, having the same mass and charge, are isomers differing in nuclear properties.

Some previous observations of the conductivity, unimolecular racemization and halogen replacements of alkyl halides in sulphur dioxide and formic acid solution are interpreted by Dr. E. D. Hughes, Prof. C. K. Ingold and A. D. Scott as arising from the slow liberation of a negative halogen ion (Cl^-) followed by the rapid elimination of a positive hydrogen ion (H^+). The original saturated compound thus becomes unsaturated, as is shown by its subsequent ability to absorb bromine.

A possible chemical mechanism to explain how the addition of sodium sulphide or of certain primary amines helps the removal of hair from hides by fresh lime liquors is suggested by Dr. H. Phillips. These substances reduce the sulphenic acid side-chains to cysteine, and thus prevent the generation of aldehyde groups ; this facilitates the severing of the cystine disulphide cross-linkages of the keratin substance.

From the rate of sedimentation of solutions of thyroglobulin (the active constituent of the thyroid gland) under the influence of strong centrifugal forces, Dr. H. P. Lundgren concludes that it consists mainly of particles of 'molecular' weight 700,000. Low concentration of thyroglobulin or of salts, high temperature, high dielectric constant and *p*H above the isoelectric point have been found to favour the dissociation of thyroglobulin into components of lower particle weight.

The atomic heat of palladium between 2·5° and 22° K. has been determined by G. L. Pickard. He finds, in agreement with Mott's views, that it can be expressed as the sum of two factors, one due to lattice vibrations, which varies with the cube of the temperature, and another, the electronic specific heat, varying directly with the temperature and due to unfilled quantum states (positive holes).

The transparency of thin films of sodium and potassium in the far ultra-violet (Schumann region) has been determined by Prof. W. H. Watson and D. G. Hurst. They point out the value of sodium films as filters to remove the visible and ultra-violet light above 2100 A., and direct attention to the conflict between experimental results and the existing theory of the optical properties of metals.

Rats from which the adrenal body has been removed live longer if fed on bread than when fed on Purina Dog Chow. Dr. R. A. Cleghorn and G. A. McVicar suggest that this is due to the lower potassium content of the bread, since it has been shown that potassium is detrimental to adrenalectomized animals.

By grafting on to chick embryo the anterior part of the embryonic axis of a two somite rabbit, a small but definite neural plate was induced in the host. This, C. H. Waddington states, shows that the rabbit contains an organization centre, and is additional proof that determination of the mammalian embryo is in fact produced by an organization centre.

Dr. C. H. Douglas Clark finds that the optical polarization ellipsoids of the four hydrogen halide gases constitute similar figures having equal anisotropies and depolarization factors. He calculates the polarizabilities for the four cases, and finds that the polarizability at right angles to the internuclear line is about 75 per cent of that along this line, and is equal to the polarizability of the corresponding negative ion.

In view of the divergence in the interpretation of the seismograms of the Hawke's Bay earthquake of 1931 and the calculations of the focal depth therefrom, R. C. Hayes has re-examined the original Takaka seismogram. Its record, he states, confirms in the main the original interpretation, from which a focal depth of 16–24 km. was inferred.

Referring to the note in this column (July 11, p. 81) on "Inactivation of Crystalline Pepsin", Dr. J. Steinhardt states that the fifth-power relation reported in his communication does not extend over the small interval *p*H 6·2–6·45, but from the most acid solutions measured to *p*H 6·45. The velocity interval was over 1 to 5,000, while the smaller interval given in the synopsis is equivalent only to a range of about 1 to 15.

Research Items

Actions of Acetylcholine on the Brain

THE pharmacological actions of acetylcholine are of particular interest because, in almost every case in which this substance has been shown to have an action in the body, evidence has been obtained of the presence of a nerve which liberates acetylcholine locally in such a way as to produce this action. Henderson and Wilson have recently filled an important gap in our knowledge of the actions of this substance (*Quart. J. Exp. Physiol.*, 26, 83 ; 1936). They have injected acetylcholine into the ventricles of the brain in man. This causes vomiting, intestinal peristalsis and sweating. Its effects on the heart rate, blood pressure, respiration, the pupil, etc., were small and inconstant. The injection of eserine caused similar effects, and potentiated the effect of a later injection of acetylcholine. These effects were produced by comparatively small doses, and it is clear that they were due to a local action on the brain and not to a general action after absorption into the general circulation. Atropine, injected into the ventricles, prevented or abolished the effect. Apart from the interest of the observations themselves, these results are important because they suggest that certain impulses may be transmitted chemically by acetylcholine across synapses in the central nervous system.

Flour Beetles of the Genus *Tribolium*

THE small beetles of this genus are of great economic importance since they are able to subsist on a wide variety of food materials, and have become widely distributed through commerce. The ease with which they can be reared under controlled environmental conditions has also marked them out as very suitable material for population studies and other kinds of laboratory investigation. In Technical Bulletin No. 498 (March 1936) of the United States Department of Agriculture, Mr. Newell E. Good has brought together a mass of useful information respecting the biology, habits and control of the species of *Tribolium*, together with a selected bibliography of the genus. Keys are given as an aid to the identification of the economically important species, which are also admirably figured. Although primarily written from the economic point of view, the Bulletin will prove useful to laboratory workers also. In the latter connexion, the tabular data respecting development at specified temperatures and on oviposition and longevity may be specially mentioned.

Spotted Wilt Virus and the Hormone Heteroauxin

WE have received a communication from Dr. B. J. Grieve, of the Department of Botany, University of Melbourne, in which he describes the results of his investigations into the action of the spotted wilt virus upon the growth regulator heteroauxin. It is well known that spotted wilt arrests the growth of infected tomatoes, and it seemed likely that the virus inactivated the growth hormones in these plants. The technique of Went was first used to compare the effects of diseased and healthy juice upon the inward curvature induced by heteroauxin on split pea stems. In four experiments, such curvatures were observed upon the stems placed in healthy juice with heteroauxin, but were absent from those treated with virus juice and the hormone. This seemed to show an inactivation of the growth regulator by the virus, but a further number of similar experiments did not indicate any difference between the two kinds of treatment. Another and more conclusive method of study involved the injection of various amounts of heteroauxin into healthy, and into diseased, tomato plants. Adventitious roots appeared upon the stem in the majority of healthy plants, but did not form upon diseased tomatoes, unless the plant appeared to have thrown off the disease. The inhibitory action of spotted wilt virus on heteroauxin is not shared by two other viruses which were used, namely, tobacco viruses 1 and 6.

X-Chromosome of *Drosophila*

THE *X*-chromosome of *Drosophila melanogaster* and *D. simulans* contains near the end an enlargement or 'bulb' in the salivary gland chromosome, the nature of which has been investigated by Dr. C. A. Offermann (*J. Genetics*, 32, 103). He finds that the bands run obliquely in two series in the 'bulb', and that it represents a symmetrical duplication or 'branch' of a short chromosome segment. This might arise through three breaks and two re-attachments in a pair of chromosomes, or by five breaks and three re-attachments. In either case, one of the breaks must occur at the same level in both chromatid strands. As the 'bulb' occurs in two closely related species, it must have arisen in their common ancestor and must therefore be a stable feature of the chromosome. This is accounted for by the fact that crossing-over can occur between the two arms of the duplication, the bands of which are in reverse order. The less condensed appearance of the 'bulb' in salivary chromosomes of the male than in the female is attributed to a lesser synaptic attraction between the chromonemata in the male nuclei.

Strength Tests of Structural Timbers

UNDER this title in *Forest Products Research Records*, No. 8, Part I dealt with general principles, with data on redwood from Gefle and Archangel. Part 2 of the same series (April 1936) deals with general procedure of selecting and testing joists, with data on British Columbian Douglas fir (*Pseudotsuga Douglasii*) by C. J. Chaplin and E. H. Nevard. The tests were carried out with small clear specimens and also on a full scale : the results are of considerable interest. In summarizing them, the Director of the Princes Risborough Laboratory says that "A comparison between the results given in this report and those published by the Forest Products Laboratories of Canada may show an apparent discrepancy in the strength values. This is due to difference in the relation between width and depth of cross-section of the pieces tested and to differences in character which may occur between samples of the timber. Such differences in character must be expected where a wide range of the timber is dealt with in the country of origin. The Forest Products Research Laboratory at Princes Risborough accepts completely the validity of the Canadian figures, and urges their use in all circumstances concerning the strength of Canadian Douglas fir. The same applies to results published by the Forest Products Laboratory at Madison, U.S.A., for Douglas fir grown in that country."

Experiments with 'Electrets'

A COMMUNICATION entitled "The Disengagement of Energy in Melting Electrets" has been received from Drs. G. Groetzinger and H. Frei, of the University of Vienna. An 'electret' is produced by solidifying certain types of wax, for example, carnauba wax, in a strong electric field. The wax thereby acquires a polarization, in the direction of this applied field, which may be retained unimpaired over very long periods of time. It may be said to be the electrical equivalent of the permanent magnet. A paper by A. Gemant, published in the *Phil. Mag.* (20, 929; 1935) describes much research work on the subject, with a bibliography of earlier papers. Drs. Groetzinger and Frei state that, when an electret is melted, the stored charge is released as an electric current, and that this charge is the same whether the electret is melted immediately or several days after its preparation. This, however, is to be expected, since it is known that electrets can retain their original charge for a considerable period. The authors also record that, when the electric field is applied to an already solid sample of the electret material, the stored charge is much less than before, and instead of being retained, as in the normally produced electret, it disappears fairly rapidly. This is quite a normal procedure, and the experimental result is what would naturally be expected.

Transmutation of Platinum by Deuterons

TRANSMUTATION by bombardment with artificially accelerated deuterons, which is nearly general among the light elements, has now been observed with very heavy elements. J. M. Cork and E. O. Lawrence (*Phys. Rev.*, 49, 788, June 1) have bombarded platinum foils with deuterons of maximum energy 5×10^6 volts. The induced radioactivity was composite in character; periods of 28 min., 8·5 hr., 49 min., 14·5 hr. were detected, and a chemical investigation showed that the first two periods were associated with iridium and the second two with platinum. Both positrons and electrons were emitted. The transmutation of such heavy elements is not to be explained on the Gurney-Condon-Gamow theory of the penetration of potential barriers, and the formation of iridium isotopes is not explained by the theory of Oppenheimer and Phillips, in which only the neutron part of the deuteron enters the nucleus. The direct action of secondary neutrons was excluded by a special experiment. The production of iridium isotopes probably follows the entry of deuterons of special velocities into the nucleus by a 'resonance' process, and the dependence of transmutation efficiency on deuteron velocity is in accordance with this view.

Velocity of Rapid Reactions

SOME years ago, Hartridge and Roughton devised a method for the study of rapid reactions in which two solutions were mixed and then made to flow down a tube. The progress of the reaction at points along this tube was measured by optical methods. The method has now been improved by the use of photo-electric cells and by reducing the scale of the apparatus (F. J. W. Roughton and G. A. Millikan, *Proc. Roy. Soc.*, A, 155, 885, June 2). The mixing arrangements and the character of the flow down the tube have been specially studied. The smallest apparatus may be used with 20–30 c.c. of fluid to study reactions with half-periods of 0·0005 sec. Some experiments on reactions which have been studied by other methods confirm the validity of the method.

Low Temperature Carbonization of Coal

THE Department of Scientific and Industrial Research has published the results of tests made in accordance with a standing arrangement by the Director of Fuel Research on a plant erected by the Coal Research Syndicate, Ltd., at Mansfield, for the carbonization of coal at low temperatures (London: H.M. Stationery Office. 9*d*. net). The process has interesting features. A charge of lump coal (35 tons), almost devoid of caking properties, is carbonized in a chamber 10 ft. in diameter and 25 ft. high by the combustion at the top of the column of part of the gas made. The products of combustion and distillation are drawn downwards through the charge, and leave the bottom for the gas treatment plant. A portion of the gas is returned to the top of the carbonization chamber when, as mentioned above, it is burnt after the addition of air. At the end of the carbonization, the bottom of the retort is withdrawn by hydraulic gear, and the whole charge is dropped for quenching. The coke product was found, on test, to be a satisfactory fuel for the open grate. This process is interesting because, unlike most low temperature processes, it handles the material in bulk comparable and exceeding that in modern coke ovens.

Development of the Coiled-Coil Lamp

IN the *Technical Review* of April published by the Philips Laboratory, Eindhoven, Holland, there is an instructive paper by W. Geiss on the development of the coiled-coil lamp. The first material used for lamp filaments was carbon and later graphite. A further increase in temperature was made possible by the adoption of metals with high fusion points like osmium, tantalum and tungsten. At present, tungsten is considered the best material for lamp filaments. To obtain a high efficiency, it is essential to keep the rate of volatilization as low as possible. A 'filling' of argon or nitrogen at 50–100 cm. pressure greatly diminishes the rate of volatilization. Unfortunately, the gas filling increases the losses by thermal conduction and convection. In this respect thick filaments give much more satisfactory results than thin ones. If a long thin filament is wound in the form of a spiral, its total heat losses are of the same order as for a filament of the same length and cross-section as the spiral. It has been found possible to reduce the effective length of the coil still farther by winding the coil itself round a core, and this gives the 'coiled-coil' arrangement. The first attempts to use coiled coils were made twenty years ago, and failed mainly because the filaments expanded during service. By suitable pre-treatment, this difficulty was overcome. A mixture of argon and nitrogen has been used for filling these lamps. If krypton or xenon were used as a filling, the heat losses would be greatly diminished. Whether they will ever be used depends on the progress that is made in isolating these rare gases. If the flux from a single-coiled and a coiled-coil lamp is the same, the saving in power in the latter lamp is 7–10 watts; in addition, it maintains its efficiency better during life. The increase in the efficiency obtained by coiling the filaments is more marked for lamps of small candle-power.

Tercentenary of the University of Utrecht

ON June 22–24, a brilliant sun shone on the ancient and famous city of Utrecht, thronged with students and visitors from many lands and gaily decorated with the national flag of Holland and the colours of all the Faculties. The occasion was the celebration of three hundred years of the University's existence. To Utrecht had come the representatives of most of the universities and learned academies of the world, to pay homage and do honour to her ancient and distinguished university. Amidst the scarlet gowns and many coloured hoods of the professors and academicians flashed the white plumes of the horses and the gay cockades of the splendid coachmen of the students' carriages, for to Utrecht had also come the representatives of the students' "senates" from all the universities of Holland, and the associations and clubs of old University of Utrecht men from every part of the country. In this land won by brave men from the sea, where freedom dwells and learning flourishes, all had met to place another milestone on the long road of civilization, wherewith to mark the completion of the third century of a great university's beneficent life.

During the forenoon of Monday, June 22, the associations and clubs of former members of the University came with their banners in a procession from the station, whilst a great carillon pealed and thundered from the thirteenth century tower of the Cathedral Church. In the afternoon, gifts were presented to the University. At eight o'clock in the evening, the foreign delegates, representing universities and learned academies and societies, were received by the Council and Senate in the great Hall of the University, while at nine o'clock the municipality of Utrecht held a reception in the rooms and beautiful garden of the Municipal Art Gallery.

Serious business began on Tuesday, June 23. In the morning the delegates, in academic robes and decorations, were received by the University in the Church of St. Peter. Addresses of welcome were delivered by Dr. S. Jacob, the President of the Council, and Prof. C. H. Vollgraff, the Rector Magnificus. Speeches of congratulation and thanks were then made by Prof. J. Huizinga, of the University of Leyden, and by several foreign delegates, including Dr. Clarke, of the University of Oxford. The University hymn, "In Babylonia", was played on the viola, with organ accompaniment, by Mrs. Vogelsang. As the name of each delegate was called, he came forward and presented an address of congratulation to the President and the Rector. Then the members of Council, the professors of the University of Utrecht and the foreign delegates walked in procession from the Church of St. Peter to the Cathedral Church, where lunch was provided in the cloisters and the beautiful old cloister garden. Among the other English delegates present may be mentioned Prof. G. Barger (representing the University of Edinburgh), Prof. F. G. Donnan (representing the Royal Society and the University of London), and Prof. D'Arcy Thompson (representing the Royal Society of Edinburgh and the University of St. Andrews).

After lunch, the great procession of professors and delegates walked through the streets of Utrecht, which were thronged by enormous crowds of citizens and guarded by cordons of police. This brilliant and most impressive scene was watched by the Queen of Holland and the Princess Juliana. The procession returned by a different route to the Cathedral Church, where a solemn service of commemoration was held in the presence of the Queen and the Princess, and a great gathering of invited guests, including many high officers of the army and navy and high officials of the State. After some of the beautiful organ music of Bach, addresses were delivered by the President of the Council and the Rector Magnificus, the latter giving a long account of the struggle of Western civilization for freedom of learning and liberal government. Then came a very interesting ceremony, the presentation of the first gold medal of honour of the University to the Queen, to which Her Majesty made a suitable reply of thanks. After some more organ music, a short and eloquent address was delivered by His Excellency the Minister of Education, Art and Science. The proceedings were concluded by the ceremony of attaching the third centenary ring to the pole of the great banner of the University.

After the commemoration service, a number of foreign delegates were presented to the Queen, and as the great procession again filed out of the Cathedral Church, a carillon was played by J. A. H. Wagenaar.

In the evening, a banquet was given by the Senate of the University, at which many delegates made speeches of congratulation and thanks. After the banquet the guests were taken by bus to a wonderful open-air performance by members of the Students' Associations. This was a dramatic pageant entitled "De Groote Geus" (The Great Vagabond). The façade of a great castle had been erected in a large meadow, representing the stronghold of a Spanish noble. In front of this the peasants and citizens held a market fair. Then came the "Groote Geus"—the Dutch Tilleulenspiegel—with his jesters and his jests, to amuse the people and by sarcastic innuendo to arouse them from their bondage. Their anger grew, but Spanish horsemen and men-at-arms poured from the castle gates to quell them. Finally, the Hidalgo with his chatelaine and retinue came out to witness a masque prepared by Tilleulenspiegel. But the people saw what he meant—it was a masquerade of the "Fat- and swollen-headed overlords". In a burst of rage and anger, they stormed and burnt the castle. The drama thus represented the struggle of the Netherlands for freedom from the Spanish yoke. It was a fine performance, played by something like three hundred students, with elegant costumes and elaborate flood-lighting effects. High praise must be accorded, not only to the author, producer and director, but also to the excellent acting and speaking of Tilleulenspiegel, who had a very heavy part. A special and very enjoyable feature of the pageant was the dramatic music, which was played from behind the façade by the municipal orchestra. This music was specially composed for the occasion by Dr. H. E. Enthoven.

The forenoon of Wednesday, June 24, was taken up by the conferring of honorary degrees on a number of delegates in the Great Hall of the University. Among those who were thus honoured may be mentioned Sir Henry Dale, Prof. Herbert Freundlich (University College, London), and Dr. Clarke (University of Oxford). At midday the delegates and their ladies were entertained to lunch in the cloisters and cloister garden of the Cathedral Church, after which they witnessed the march past the University of the students' "Masquerade". This was a dramatic procession of pikemen, mounted knights, etc., of which the special feature was the "Prince of Orange" and his retinue.

In the afternoon, there was a very enjoyable excursion (by autobus) into the province of Utrecht, including a visit to Hilversum and its new town hall (a fine building in the modern unadorned style) and tea in the park of the Chateau Deynselburg, given by Madame and Dr. S. Jacob. On returning to Utrecht, the guests paid homage to the "Prince of Orange", who held a Court.

The day concluded with a gala concert in the Tivoli Concert Hall, conducted by the famous Willem Mengelberg. The programme was: *Sol Justitiae*: a hymn dedicated to the University of Utrecht on the occasion of the third centenary (composed by Dr. H. E. Enthoven); *Piet Hein*: a Dutch rhapsody (composed by Dr. P. G. van Anrooy); Overture to the "Taming of the Shrew" (composed by Dr. Joh. Wagenaar); Beethoven's Fifth Symphony.

The music was well played by the municipal orchestra under the spirited leadership of Mengelberg. An amusing incident was the arrival of the "Prince of Orange" and his retinue. Even the great Mengelberg had to come down from his rostrum and pay homage!

Thus ended three wonderful days of lavish Dutch hospitality, academic ceremony and students' pageantry. As if in remembrance of the University motto, *Sol Justitiae, illustra nos*, the sun shone brightly on the gay scene of scarlet gowns, white-plumed horses, knights on horseback and the great Prince of Orange. The professors of the University amply sustained the honour of their city and their country in offering very kind private hospitality to many of the invited guests.

It was a great demonstration of the universality of learning, of the brotherhood of truth and freedom. As one stood in the peaceful cloister garden and listened to the carillons from the ancient tower, the message of a noble civilization resounded in one's ears. One was glad to feel that Holland had kept the sweet music of her old carillons and in the benign tolerance of a greater humanity had won the freedom of her soul.

F. G. DONNAN.

Fractures in Metals and Brittle Materials

A DISCUSSION on "Fractures in Metals and Brittle Materials" was held at the Royal Society on Thursday, June 11. Many points of importance were brought out in this interesting discussion, and it is perhaps difficult in the small space of a general article to do justice to them.

In introducing the subject, Dr. H. J. Gough presented a review of the present position of knowledge in regard to the understanding of the mechanism of failure. As regards metals, he holds that in view of their essentially crystalline structure the required physical explanation must be in terms of atomic structure before any real progress in ideas can be achieved. Stripped of non-essentials, the problem is that of obtaining an understanding of plastic deformation and a realization of the exact conditions under which a crack is formed. He emphasized the disability of not having available a satisfactory conception of the laws of cohesion in the metallic state, and the extreme value of any new contribution in this direction. Elasticity is an expected property in a metallic crystalline aggregate, but plasticity is a property which is extremely difficult, at the present time, to understand.

The study of single crystals is very helpful since the processes of deformation and fracture are characteristics associated with the crystal structure, and effects in crystal aggregates are modifications of the effects occurring in single crystals. The geometrical aspects of deformation are established, but give no information on the mechanism of fracture. While stressing the fact that the characteristics of deformation and fracture are probably capable of explanation in terms of single crystals, it must be remembered that the strength of polycrystalline aggregates depends to some extent on crystal size, so that an understanding of the part played by the crystal boundaries is a very important factor in the solution of the whole problem. No established explanation has yet been provided in regard to work-hardening, strain hysteresis, twinning and the process of conversion of strain energy indefinitely into heat energy.

Assuming that the mechanism of fracture is essentially a property of the individual crystals, Gough and Wood have described, in a recent paper, an investigation by X-ray methods into the physical system prevailing after different numbers of cycles in fatigue tests. It would appear that at fracture the physical system is the same under all conditions. Under a safe range of stress the damage to the crystal structure is not progressive, but a stable state is reached, whereas under an unsafe range of stress progressive change takes place. The changes in the neighbourhood of the ultimate fatigue crack are characteristic and exactly similar under all unsafe ranges of stress, and in this area the original structure is destroyed and new crystallites formed. This appears to be a definite advance in knowledge.

Prof. G. I. Taylor confined his remarks chiefly to the more precise mathematical theory of internal flaws. If one crystal is deformed, and hardening is produced in the crystal, additional stresses are imposed on the surrounding crystals, which therefore tend to become deformed. In steel at the yield point the stress is reduced on deformation. In this case the deformation tends to proceed in the same crystal and an irregular deformation results.

If the material has internal flaws—such as might be represented by small spherical and ellipsoidal cavities—the stresses acting locally are increased. Failure under these local stresses would be expected to occur when certain critical combinations of shear and direct stress are reached. (The exact relationships between shear and direct stress which follows from Mohr's hypothesis and from that of von Mises differ somewhat.) A special case is that where the cavity is filled with a material. For simple shapes of cavity, the stresses can be calculated, and one result is that if a flaw is assumed to be ellipsoidal, then the greatest concentration of stress may occur with the direction of the flaw at 45° or at right angles to the direction of principal stresses, according to the relative compressibility of the 'inclusion'.

Prof. L. N. G. Filon dealt chiefly with the different types of fracture which occur in solids, and illustrated his remarks with a large number of fractures in cast iron and glass. In ductile materials, slip does not always occur at 45° to the principal stresses. A fracture in a strip of mild steel broken in tension showed a fracture at approximately 60° to the line of the principal stresses. This was not due to any assymetrical properties of the steel, since a second slip line clearly shown by the material was exactly symmetrical with the first. In cast iron, brittle fractures can be obtained by a bending operation in which pure tension is applied to some parts of the material, and pure longitudinal compression in other parts. In this case fracture occurs at right angles to the stress lines. A curious 'staircase' fracture has been observed in these brittle materials in which the fracture began at right angles to the tension, but after passing through the material for some distance, branched along the line of tension, and branched back into the original direction and gave a step. In some cases several steps were observed. The conclusion reached was that in the same material the type of fracture obtained depends on the method of application of stress.

The possible effects of sub-microscopic cracks was the chief point discussed by Prof. E. N. da C. Andrade. He considers that the existence of surface cracks has been well established in three series of experiments. A strip of mica loaded so that the edges are stress free has a strength of about ten times the normal value. Andrade and Martindale in experiments on thin metal films on glass, diamond or other substance, have found that recrystallization proceeds on definite lines on the surface. These lines do not appear when the film is produced on the very perfect cleavage faces of mica. Indirect evidence of these surface cracks is afforded by experiments of Roscoe on cadmium wire, which had its critical shear stress increased to double the normal value when coated with a thin film of oxide a few molecules thick. It is well known that freshly drawn threads of quartz and glass are stronger than old threads. Griffiths believes this to be due to the absence of cracks in the freshly formed threads. In concluding, Prof. Andrade indicated briefly some of the difficulties of forming a theory of plastic deformation. In plastic materials, twinning and gliding take place on the twinned material in a way which is very complicated even in single crystals.

Dr. W. H. Hatfield said that the stress which may be safely applied is far removed from the stress which produces fracture, and that from the point of view of the engineer and metallurgist, the actual mechanism of fracture is less important than a satisfactory explanation of the means which are effective in increasing the safe range of stress. In iron, the fatigue range of the crystalline aggregate is increased and the stress to produce initial plastic deformation is also increased by 'sprinkling' particles of a hard, brittle substance, carbide of iron, through the mass of the ductile metal. It requires to be explained how the presence of such carbide particles raises the stress required to produce initial deformation in the continuous matrix of ductile ferrite. An increase in the value for the stress up to which strain is proportional to stress is difficult to understand. Particles of other hard brittle materials such as slags, sulphides, etc., do not have the same effect, in that they leave the yield point and maximum stress unaltered, but the ductility is very much decreased. It seems, therefore, that the adhesion and cohesion between the ductile matter and the particular inclusions is an important factor. An interesting fact which requires explanation is the influence of cold work on the fatigue values. It seems peculiar that a process of plastic deformation should increase the resistance to fracture. Much has been written on the effect of grain size, but it is easy to overlook the fact that to modify grain size as the only variable is extremely difficult, if not impossible. The causes of the modification of grain size may well be the real cause of the apparent effect of grain size.

Prof. P. B. Haigh's contribution was of particular interest in that it could be considered that his observations postulated a resuscitation of the idea of stress in metals translating the crystalline to the amorphous phase. When a slip band is formed in a crystalline ductile metal, the increase in the volume from the crystalline to the amorphous state tends to produce fluid pressure in a core surrounded by increased shear stress, and the band tends to spread across planes of easy cleavage in the grain.

Mr. S. A. Main suggested that more work on the speed of testing and the influence of temperature might lead to further information on the main problem. He also referred to the characteristic appearance of slip bands which are visible under the microscope and are therefore of a different size from Gough's 'crystallites'. There can be little doubt that the characteristic separation of the bands has a fundamental bearing on the problem.

Sir Robert Hadfield, in a written contribution, said that when attending trials of projectiles against modern armour, he had often observed that there seemed to be little difference in the appearance of a fracture, as compared with the fractures met with under ordinary static or dynamic conditions at comparatively low velocities of impact. Nevertheless, there were instances of remarkable differences in behaviour of various steels according to the manner in which they were tested, that is, whether comparatively slowly or rapidly. Some materials like over-heated mild steel, tough under slow stressing, are quite brittle at moderate speeds of testing. Mild steel of ordinary good quality is tough at all normal speeds used in impact testing, but tends to break with a brittle fracture when attacked at high speeds with rifle bullets. With regard to the effect of low temperature, there seems to be no simple explanation of the different responses made by different metals. Thus the retention by nickel of its toughness at very low temperature is not simply explained by its particular type of cubic structure, namely, the face centred cubic, in contrast with that of iron, which is body centred cubic.

The discussion was an extremely valuable one, and has served to indicate many directions in which intensive investigation can usefully proceed.

Research Fellowships and Grants

ROYAL SOCIETY AWARDS

THE Council of the Royal Society decided in the spring of this year to found an E. Alan Johnston and Lawrence research fellowship in medicine by means of funds available to the Society by bequests under these two names. The value of the stipend is £700 per annum, plus superannuation allowance. Seventeen candidates applied for the fellowship and of these, four were selected for special consideration. Council would gladly have appointed any one of them to a fellowship had four fellowships been available. The reception of the fellowship is a strong indication that candidates of high merit are available for full-time research posts in medicine. Council finally selected Dr. John McMichael, of Edinburgh, to work at the Edinburgh Royal Infirmary on the pathology of heart failure. From 1934 to 1936 he has been a lecturer in human physiology at Edinburgh. He has been offered special facilities for his work at the Edinburgh Royal Infirmary.

The Council of the Royal Society has also approved plans for medical research on malaria and on nutrition in India, involving a total expenditure of more than £8,000 in the next five years. Colonel Sinton has been appointed to investigate certain aspects of malaria at the Horton Centre. Another series of investigations on malaria, in conjunction with the London School of Hygiene and Tropical Medicine, provides for a study of mosquitos in the tropics, and Dr. C. Wilson has been offered a research appointment to enable a survey of nutritional conditions in India to be undertaken.

LEVERHULME FELLOWSHIPS AND GRANTS

Awards of Leverhulme fellowships and grants in aid for research for 1936 have been made to the following, among others, the subject of research being indicated in brackets: Dr. Agnes Arber (studies in the principles of angiospermous morphology and in the history of botany); S. J. Duly, head of the Department for the Scientific Study of Commercial Products, City of London College (carriage of goods by sea); Dr. F. Fairbrother, senior lecturer in chemistry, University of Manchester (the study of electrolytic dissociation processes and the mechanisms of chemical reactions by the use of induced radioactivity); C. P. Fitzgerald (sociology of the non-Chinese tribes of Yunnan, S.W. China); S. D. Garrett, formerly assistant plant pathologist, Waite Agricultural Research Institute, University of Adelaide, South Australia (biological antagonism of the soil microflora towards root disease fungi or crop plants—renewal of present fellowship); Dr. J. de Graaff Hunter, lately director of the Survey of India (planning and execution of geodetic triangulation of great extent); Mrs. K. Lonsdale, research worker, Royal Institution (relation between structure and physical properties of organic molecules—renewal of present fellowship); E. P. Mumford, lately director of the Pacific Entomological Survey, Honolulu (terrestrial and freshwater biota of the Marquesas Islands—renewal of present fellowship); F. R. Perry, member of Research Department, Metropolitan-Vickers Electrical Co., Ltd., Manchester (the study of overvoltages due to lightning on transmission lines—renewal of present fellowship); Dr. A. L. Reimann, research physicist, General Electric Company, Limited, Wembley, Middlesex (electronic conduction phenomena in solid insulators and semi-conductors); Dr. R. H. Thouless, head of the Department of Psychology, University of Glasgow (research in visual perception); Dr. W. E. Williams, lecturer in physics, King's College, London (determination of the vacuum wave-lengths and the structures of spectral lines by means of his reflection échelon).

Grants in aid of research have been made to the following: Prof. A. E. Boycott, late Graham professor of pathology, University of London (ecology and genetics of British non-marine Mollusca); Prof. H. J. Fleure, professor of geography, University of Manchester (physical (racial) characteristics of the peoples of Wales); Prof. J. W. Heslop Harrison, professor of botany, Armstrong College, Newcastle-on-Tyne (researches on evolution and heredity—renewal of present grant); T. N. Hoblyn, statistician, East Malling Research Station, Kent (technical problems in the layout and conduct of horticultural field experiments under tropical and sub-tropical conditions); Dr. W. H. Pearsall, reader in botany, University of Leeds (growth of Algæ); Dr. O. W. Richards, lecturer in entomology, Imperial College of Science and Technology, London (habits of South American bees and wasps); Prof. C. W. Valentine, professor of education, University of Birmingham (psychology of early childhood). A Leverhulme travelling fellowship has been awarded to Mr. A. Ruscoe Clarke on the nomination of the Medical Research Council.

Particulars of these awards can be obtained from the Secretary, Leverhulme Research Fellowships, Union House, St. Martins-le-Grand, London, E.C.1.

BEIT MEMORIAL FELLOWSHIPS

The trustees of the Beit Memorial fellowships for medical research have made the following awards, the subject and place of research being given after the name of each new fellow: *Fourth Year Fellowships* (£500 a year): Dr. E. S. Horning, to continue his research on the cancer-producing effects of œstrogenic compounds, and on the possibility of producing tumours *in vitro* (Imperial Cancer Research Fund, Queen Square, London); Dr. W. J. Dann, to continue his work on the vitamin B_2 complex in reference to the treatment of pellagra (Duke University School of Medicine, North Carolina, U.S.A.). *Junior Fellowships* (£400 a year): Dr. I. Berenblum, to study the mechanism of skin irritation by chemical substances in reference to their action as exciting or preventing the development of cancer (Dunn School of Pathology, University of Oxford); D. D. Woods, to study the metabolism of the anaerobic bacteria, and the phenomenon of adaptation in bacteria (Dunn Institute of Biochemistry, University of Cambridge); Dr. A. Neuberger, to study the carbohydrate group in proteins and its possible relationship to their antigenic properties in bacterial immunity (Department of Pathological Chemistry, University College Hospital Medical School, London); C. W. Bellerby, to investigate the control of the reproductive cycle by the anterior lobe of the pituitary (Department of Social Biology, University of London); Dr. T. W. Birch, to attempt to identify the component parts of the vitamin B_2 complex (Nutritional Laboratory, Cambridge); Lilian M. Pickford, to study the part played by the posterior pituitary gland in the control of water excretion by the kidneys (Pharmacological Laboratory, University of Cambridge); Dr. R. J. Pumphrey, to investigate the sensory physiology of insects, and the electrical response in the central nervous system to peripheral stimulation of afferent nerves (Zoological Laboratory, University of Cambridge); T. A. H. Munro, to study the role of inheritance in mental disorder (Research Department, Royal Eastern Counties Institution, Colchester).

AWARDS OF ROYAL COMMISSION FOR THE EXHIBITION OF 1851

The Science Scholarships Committee of the Royal Commission for the Exhibition of 1851 announces the following appointments for 1936: *Senior Studentships:* Dr. R. C. L. Bosworth, for research in chemical physics at Cambridge; N. A. Burges, for research in mycology at Cambridge and the Strangeways Research Laboratory, Cambridge; T. T. Paterson, for research in geology and prehistory at Cambridge; A. F. Rawdon-Smith, for research in physiology and psychology at Cambridge; Dr. D. Shoenberg, for research in physics at Cambridge. All the above awards were made on the recommendation of the University of Cambridge. *Overseas Scholarships:* D. G. Hurst, for research in physics at the Universities of California and Cambridge; J. Marsden, for research in physical chemistry at the University of Cambridge; on the recommendation of McGill University, Montreal. A. D. Misener, for research in physics at the University of Oxford or Cambridge; S. L. Cohen, for research in biochemistry at the Technische Hochschule, Zurich; on the recommendation of the University of Toronto. H. C. Corben, for research in theoretical physics at the University of Cambridge; on the recommendation of the University of Melbourne. R. N. Robertson, for research in botany at the University of Cambridge; on the recommendation of the University of Sydney. I. E. Coop, for research in physical chemistry at the University of Oxford; on the recommendation of the University of New Zealand. Dr. B. G. Shapiro, for research in biochemistry at King's College Hospital, London; on the recommendation of the University of Cape Town. C. O'Kelly, for research in experimental physics at the University of Cambridge; on the recommendation of the National University of Ireland.

SALTERS' INSTITUTE AWARDS

The following awards for 1936–37 have been made by the Salters' Institute of Industrial Chemistry and approved by the Court of the Salters' Company: Fellowships renewed to: E. I. Akeroyd, Emmanuel College, Cambridge; L. R. Barrett, Lincoln College, Oxford; T. K. Hanson, Oriel College, Oxford; and C. S. Windebank, University of London. Fellowships awarded to: L. M. Baxt, King's College, London; and T. A. Dent, St. Catharine's College, Cambridge. The Institute has also awarded 150 grants-in-aid to young men and women employed in chemical works to facilitate their further studies.

MEDICAL RESEARCH COUNCIL AWARDS

The Medical Research Council announces the following awards of travelling fellowships for the academic year 1936–37: Medical Research Council fellowships in medical science: J. T. Chesterman, H. E. Holling. Dorothy Temple Cross Research fellowships in tuberculosis: A. L. Jacobs, J. Smart, Dr. B. C. Thompson, V. C. Thompson. Rockefeller fellowship in psychiatry: Dr. J. H. Quastel.

Excavations at Tell Duweir, Palestine, 1935-36

AN exhibition of antiquities from Tell Duweir, the ancient Lachish, which have been obtained by the fourth expedition of the Wellcome Archæological Research Expedition to the Near East in 1935–36, opened at the Wellcome Research Institute, Euston Road, London, N.W.1, on July 9 and will remain open until the end of the month.

The excavations, which again were under the field direction of Mr. J. L. Starkey, were mainly directed to completing the clearance of a number of areas attacked in the course of previous seasons' work; but nevertheless, material of considerable archæological interest and importance was obtained. An interesting group of bronze objects, much crushed, came from a quarry on the saddle, which had partially collapsed in ancient times. These objects date from the early Middle Bronze Age of pre-Hyksos times, and among them were a kohl stick and mirror, of which the latter is the first example to be found at Tell Duweir.

A further clearance of the temple and its superimposed reconstructions made it clear that the essential plan of all three structures was identical, but that there had been a great expansion in the second temple. Further evidence was obtained pointing to the temple having been the seat of the cult of a triad of deities, of which one was female, and of affinities with the north. Below the floor of the second temple, a mass of pottery was found under the altar bench, which included a Late Helladic II goblet, dating at about 1450–1400 B.C. It is of buff paste with cream slip and has a painted band decoration showing an ivy leaf motif. This, from the point of view of the archæologist, is one of the most important finds of the season, as it dates more or less accurately, and links up a number of Palestinian finds.

Two sides, measuring eighty-five and seventy-five feet respectively, of a remarkable opening, apparently the entrance to a subterranean tunnel, have been cleared; and a clearance within the gate has revealed under the Persian level what was apparently the commercial quarter, with shops of a wine or oil seller, corn chandler and a weaver containing many of the appurtenances of their trades.

What proved, however, to be the most extensive and, in some ways, the most important discovery of the season, was made in the western valley in continuation of work begun two years ago. Here in a little-disturbed, small circular tomb lined with plaster was a collection of objects in number such as is rarely found in so small a space. From this were taken two hundred pots, of which fifty-three were types new to Tell Duweir. The most interesting was a censer, which in paste and finish recalls the famous Tell Duweir ewer on which was the inscription in the early Palestinian alphabetic script. This censer has lugs and a flat cover, on the upper side of which is an incised decoration with tree or plant motif in a hatched border, and on the under side a further example of the early script.

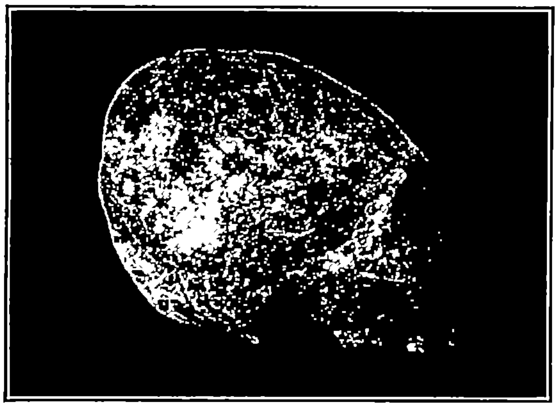

Photo *Ralph Richmond Brown*

FIG. 1. Artificially deformed skull from Tell Duweir. By courtesy of the Wellcome Archæological Research Expedition to the Near East.

The tomb itself, as is shown by a number of scarabs, dates from 1400 to 1300 B.C. or even 1275 B.C. Among the objects found are a long-tanged bronze dagger of Eighteenth Dynasty type, bronze lance and sporting arrow heads, and faience draughtsmen with plaques from the gaming board. In an adjacent larger sepulchral chamber the upper levels were a mass of rubbish, possibly from the Assyrian occupation, but the lower levels were composed of a conglomerate of human skeletal remains, of which the condition suggests that they may have been thrown through a hole in the roof—the door on the west side was found still blocked—as salvage from the buildings, when the city was sacked by Sennacherib in 701 B.C.

This skeletal material will afford valuable evidence of the physical characters of the early inhabitants of Palestine, especially as a remnant of the Canaanitish population may have lingered on at Lachish. Even more interesting is the fact that, in addition to head wounds, several of the skulls show a number of pathological conditions. Some have been artificially deformed (Fig. 1) and show such elongation in the occipital region that they resemble in shape the form of head familiar in the representations of Akhenaton; others have been trephined. Of these latter, two examples, instead of the more usual circular operation, have had a square section of bone, about an inch across, removed by sawing cuts, which intersect. This method, known in the Inca skulls from South America, is new to the ancient civilization of the Old World.

Educational Topics and Events

BELFAST.—Dr. W. H. McCrea, at present reader in mathematics in the University of London, has been appointed to the chair of mathematics in the Queen's University.

READING.—Under the will of the late Dr. Alfred Palmer, who died on May 20 last, the University has benefited by a valuable bequest of freehold property. It includes the main buildings of St. Andrew's Hall, the largest of the University's halls of residence for women students; a house known as "Summerbrook", near the main University site, which serves as the headquarters for the advisory officers of the Southern Agricultural Province; two houses used by Wessex Hall, another of the University's halls of residence for women students; four houses adjoining the main University site and used for general University purposes. The properties, which have hitherto been held on lease by the University, have been bequeathed free of duty.

Mr. Gerald E. H. Palmer has been elected a member of the University Council to fill the vacancy caused by the death of Dr. Alfred Palmer.

Mr. G. T. H. Kimble has been appointed lecturer in geography.

SHEFFIELD.—The following appointments have recently been made: Mr. N. S. Boulton, as lecturer in civil engineering; Mr. W. S. Milner (at present assistant lecturer), to be lecturer in electrical engineering; Mr. W. Skyrme Rees, as demonstrator in anatomy.

"ACADEMIC FREEDOM" continues to form the subject of much anxious discussion in America. The president of the University of California in a recent speech on "Problems of an American University" (*School and Society*, May 30) declared that more and more in the last year or two his university has felt, in common with others, the pressure of special groups, and he drew a lamentable picture of what the loss of freedom has meant to the universities of Germany, Italy and Russia. In these countries, "to-day there are no universities—only names and shells from which the spirit has departed. In each of these totalitarian States, universities have become the agents, the adjuncts, the subordinates of the State". In the same journal in which this speech is reported appears a letter from the president of the University of Minnesota referring to the increasing amount of control the Federal Government is exercising over the schools of the country, and to the necessity of keeping the schools and universities free from dictation by pressure groups and from regimentation by Government agencies. In the preceding issue, Prof. Thomas Woody, of the University of Pennsylvania, writes of the "hysterical efforts to create loyal citizens by legislative fiat" in recent attempts to pass laws to keep history "pure", and to regulate and restrict the teaching of science. "Even more serious in its ultimate possibilities for the suppression of freedom of the schools and colleges of the nation is the present obsession with respect to loyalty oaths for teachers". He proceeds to examine at length the grounds on which the requirement of such oaths (now prescribed in nineteen States) has been defended.

Science News a Century Ago

Sir Goldsworthy Gurney and his Steam Carriages

AMONG the successful pioneers of steam locomotion on roads was Sir Goldsworthy Gurney (1793–1875), the Cornish surgeon and inventor, known also for his invention of the oxy-hydrogen blowpipe and the limelight. It was while living in London that he turned his attention to steam-carriages, and in 1829 he went from London to Bath and back at a rate of fifteen miles an hour. On July 18, 1836, in the House of Lords, reference was made to the Steam-carriages Tolls Bill which had then passed through the committee stage. The Marquess of Salisbury, however, proposed it should be referred to a select committee for further consideration. In the course of his reply to this suggestion, the Earl of Radnor said: "Mr. Gurney, a gentleman of considerable talent, had directed all his attention to the construction of steam-carriages applicable to the road. He had given up a lucrative business, and applied himself wholly to that point. He had brought his invention to a state of great perfection; when all at once, a bill was introduced, not directly affecting his invention, but by a side-wind, entirely obstructing it, and laying such a tax on steam carriages as would completely defeat his object. His invention had been used without any accident whatever occurring; and this bill was intended merely to take off that burden which indirectly would operate greatly to the prejudice of Mr. Gurney".

Geology of the Island of Ascension

ON July 19, 1836, H.M.S. *Beagle* reached the island of Ascension, which Darwin compared to "a huge ship kept in first-rate order". Speaking of the geology of the island, he said: "The lava streams are covered with hummocks, and are rugged to a degree which, geologically speaking, is not of easy explanation. The intervening spaces are concealed with layers of pumice, ashes and volcanic tuff. . . . In several places I noticed volcanic bombs, that is, masses of lava which have been shot through the air whilst fluid, and have consequently assumed a spherical or pear-shape. Not only their external form, but, in several cases, their internal structure shows in a very curious manner that they have revolved in their aerial course". Describing more particularly one of these objects, he said: "The central part is coarsely cellular, the cells decreasing in size towards the exterior; where there is a shell-like case about the third of an inch in thickness, of compact stone, which again is overlaid by the outside crust of finely cellular lava. I think there can be little doubt, first, that the external crust cooled rapidly in the state in which we now see it; secondly, that the still fluid lava within, was packed by the centrifugal force, generated by the revolving of the bomb, against the external cooled crust, and so produced the solid shell of stone; and lastly, that the centrifugal force, by relieving the pressure in the more central parts of the bomb, allowed the heated vapours to expand their cells, thus forming the coarsely cellular mass of the centre".

The Herbarizing Dinner of the Society of Apothecaries

ON July 20, 1836, "the annual herbarizing dinner of the Society of Apothecaries took place . . . preceded by a lecture given at their hall by John Lindley, Ph.D., Professor of Botany to the Society. The noble President of the Medico-Botanical Society (Earl Stanhope), the Vice Presidents of the Linnean and Horticultural Societies, the President of the Royal College of Surgeons (Sir Astley Cooper), the ex-censors of the Royal College of Physicians, the Professors of Botany at the Metropolitan Schools of Medicine, and about 150 other gentlemen, attended on the occasion" (*The Times*).

Death of Jean-Félix-Adolphe Gambart

ON July 23, 1836, the French astronomer Jean-Félix-Adolphe Gambart, died at the early age of thirty-six years. He was born at Cette, in the Department of Hérault in May 1800. While quite a young boy he went to sea and then lived with his father, a teacher of navigation at Havre. His talents having attracted the attention of Alexis Bouvard (1767–1843), "the computing partner" of Laplace, he went to Paris, and in 1819 through Bouvard was made an assistant at the observatory at Marseilles of which Jean Louis Pons (1761–1831) was then the director. Pons having removed to Italy, Gambart in 1822 was made director of the Observatory, and though supplied with somewhat inferior instruments, in the course of eleven or twelve years discovered thirteen comets, including Biela's comet, first seen on February 17, 1836. In recognition of his work he was made a member of the Paris Academy of Sciences. Recalled to Paris in 1834 for work at the Bureau des Longitudes, his promising career was cut short by consumption.

Medical Statistics

IN his retrospective address delivered at the third anniversary meeting on July 23, 1835, of the Provincial Medical and Surgical Association held at Oxford, Dr. J. C. Prichard, F.R.S., senior physician to the Bristol Infirmary, said that there could be no method of research more in harmony with the philosophical character of the present age than inquiries which were termed statistical. There was no investigation more calculated to extend our knowledge, on a great scale, both of the physical and moral condition of mankind without opening the door to anything discursive or imaginary. Statistical researches were likely to afford the most satisfactory solution of difficult problems which had hitherto been thought to lie within the realm of speculation; and our mistrust of the speculative way of treating such questions was increased by the remark that in almost every inquiry submitted to the test of accurate numerical calculations, the result had turned out in direct opposition to what appeared to be the most probable conjecture. Who, for example, would ever have imagined that human life would not exhibit a larger average duration in the genial climate of Greece, Italy and other countries on the northern coast of the Mediterranean . . . than on the inclement shores of the Baltic and Frozen Ocean? It had been demonstrated, however, in a memoir drawn up with great accuracy of research and presented to the Academy of Sciences that human life had double the duration, or that men lived on the average twice as many years in the *Ultima Thule*—the bleak Iceland and on the Norwegian coast—as in the delightful plains of Campania and in the valleys of Andalusia.—(*Trans. Prov. Med. and Surg. Assoc.*, 1836.)

Societies and Academies

Paris

Academy of Sciences, June 8 (*C.R.*, 202, 1881–1952).

André Blondel : A radioelectric method for the calculation of transient régimes.

Georges Claude : The presence of gold in sea-water. An application of the method suggested by Glazunov to 168 cubic metres of sea-water taken off the coast of California. The gold was too small to be determined, and was less than 0·1 mgm. per cubic metre.

Dimitri Riabouchinsky : The paradox of d'Alembert at supersonic velocities.

Edgar Baticle : The problem of collisions.

Salvatore Cherubino : Holomorph functions of a matrix.

Léon Pomey : The general harmonic properties of unicursal involutions of order *n*.

René Lagrange : An inequality of Hobson.

Alexandre Weinstein : The equations of the vibrations of a fixed-in plate.

Mlle. Nina Baby : The Diophantic nature of the unicity problem of the trigonometrical development.

Jean Hely : The application of a synthetic theory of relativity to the orbits of the planets.

Charles Platrier : The problem of Barré de Saint-Venant *in perfectly flexible homogeneous* media.

Imai-Isao : The stability of the double row of vortices in a rectilinear canal.

A. Toussaint and S. Pivko : The influence of the limitations of the fluid sheet on the aerodynamic characteristics of supporting wings. Experimental verifications.

Bernard Kwal : Dirac's equation and the theory of the electromagnetic field.

Marcel Pauthenier and Mme. Marguerite Moreau-Hanot : An ionic generator giving a million volts. Details of the practical realization of an apparatus based on a theory previously described.

Jean Granier : *An important cause of error in* the measurement of capacities by the ballistic method. In measuring condensers of high capacity, either the variations of period must be taken into account or less sensitive galvanometers, heavily shunted and with a high moment of inertia, must be used.

Jean Lecomte : Infra-red absorption spectra and the modes of vibration of organic compounds. From the study of compounds of the types $X.CH_2CH_2.Y$ and $X.CH_2.CH_2.CH_2.Y$, the numerous absorption bands found in nearly all the spectra for frequencies lower than 1,100 $cm.^{-1}$, can be explained only if the existence of several molecular forms is admitted.

Jean Reboul : The action exerted by ordinary metals on the photographic plate and on the electrometer. The study of the ionization of the atmosphere surrounding ordinary metals, suggests that there is an emission by these metals of an X-radiation of small quantum. The action on the photographic plate is not parallel to the ionization, and Russell's suggestion of the formation of hydrogen peroxide may apply in some cases.

Pierre Auger and Albert Rosenberg : The properties of the cosmic corpuscles of the penetrating group.

Hormisdas : A new colorimeter for determinations in series.

Horia Hulubei : Researches relating to eleme No. 87. The results of experiments given are co sistent with the presence of element 87 in extreme small quantity in pollucite.

Clément Courty : The diamagnetism of thi cyanates and of the ion Cu^+.

Marc Tiffeneau and Mlle. B. Tchoubar : T differences of behaviour of the *cis* and *trans* cycl hexanediols during their dehydration.

Albert Kirrmann and Pierre Renn : T mechanism of the allyl transposition.

François Dupré la Tour : Inversion of pol morphism in the series of normal saturated diacic

Georges Rempp : A differential frigorimeter. simple instrument for measuring the mean veloci of the air, possessing a greater thermal inertia th the hot wire anemometer.

Etienne Fœx and Maurice Lansade : Tl *pathogenic action of a bacterium isolated from pota* tubers. The characters of this organism agree wi those of *Bacterium xanthochlorum*. Studies have bee made of its pathogenic action on potato tubers ar buds, leaves of Solanaceæ and Leguminoseæ and c seeds of Solanaceæ.

Paul Riou and Joachim Delorme : The lea *values in maple and cane sugars.* From a determin tion of the lead values of cane sugars from variou sources, it is concluded that this value can give r indication of the adulteration of maple sugar wit raw cane sugar.

Albert Raynaud : The heterochromosomes c mulot.

Robert Brunet and Antoine Jullien : Tl architectural characteristics of the heart in tw marine lamellibranchs, *Ostrea edulis* and *Venus gallin*

Mlle. Marie Louise Rocco : The presence c allantoinase in insects. The aerial arthropods, lik the aquatic arthropods, contain the enzyme allar toinase.

Francis Rathery, André Choay and Pierre D Traverse : Isolation from the mucous membrane c the jejunum of a principle reducing glycæmia.

Maurice Doladilhe and Mlle. Marguerit Michel : Contribution to the study of the alex properties of protein C.

Official Publications Received

Great Britain and Ireland

Fifty Years a Borough, 1886–1936 : The Story of West Han Edited and compiled by Donald McDougall. Pp. 298. (West Ham Central Library.) 3*s*. 6*d*. [2

The North of Scotland College of Agriculture. Guide to Experimen and Demonstration Plots at Craibstone, 1936. Pp. xii+72. (Abe deen : North of Scotland College of Agriculture) [3

Other Countries

Commonwealth of Australia : Council for Scientific and Industri Research. Bulletin No. 97 : *Studies on Contagious Pleuro-Pneumon* of Cattle. By A. D. Campbell, Dr. A. W. Turner, Dr H. R. Seddo and Dr. H. E. Albiston. Pp. 88. Bulletin No. 98 : Cercospora Lea Spot (Frogeye) of Tobacco in Queensland. By A. V. Hill. Pp. 46- 7 plates. Pamphlet No. 62 : The Chemistry of Australian Timber Part 5 : A Study of the Lignin Determination, 3. By Dr. W. Cohen. (Division of Forest Products : Technical Paper No. 20.) P 30. Pamphlet No. 63 : Studies of Five Introduced Grasses. By D A. McTaggart, W. Hartley, T. B. Paltridge and H. K. C. Mair. P 32+2 plates. (Melbourne : Government Printer.) [22

Peabody Museum of Natural History. Bulletin 4 : Miocene Marin Mammals from the Bakersfield Region, California. By Leslie Wilson. Pp. 143. (New Haven, Conn. : Yale University.) 1 2 dollars. [24

Proceedings of the United States National Museum. Vol. 83, N 2986 : A New Genus and Species of Trematode from the Little Brow Rat and a Key to the Genera of Pleurogenetinæ. By Ralph W Macy. Pp. 321–324. (Washington, D.C. : Government Printin Office.) [24

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The Planning of Human Life

THERE must be many among the ranks of scientific workers who, from time to time, have been alarmed at the consequences which might attend the further extensions of the restrictions on freedom of scientific thought and investigation already imposed in various European countries and elsewhere, or the continued prostitution of scientific effort on an ever-growing scale on preparations for war. Others have been disturbed at the paradox presented by the heavy incidence of unemployment and distress in a world which science has already endowed with resources undreamed of scarcely a generation ago.

Few, however, as yet have concerned themselves with the underlying causes of the present unhappy and threatening position, and Prof. L. T. Hogben's recently delivered Conway Memorial Lecture* is accordingly the more welcome because of its stimulating challenge to creative thought on new lines about social life, and therefore about politics and economics. His outspoken comments were much more than a plea for a biological basis for social and political thought. The whole lecture was a call for a courageous linking of knowledge and action and seeing life as a whole, in which scientific method finds its use in arriving at new knowledge and solving practical problems, and action is seen as an essential if life is to be achieved in its fullness.

At a time when what Prof. Hogben describes as the retreat from reason is at full flood, it is refreshing and inspiring to meet such a frank exposure of past failures and an exposition of new lines of advance which may yet retrieve the position. Science could desire no better apologist, and even those who are unconvinced by Prof. Hogben's arguments can scarcely fail to admit the impossibility of tame acquiescence in the present position, unless we are content to see the very spirit of science slowly choked to death.

The retreat from reason, the growing dominance of prejudice and ignorance in public affairs, is attributed to neglect of education. The most expensive products of the educational system of Western civilization are really uneducated for life in the present world; and democracy is becoming a farce, because this expensively educated class, from which Capital and Labour attract the leaders and administrators, is increasingly at the mercy of technical experts whose own training involves no recognition of their social responsibilities.

The training of the statesman or the man of letters gives him no prevision of the technical forces which are shaping the society in which he lives: the education of the scientific worker and the technician may well leave him indifferent to the social consequences of his own activities. If we are to arrest the retreat from reason, we must devise an education which will give us representatives who can co-operate intelligently with technical experts in constructive social enterprise, and teach us how to choose them.

This is the first task, and upon it Prof. Hogben makes many shrewd remarks. He questions, for example, whether we now have as large a proportion of scientific men actively interested in politics as there were at the time of Joseph Priestley and Benjamin Franklin. Moreover, a nation cannot expect men of science to help in times of difficulty unless it elects representatives who know enough about the scope of technical possibilities to enlist their skill. If, however, a man is not politically educated unless he has some knowledge of natural science, the teaching of natural science has still to be adapted to the requirements of a rational curriculum of humanistic studies. We need more science, but not more science as it is taught for vocational purposes.

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* The Retreat from Reason By Lancelot Hogben. (Conway Memorial Lecture delivered at Conway Hall, Red Lion Square, W.C.1, on May 20, 1936.) Pp. xi+83. (London: Watts and Co., 1936.) Paper, 1s. net; cloth, 2s. net.

The real reason why science must be an important part of education is that intelligent citizenship is no longer possible unless we understand the place of science in the everyday life of everybody. Attention is directed to the closer co-operation between the teaching of history and of natural science in school and university alike which this demands. Co-operation between the historian and the man of science is, in fact, required to make education socially fertile; and the social value and interest of scientific teaching could be further enhanced if the relation of growing knowledge to the developing social needs of mankind were emphasized in the teaching of natural science.

The interest which the British Association has taken in the relation of scientific work to social questions in recent years indicates that Prof. Hogben is not alone in many of his arguments. To reinstate confidence in human reason, however, the teaching of history in such a way as to produce citizens capable of realizing the part which advancing scientific knowledge has played in the material progress of mankind is only one factor. The teacher of science can and should let his pupils understand from the beginning what are the responsibilities in everyday life which scientific discipline lays on all those who have once submitted to it, but that in itself it is not sufficient to secure action in discharge of those responsibilities.

No single point is so strongly stressed by Prof. Hogben as this of action. Quoting T. H. Huxley that "the great end of life is not knowledge but action", he suggests that the divorce of thought from action is one of the prime causes of our present difficulties. The pursuit of the social sciences has not been closely linked with the development of new institutions and the discovery of new modes of social living; and unless knowledge is encouraged as a means to action instead of as a means to more knowledge, we are unlikely to regain control over events and reap the possibilities of plenty which science has put within our reach.

Lack of familiarity with scientific matters has been an important factor in the crumbling away of our social traditions under the stress of economic disaster, but we can only stabilize the new social pattern by securing that action is related to knowledge and that the new knowledge to be acquired is pursued in relation to a definite plan of action. We have still to discover the laws of change of human nature, and until in this way we have arrived at a science of human nature, it is idle to expect the public needs of a progressive society to harmonize with the private needs of human nature.

Nor is this all. We are blundering on the threshold of an era of technical changes, the consequences of which can scarcely yet be predicted even by the technical man, let alone visualized by the average administrator. The introduction of the new plastics in building, housing and clothing, the replacement of heavy metals by light metal alloys in constructional work, changes in power production, increased productivity of pastures, field crops and live-stock through the use of fertilizers, soil control, genetic selection and control of pests, hold revolutionary consequences which demand study and reconstruction in all directions.

Equally we are entering on an era of biological inventions, with new possibilities of bodily and mental health if our resources are planned intelligently with the object of satisfying real human needs. A rational basis for human society involves planned consumption to ensure the maintenance of population. The only rational basis for such planning is scientific research into the character of fundamental human requirements and the national resources available for gratifying them. We could then formulate a policy and programme of national reconstruction which would command the irresistible support of the wage-earning and salaried classes, and should be above the squabbles of party politics as we have known them. When the existence of a universal need is recognized, the problem of satisfying it is a joint matter for economists and technicians.

A science of preventive social medicine must have as its first concern the satisfaction of known universal needs, and psychologists should be encouraged to explore the distribution of human capabilities in relation to the idiosyncratic requirements of individual human beings. Prof. Hogben, in fact, boldly calls for an inquiry into the wealth of nations on entirely new lines, including the utilization of social personnel and the study of the social resources available for canalizing a common will to increase the wealth of nations. In regard to the first, the studies of recruitment he suggests, including the large-scale testing of Parliamentary candidates for vocational aptitudes on similar lines to those worked out for various purposes by the National Institute of Industrial Psychology, though likely to meet with ridicule at the moment, would represent a real contribution to political science and society.

The picture which is thus presented to us does not minimize the dangers of the present situation ; rather it reminds us once more that the way of escape is still open if we choose to take it. The planning of human life, in accordance with growing knowledge of the nature of fundamental human needs and the natural forces now at our disposal if we use them intelligently, is not a task which can be or will be undertaken by political leaders, who have little regard for the nature of human needs and are unfamiliar with the technical resources which can be mobilized by intelligent organization.

The scientific worker, therefore, cannot evade his share of responsibility. He, at least, must lend his aid if anyone is to take stock of the resources of knowledge for social betterment. He as no other can lead the return to the exposition of the simple and well-tried truths of science, and resist the exploitation of speculative, socially insignificant and unproved hypotheses before mystified audiences. Also he can lend his support both to the re-orientation of scientific research in accordance with a real plan of social research, and to the political and social forces necessary to compel action along the lines of knowledge rather than those of prejudice.

Enzyme Studies

Ergebnisse der Enzymforschung
Herausgegeben von F. F. Nord und R. Weidenhagen. Band 5. Pp. xi + 378. (Leipzig : Akademische Verlagsgesellschaft m.b.H., 1936.) 30 gold marks.

THESE "Ergebnisse" once more contain valuable summaries of selected sections in the continually expanding field of biochemistry included under the term 'enzymes'. The contributions are as international as ever, but only the minority are from German laboratories : it is an interesting question whether this denotes a falling off in scientific activity there under present political conditions.

Prof. Alex. McKenzie of Dundee gives the complete story of asymmetric synthesis, a subject to which he has devoted his energies and which has not been monographed as yet. Very opportune is an account written by Folley and Kay, fifty-four pages in length, of the phosphatases, since the substrates on which they act, the phosphoric esters, hold a key position in many of the processes taking place in living organisms : thus they are concerned in alcoholic fermentation, muscular contraction, bone formation and lactation, whilst the many phospho-organic compounds in living matter are probably all dependent on the activity of phosphatases. At present there is no real understanding of the true role of these enzymes, but much progress can be reported in the accumulation of facts : the summary should help to arouse fresh interest in the subject. It is followed by an article on lecithase, the mixture of enzymes which hydrolyse lecithin in a variety of ways : this is from Milan and is written by Messrs. Belfanti, Contardi and Ercoli. No less than seven different enzymes take part in the simplification of lecithin by a series of steps which thus afford a very interesting biological problem.

Another summary, dealing with a problem which is still unsolved despite its importance, is that on the biochemical synthesis of fats, from the pen of Dr. Smedley Maclean. We know that the pig in particular is able to effect the transformation with ease, but neither the site in the body where it happens, nor the nature of the first products of the synthesis, has been determined. The author inclines to the theory, for which there is some experimental support, that pyruvic acid is the intermediate stage, rather than accepting the alternative formation of fat direct from hexose or through acetaldehyde.

There is a stimulating article on proteases by Grassmann and Schneider, of Dresden. Since Northrop has been so successful in obtaining some of these enzymes in the crystalline state, enhanced interest is attached to their behaviour. It is now possible to lay down exact conditions for the structure of the substrate favourable for the action of the peptidases, and the same applies to the carboxy-polypeptidases, which require also a free carboxyl group in the substrate. Progress is also to be recorded in the identification of some of the active groups in these substances.

A group of enzymes, of which the knowledge is vague, are those that hydrolyze the pectins : a useful summary about them is provided by Kertesz, of Geneva, N.Y. Pectinase appears to be a complex of enzymes containing at least a polygalacturonase and a pectin methoxylase, the former being a glycosidase and the latter an esterase: other constituents appear to be able to split off arabinose or galactose from the pectin complex. This is obviously a field requiring much further investigation.

Müller, of Copenhagen, describes an oxidase prepared from *Aspergillus* or *Penicillium*, which is able to oxidize glucose to gluconic acid with atmospheric oxygen: the significance of this reaction in the economy of these fungi is discussed.

Space considerations allow only of reference to one other review, namely, that on chlorophyll photosynthesis, from the pen of Robert Emerson of Pasadena. The review is opportune, for the subject continues to be a very difficult one, and in spite of a lot of work there has been no great progress in it during the last decade. At least the behaviour of enzymes towards carbon dioxide is being studied energetically, whilst a great deal more is known about chlorophyll.

The items which have been picked out for comment serve to indicate the value of the book: the editors once more deserve thanks for providing such stimulating fare. E. F. A.

History of Medicine

(1) The Story of Medicine in the Middle Ages

By Prof. David Riesman. Pp. xii+402. (New York: Paul B. Hoeber, Inc., 1935.) 5 dollars.

(2) A Short History of Talmudic Medicine

By Dr. J. Snowman. Pp. 94. (London: John Bale, Sons and Danielsson, Ltd., 1935.) 3*s*. 6*d*. net.

(3) Medical Practitioners in the Diocese of London

Licensed under the Act of 3 Henry VIII, C. II.; an Annotated List 1529–1725. By J. Harvey Bloom and R. Rutson James. Pp. viii+98. (Cambridge: At the University Press, 1935.) 5*s*. net.

(4) An Essay on the External Use of Water

By Tobias Smollett. Edited, with Introduction and Notes, by Claude E. Jones. (Reprinted from *Bulletin of the Institute of the History of Medicine*, Vol. 3, No. 1, January 1935.) Pp. 31–82+1 plate. (Baltimore, Md.: Johns Hopkins Press; London: Oxford University Press, 1935.) 4*s*. 6*d*. net.

(5) The Story of the Middlesex Hospital Medical School

Written at the request of the Council of the Medical School on the Occasion of the Centenary. By Dr. H. Campbell Thomson. Pp. xiii+182+20 plates. (London: John Murray, 1935.) 10*s*. 6*d*. net.

(6) American Medicine

By Dr. Henry E. Sigerist. Translated by Hildegard Nagel. Pp. 316+30 plates. (New York: W. W. Norton and Co., Inc.; London: Oxford University Press, 1934.) 16*s*. net.

(1) THE work on medicine in the Middle Ages by Dr. David Riesman, professor of the history of medicine in the University of Pennsylvania, contains an admirably comprehensive study of the medical aspects of an age which until recently had received comparatively little attention. As Dr. Riesman points out, we are in the first place indebted to medieval medicine for the preservation of the writings of the Greeks, Romans, Arabians and Jews, without which progress in medicine would never have taken place. As regards Arabian medicine, he judiciously remarks that it is yet too early to pass a final judgment in view of the probable existence of many undeciphered texts, but he brings forward in its favour the preservation of many texts, many chemical discoveries, good advice concerning diet, a clear account of many diseases, and a considerable number of plant remedies.

The work of the universities, the foundation of which Dr. Riesman regards as probably the greatest achievement of the Middle Ages, next receives attention, special chapters being devoted to the medical personalities and studies at Montpellier, Bologna, Padua, Paris and Oxford and Cambridge respectively.

Considerable attention, of course, is given to the description of the various diseases prevalent in the Middle Ages, of which the most important were plague, leprosy, sweating sickness, St. Anthony's fire, the King's Evil and epilepsy. The vexed question as to the existence of syphilis in medieval times is fully discussed, the author being of opinion that it is not yet possible to say definitely whether the disease was imported from America or not. Other aspects of medieval medicine considered are alchemy, the hospitals of the period, medicine and the guilds, medical text-books in use, hygiene and sanitation, and the lay attitude towards the medical profession with special reference to the unkindly criticisms of Petrarch and Chaucer.

In conclusion, Dr. Riesman points out that the greatest difference between modern times and the Middle Ages in medicine, as in all sciences, is the objective experimental method characteristic of modern times. The text is liberally interspersed with portraits and other illustrations.

(2) In his little book on Talmudic medicine, which is based on the works of Julius Preuss, I. L. Katzenelsohn and M. Pearman, Dr. J. Snowman describes the medical conceptions current among the Jews during the Talmudic period, that is, from A.D. 200 to 600. An excellent account is given of the Talmudic theories as to the causation and cure of diseases, contemporary anatomy and physiology, and the progress made in the various branches of medicine.

The descriptions of superficial anatomy in the Talmud are remarkably accurate, but owing to the absence of dissection little could be learnt about the internal organs, though fanciful views were expressed as to their functions. The medical diseases mentioned in the Talmud include acute intestinal disorders probably due to dysentery, and leprosy, quinsy, cold in the head, worms and headaches, while the surgical disorders consist of superficial wounds, stone in the bladder, abscesses, burns and scalds, bites of mad dogs, snake-bites and fractures and dislocations. A special chapter is devoted to the minor operations of ritual circumcision and venesection, which was used for therapeutic and hygienic purposes.

As regards gynæcology and obstetrics, the diseases of women mentioned in the Talmud are mainly connected with uterine hæmorrhage. Difficult labour is frequently noted; sacrifice of the infant and Cæsarean section appear to have been practised. Diseases of the eye are frequently mentioned, especially cataract and corneal opacities.

The rabbis' knowledge of comparative anatomy, though gained only from the study of certain cattle, sheep and poultry, seems to have been remarkably extensive, being concerned with changes in the lungs, brain, heart, liver, spine, stomach, gall-bladder and intestines.

(3) In their work on medical practitioners in the diocese of London 1529–1725, Messrs. J. Harvey Bloom and R. Rutson James have compiled an annotated list drawn from various sources of those licensed to practise under the Act of 3 Henry VIII, c. II in the diocese of London. The book does not contain the names of all the practitioners in the diocese, as those licensed by the Royal College of Physicians as well as some surgeons and barber surgeons are not included. The Act laid down that no person within the City of London or within seven miles of the same should take upon himself to practise as a physician or surgeon unless he had been first examined, approved and admitted by the Bishop of London or by the Dean of St. Paul's, assisted by doctors of physic and other expert persons in the faculty of surgery. Of the examiners, the only well-known names that have been preserved are those of Sir Hans Sloane, president of the Royal Society and of the Royal College of Physicians, John Evelyn the diarist, and the infamous Titus Oates.

The list contains in all 360 names, of which 184 have their documents preserved at Somerset House and 176 in the registry of the Bishop of London. The most eminent licencees in the list are William Clowes (1540–1604), the famous Elizabethan surgeon attached to St. Bartholomew's Hospital; Charles Bernard (1656–1710), Sergeant-Surgeon to Queen Anne, surgeon to St. Bartholomew's Hospital and owner of a fine library; Ambrose Dickins (1687–1747), surgeon to Westminster and St. George's Hospitals and Master of the Barber Surgeons' Company; and William Cheselden (1688–1752), surgeon to St. Thomas's and St. George's Hospitals and famous for his operations for stone and cataract. The Act was never repealed, but died a natural death through lack of applicants.

(4) Smollett's essay on the external use of water, which was originally published in 1752, is preceded by an introduction by Mr. Claude E. Jones, who remarks that Smollett's writings are of interest to the student of medical history for two reasons; first on account of his small ventures in the field of medicine proper, of which the present essay is an example, and secondly for the vast number of medical pictures and comments scattered through his other works.

The present essay purports to be a letter addressed to Dr** "on the external use of water with particular remarks upon the present method of using the mineral waters at Bath in Somersetshire, and a plan for rendering them more safe, agreeable and efficacious". After a brief account of the value of the internal use of pure water, Smollett describes its employment in the form of foot-baths, universal baths and fomentations in the treatment of various disorders. In conclusion, he directs attention to certain inconveniences attending the use of the waters at Bath, such as promiscuous admission of diseased persons of all ages, sexes and conditions into an open bath, the confinement of their use to the most severe seasons of the year, and the lack of attendants and proper conveyances, and draws up a series of proposals to remedy these inconveniences.

(5) The history of the Middlesex Hospital Medical School is admirably told by Dr. H. Campbell Thomson, consulting physician to the Department for Nervous Diseases at the Hospital, and from 1908 until 1919 dean of the Medical School. Although the school was not founded until 1835, teaching in the hospital began shortly after the hospital was established in 1745. The inaugural address on October 1, 1835, when the medical school was formally opened, was delivered by Sir Charles Bell, the eminent anatomist and artist, and one of the three surgeons to the hospital. It

is noteworthy that five of his colleagues on the staff were, like himself, fellows of the Royal Society, the most eminent of them being Sir Thomas Watson, the senior physician and professor of medicine in the School, whose work on the principles and practice of physic is a medical classic.

Since that time, the Medical School has had a number of famous men on the staff, the most remarkable co-existence of celebrities at one time being the triumvirate in 1906 consisting of Sir Henry Morris, president of the Royal College of Surgeons, Sir Richard Douglas Powell, president of the Royal College of Physicians, and Sir James Kingston Fowler, dean of the Faculty of Medicine of the University of London.

Two scientific institutes connected with the School deserve special mention, namely, the Bland-Sutton Institute of Pathology opened in 1914, and the Courtauld Institute of Biochemistry opened in 1928, where there are always a number of research workers from Europe and the United States.

(6) In the excellent English translation by Miss Hildegard Nagel of his work on American medicine, Dr. Henry E. Sigerist, professor of the history of medicine at Johns Hopkins University, who had formerly held the corresponding chair at Leipzig, has given a lively account of the development of American medicine, from the earliest times until the present day as seen by an unprejudiced and sympathetic observer.

The book contains an interesting account of primitive medicine in North America, followed by a description of medicine in the colonial period, biographical sketches of medical pioneers in the United States from John Morgan and Benjamin Rush in the eighteenth century down to Billings and Osler in our own time, the present condition of medical education with special reference to Johns Hopkins University, where attention is focused on science and research, the organization of hospitals and nursing, public health work including campaigns against infectious diseases, maternity and child welfare, mental hygiene and various scientific institutions connected with medical clinics.

Dr. Sigerist rightly claims that whereas fifty years ago American schools counted for nothing in world medicine, to-day the standard of education equals that of most European countries and in many places and in some points is superior.

Theory and Practice of Electrochemistry

(1) Electrolytic Oxidation and Reduction: Inorganic and Organic. By Dr. S. Glasstone and Dr. A. Hickling. (Monographs on Applied Chemistry, Vol. 9.) Pp. ix+420. (London: Chapman and Hall, Ltd., 1935.) 25*s*. net.

(2) Principles of Experimental and Theoretical Electrochemistry
By Prof. Malcolm Dole. (International Chemical Series.) Pp. xiii+549. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 30*s*. net.

(3) Principles and Applications of Electrochemistry
By Prof. H. Jermain Creighton. In 2 vols. Vol. 1: Principles. Third Edition, revised and enlarged. Pp. xviii+502. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 20*s*. net.

(4) Principles and Applications of Electrochemistry
By Prof. W. A. Koehler. In 2 vols. Vol. 2: Applications. Pp. xiv+545. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 25*s*. net.

SOME sections of the broad science of chemistry are purely theoretical, others are essentially practical, but electrochemistry in its modern developments combines the two aspects. The appreciation of its principles demands an intensive knowledge of mathematics and thermodynamics; the application of those principles to industrial purposes is of fundamental importance, both on the inorganic and on the organic sides. No Chancellor of the Exchequer needs to ask to-day, as Gladstone did: "What's the use of it?"; he has long ago taken advantage of Faraday's reply to the question: "Why, sir, there is every probability that you will soon be able to tax it!"

(1) The monograph by Drs. Glasstone and Hickling illustrates to an unusual degree the close intermingling of present-day electrochemical theory and practice. As the preface states, purely empirical methods are no longer satisfactory in the control of industrial processes, and success in such operations can only follow from an understanding of the fundamental principles involved.

The basic theory of the subject is clearly presented in this book, and a multitude of practical illustrations discussed in detail. Full references to scientific and patent literature are appended at the end of each chapter, and the hope of the authors that "the book will be of value both to research workers and to technical chemists interested in the enormous possibilities of electrolytic methods" will no doubt be amply fulfilled. The book is one to be highly recommended.

(2) The volume by Prof. Dole, of Northwestern University, Illinois, is more restricted in its scope, dealing as it does only with the theoretical principles of electrochemistry. These principles, however, are introduced throughout from an experimental angle, so that in spite of the fact that the main stress of the book is upon the interpretation of electrochemical phenomena, the student who has conscientiously studied each chapter should be well equipped to put the knowledge acquired to practical use if necessary. The book constitutes a serviceable text for honours students specializing in electrochemistry and for Ph.D. research workers in this branch of the subject.

(3) The fact that Prof. Creighton's "Principles of Electrochemistry" has now reached the stage of a third edition is evidence of its popularity and merit. The treatment is elementary but thorough, and furnishes a most readable introduction for the student of electrochemical theory. In order to bring certain topics into harmony with recent advances, a great many portions of the second edition have been rewritten and new subject matter has been added. The problems inserted at the end of nearly every chapter and the numerous references to original papers add materially to the value of the book.

(4) "Applications of Electrochemistry", by Prof. Koehler, forms a companion volume to Creighton's "Principles". It is intended for two classes of readers: students in universities, colleges and technical schools for use as a textbook; and persons connected with the industry for use as a reference work. The difficult problem of making the book sufficiently complete and up-to-date without at the same time making it too voluminous for academic purposes has been very successfully met, and the impressive list of experts to whom the author makes acknowledgment for assistance and suggestions bears witness to his assiduity in ensuring accuracy in each section of the field covered.

Practically every point of importance in inorganic electrochemical industry is presented in a clear and compact manner, and the presentation is assisted materially by a large number of plates, diagrams and tables. Organic electrochemistry, presumably for reasons of space, is scarcely touched. A third volume of the series, treating this subject in the same admirable style, would be warmly welcomed. JAMES KENDALL.

Forests and Flora of British Honduras

The Forests and Flora of British Honduras
By Paul C. Standley and Prof. Samuel J. Record, in cooperation with the Conservator of Forests and the Agricultural Officer of the Colony. (Botanical Series, Vol. 12, Publication 350.) Pp. 432+16 plates. (Chicago: Field Museum of Natural History, 1936.)

FOLLOWING a short introduction on the geography, soils, climate, agriculture and forest products of British Honduras, the remainder of this substantial volume is divided into two parts, entitled respectively "The Forests" and "The Flora". In Part 1, which occupies about thirty pages, and is contributed by Prof. Record, a description is given of the forests, with a short history of the same, and a reference to and description of most of the timbers of economic importance, including uses as timber and also for pulp, with an interesting account of the Chicle gum industry. Throughout the remainder of the work Prof. Record has also contributed a description of the different woods wherever they are named, and he states that "the wood descriptions are short because all of the more important species have been covered more fully in 'Timbers of Tropical America' or in special articles in *Tropical Woods*".

Part 2, comprising the whole catalogue of the trees and shrubs of British Honduras, is the work of Mr. Standley, no doubt greatly assisted by the knowledge acquired by Prof. Record, who "began about ten years ago to compile a list of all of the available scientific and local names of the woody plants of the Colony". This splendid production is of first importance as presenting an authoritative work on a much needed subject, and comes at a timely moment, because—perhaps for the first time—a vigorous reorganization of the Colony's timber production and conservation is at work.

Prof. Record points out that "although British Honduras has been a timber-producing country for 250 years, systematic forestry was started only in 1922 with the formation of the Forest Department". This Department is vested in a Forest Trust with the Governor as chairman, and the policy laid down includes an excellent programme which should very soon yield many results, not the least of which is to find a market for some of the useful secondary woods. The work provides a full list, enabling the timber expert to trace the vernacular names to the correct identification of the botanical types, and provides the same advantages to the large number of people who are enthusiastic collectors of useful and ornamental flowering shrubs.

A painstaking and conscientiously accurate description is given of the measurement of the trees, leaves, flowers and fruit, together with the districts in which they abound.

The history of this tropical country is full of romance and interest. Why the Maya peoples settled there, or whence they came seems to be undecided. In the beginning, their fight against Nature and the jungle must have been very severe, but at last they succeeded and established their cities. Then again Nature reasserted herself, and in course of time turned them out.

Gann and Thompson say:

> "those cities which were ill situated, from an agricultural point of view, would naturally be the first deserted, while the cities in the fertile lands of north-eastern Peten would be amongst the last.
>
> "Whatever the cause, it is certain that by the third Katun of Bactun 10, or 629 A.D., the whole of the Old Empire was almost completely abandoned, and remained so for the next seven or eight centuries, when reforestation of the lands enabled at least a part of the descendants of the original dwellers to return to the home of their ancestors."

The same authors inform us that it took 250 years for the Maya to evacuate the land. They state that the reason for the evacuation is not known, but they mention seven possible reasons, of which the sixth is "exhaustion of the soil". The other reasons are: "1. National decadence. 2. Epidemic disease. 3. Earthquakes. 4. War, internecine or foreign, or both combined. 5. Climatic changes. 7. Religious or superstitious reasons."

The practice followed by almost all primitive peoples was to cut down the trees and shrubs over one area, and move on after a year or two, repeating the same process in another, which must at last have rendered the whole country barren of trees, so that erosion of the soil would have followed in the same way as in other countries. There seems to be little doubt, therefore, that the sixth reason referred to above, namely, "exhaustion of the soil", was the cause of the final evacuation.

The romance of this country did not finish with the departure of the Maya. The story of the early British voyagers who visited these far distant countries is fairly well known. Prof. Record informs us that:

> "It was at one time the practice of the class of privateers . . . cruising against Spanish traders to set fire to all vessels they captured which might be laden with Logwood, having first stripped them of everything valuable.
>
> "But it so happened that a Captain James, the master of a letter of marque, having captured a Spanish vessel the cargo of which consisted of this wood, brought the ship and cargo into the Port of London. On endeavouring to dispose of the latter he was gratified as well as surprised to find for it a ready sale at an enormous price per ton. The crew, who had used up a portion of the precious freight to burn in the galley fire, had little idea that they were using fuel at a hundred pounds per ton during the voyage."

No less romance is attached to the beginning of the trade in mahogany, which is supposed to have begun about 1725. A little later, in 1786, a treaty was made between Great Britain and Spain, which gave the right to British settlers to cut wood "not excepting even mahogany".

Having regard to the importance and value of this colony, it seems incredible that a recognized forestry service should have been started only in 1922, but with the competent activities of the present Governor, and the Conservator of Forests, good results may confidently be expected. There can be no stronger indication of its importance than the interest shown by the two very well-known authors of the present work—Samuel J. Record and Paul C. Standley. Prof. Record had already provided generous contributions to our knowledge of forests and their products, and this new book comes at a most opportune moment.

ALEXANDER L. HOWARD

Das Tierreich:

eine Zusammenstellung und Kennzeichnung der rezenten Tierformen. Gegründet von der Deutschen Zoologischen Gesellschaft. Im Auftrage der Preussischen Akademie der Wissenschaften zu Berlin. Lief. 65: Lepidoptera—Parnassiidæ pars 2 (subfam. Parnassiinæ). Bearbeitet von Felix Bryk. Pp. li + 790. (Berlin und Leipzig: Walter de Gruyter und Co., 1935.) n.p.

THE contents of this extensive work are embodied in the title. It monographs the genera and species of 'Apollo' butterflies forming the subfamily Parnassiinæ together with their numerous forms of subspecies. In each case, the synonomy is given, followed by a description of the species and form concerned, its distribution and the location of the type specimens. It is profusely illustrated by means of 698 text-figures of the various species, together with structural details of a diagnostic character. The extraordinary range of forms into which the various species are divisible has made the genus a specialized study among lepidopterists. In the case of *P. apollo*, for example, the index alone of the forms of this species runs to five pages of double columns. A detailed and authoritative work of this kind is likely to remain a standard for a number of years.

The Subject Index to Periodicals, 1935

Pp. xiii+235. (London: The Library Association, 1936.) 70*s*.

WITH this issue the "Subject Index to Periodicals" completes twenty years of existence, the first volume published being for the year 1915. The volume for 1935 appeared only five months after the close of the year covered. The general editor, Mr. T. Rowland Powel, his staff and the voluntary contributors are to be congratulated on the rapidity with which the work has been carried out. The Subject Index for 1935 comprises entries of about 26,000 articles selected from 590 periodicals. Of these periodicals 540 are English and American, 27 French and Belgian, 21 German, and 2 Italian. The articles selected are arranged under headings such as "Light", "Lighting", "Lightning", etc., but under each heading the order is that of authors' names.

The subjects selected for indexing are by no means confined to science, but cover a wide range. Verse and fiction are excluded. With few exceptions, no attempt has been made to index periodicals already indexed in the following: *Agricultural Index, Engineering Index, Engineering Abstracts, Index Medicus, Journal of the Society of Dyers and Colorists, Photographic Abstracts, Revue de Géologie, Royal Meteorological Society Bibliography, Science Abstracts, Textile Institute Journal.*

All workers in science value these Subject Indexes, and appreciate the care and efficiency which, under the auspices of the Library Association, have been devoted to their production. It is probable that many a valuable paper, published in a journal that is little read, is here introduced to a much larger world.

Pheretima (The Indian Earthworm)

By Prof. Karm Narayan Bahl. (The Indian Zoological Memoirs on Indian Animal Types, 1.) Second edition, revised and enlarged. Pp. x+85. (Lucknow: Lucknow Publishing House, 1936.) 1.8 rupees.

PROF. BAHL, the author of the memoir under notice, is also the general editor of this useful series. It is ten years since the first edition was published, and the relevant work done in the interval has been incorporated. The book has been thoroughly revised and to some extent rearranged. It is printed upon a more satisfactory paper, which does better justice to the illustrations. Five of the figures of the first edition have been omitted, nine new ones inserted and several have been redrawn, resulting in a distinct improvement. The brief account of the development has been omitted but an interesting new chapter on the receptor organs has been put in. The old chapter on habits and distribution has been rewritten and extended, and removed to near the end as "Bionomics, Distribution and Relationships".

The memoir was good when first issued and its usefulness is shown by the demand for a second edition. In its new form, where every chapter has been critically revised and added to, the illustrations improved, and the recent work included, it should be assured of a new lease of life.

C. H. O'D.

Geologie Südamerikas

Von Prof. Dr. H. Gerth. (Geologie der Erde, herausgegeben von Prof. Dr. Erich Krenkel.) Teil 2. Pp. vi+201–389+plates 18–30. (Berlin: Gebrüder Borntraeger, 1935.) 19.60 gold marks.

THE second part of Prof. Gerth's exceedingly useful treatise on the geology of South America deals with the geological history of the continent during Mesozoic times and summarizes, in a very concise manner, the rather scattered literature on the subject.

The method of treatment is similar to that employed so successfully by the author in vol. 1, and the regional discussion of each system or formation is followed by a short section dealing with the main events throughout the continent as a whole.

In contrast to the northern hemisphere, the Mesozoic era in the southern continent was a period of intense and widespread igneous activity which reached its maximum expression during the Trias but recurred locally during the Jurassic and Cretaceous. The author brings this igneous activity into line with the tectonic status of the continent and traces the development of the three great, independent zones of sedimentation from which the Tertiary orogenic zone developed.

The numerous correlation tables and abundant references to literature considerably increase the value of this excellent book, which must prove of interest and value to all geologists, and not merely to those directly concerned with the problems of South American geology.

Beiträge zur Herkunftsbestimmung bei Honig

Band 1: Pollengestaltung und Herkunftsbestimmung bei Blütenhonig; mit besonderer Berücksichtigung des Deutschen Trachtgebietes. Von Prof. Dr. Enoch Zander. Pp. 343+80 plates. (Berlin: Verlag der Reichsfachgruppe Imker E.V., 1935.) 18 gold marks.

HONEY contains large numbers of pollen grains of the blossoms visited by bees, and, consequently, a study of the pollen may yield considerable information as to the source of a honey sample—not only the flower-source, but perhaps also of the district or country of origin.

This volume contains an exhaustive account of the pollen forms that have been noted in German honey and also in occasional samples from other lands. Since the German and British floras have much in common, British students may find this work useful. Descriptions of the pollen of nearly six hundred species of plants belonging to 109 families are supplied, and pollen characters such as size, shape, number of pores and furrows are also marshalled in lists. Photographic illustrations of the pollen of nearly 350 species are also included in double-sided plates. These plates are disappointing. Each pollen form is generally shown twice, at magnifications of 160 and 450 times. For all but a small number of the larger pollen grains, the lower magnification is too low to give a picture of any value in a work of this kind, while even at the higher magnification details of diagnostic value are often obscure.

Deterioration of Structures in Sea Water

NOT the least important of the matters which concern the civil engineer engaged on port and maritime works, such as docks, jetties, wharves and piers, is the durability in a marine environment of the materials available for constructional purposes. Timber, iron and steel and concrete immersed in sea water are exposed to the action of agencies producing damage and deterioration to a far higher degree than those characteristic of a purely atmospheric environment. Timber is not only particularly prone to 'rot' or decay at or about the water-line, especially if that fluctuates in level, but also it is assailed by marine organisms of highly destructive capability, while the chemical action of the salts in sea water is equally potent, under suitable conditions, in causing and fostering corrosion in metals and disintegration in concrete. When, therefore, the Institution of Civil Engineers, in 1920, instituted a Committee of Inquiry into the Deterioration of Structures in Sea Water, it took a step which had long been desirable and which, it may confidently be asserted, has been of inestimable advantage both to the profession and to the public at large. An investigation of the kind in question is bound to be prolonged, since certain deleterious processes are slow in action, though their cumulative effect over a number of years may be extremely serious and even fatal. Each year, the Committee has published the results of its inquiries in the form of interim reports, and now it is felt that the time has come when it is fitting to issue a connected account of the whole of the investigations which have been carried out up to date, and the conclusions which, in the opinion of the Committee, may reasonably be drawn from the results so far obtained.

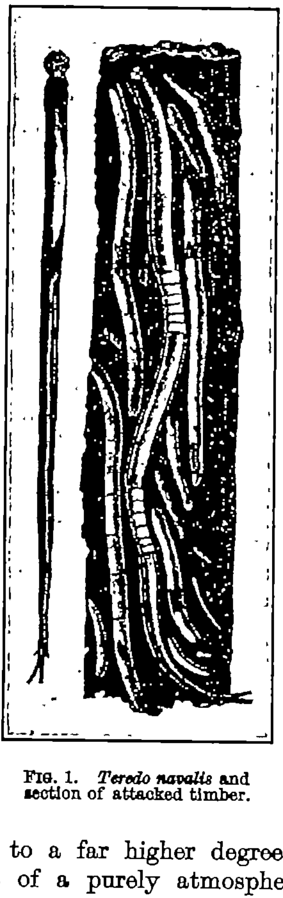
FIG. 1. *Teredo navalis* and section of attacked timber.

This has been done in a volume which has been published by the Department of Scientific and Industrial Research* embodying the fifteenth report of the Institution Committee, though the Department is careful to state that it is not responsible for the statements made or the opinions expressed therein. A similar disclaimer is made by the Institution as regards endorsing the views of contributors whose names appear in connexion with their work.

The Report comprises four sections, relating respectively to the preservation of timber, the corrosion of steel and iron, the protection of steel and iron by means of paints and other preservatives, and lastly, the deterioration of reinforced concrete.

Omitting decay, the principal cause of damage to timber structures in sea water is the *Teredo* or *Bankia*, commonly known as the ship-worm, and certain allied species (Fig. 1). The ravages of these molluscs were evident in the earliest days of shipbuilding, and they are recorded to have proved disastrous in the fourth voyage of Columbus, whose ships were "pierced with worm-holes like a bee-hive". At the present day, the damage done to timber piling in various parts of the world may be reckoned in millions of pounds. The Romans are stated to have made the discovery of a species of wood which is immune, but their secret is lost, and so far as current knowledge goes, there is no timber which is indubitably free from liability to be attacked. As the result of the experiments carried out, the Committee came to the conclusion that "no process for the preservation of timber was more satisfactory than that of impregnation with creosote" and that "the efficacy of the process depended on the completeness with which the penetration of the creosote into the timber had been effected".

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* Department of Scientific and Industrial Research. Deterioration of Structures of Timber, Metal and Concrete exposed to the Action of Sea-Water. Fifteenth Report of the Committee of the Institution of Civil Engineers: being a General Description of the Experimental Work carried out by the Committee to date. Edited by S. M. Dixon and H. J. Grose. Pp. xvi+188+80 plates. (London: H.M. Stationery Office, 1935.) 12*s*. 6*d*. net.

In order to increase the degree of penetration, incision of the fibres was resorted to, and the results of the operation are stated to have been satisfactory, the depth of the penetration being governed by the depths of the incisions, which had to be limited "in some cases" because there was a danger of injuring the timbers if the depth of the incisions exceeded ¾ inch. The warning is significant, and there are those who will feel that incision is a method to be used with extreme caution, since injury to the fibres can scarcely be avoided, with consequent impairment of strength. The normal process of impregnation with hot creosote does not appear to affect the strength of timber to any material degree, though high temperatures were observed to produce some reduction of strength. The arsenical compound, chlorodihydrophenarsazine, commonly called "D.M.", proved very deadly to *Teredo* when in the state of free swimming larvæ. The experiments did not definitely show creosote to be an efficient protection in the case of crustaceans, such as *Limnoria*, though it appeared to have some useful effect against *Chelura*. Prof. G. Barger contributes a detailed account of his experiments with various toxins, and Prof. S. M. Dixon describes his mechanical tests of foreign timbers, untreated and creosoted, with a note on incising.

The corrosion of metals constitutes a wide field of inquiry in itself, and though in the present instance limited to iron and steel, specimen bars of no less than fourteen different materials were selected for experiment: these included three representative rolled irons, four ordinary steels, two types of cast iron and five special steels. In their choice of specimens, the Committee had the advice of Sir Robert Hadfield, and the examination of the bars after exposure was made by Dr. J. Newton Friend. The test specimens were in general 24 in. long by 3 in. by ½ in.

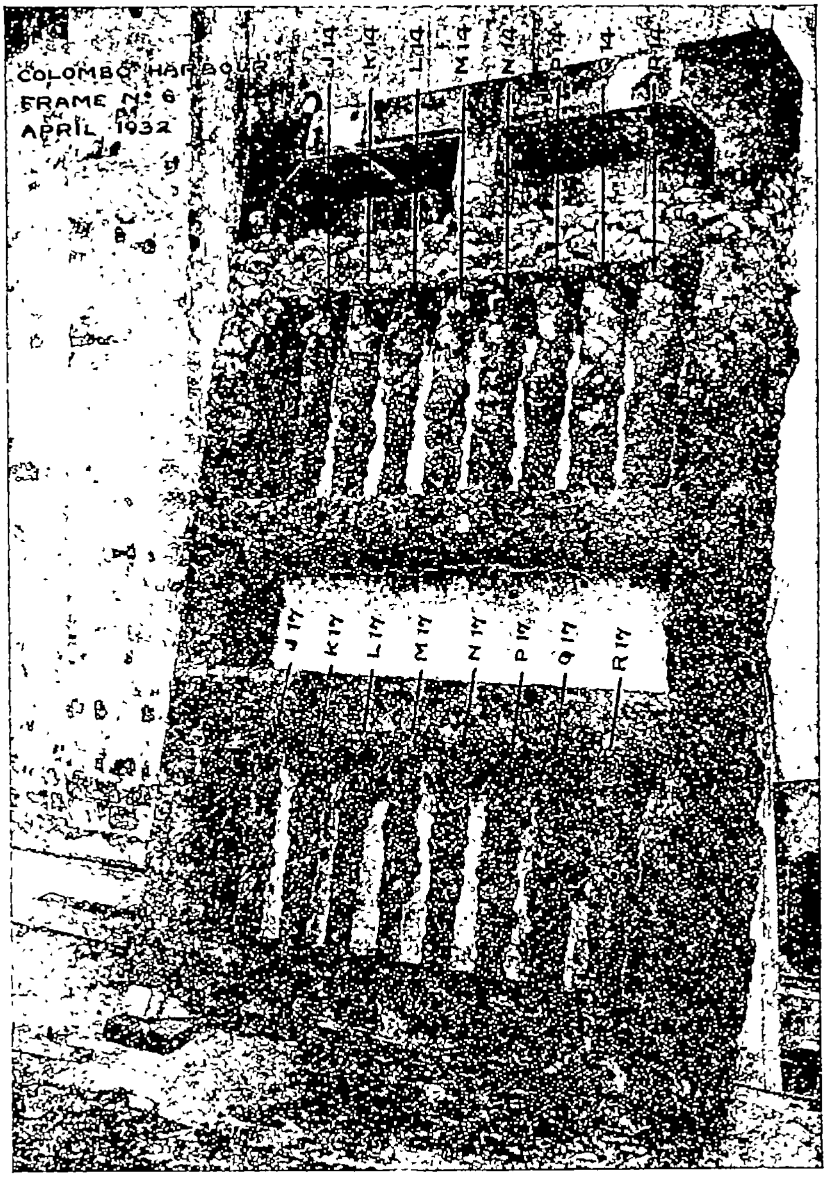

FIG. 2. Frame containing bars exposed to half-tide conditions (upper part) and to complete immersion in sea water (lower part) at Colombo for 10 years. Reproduced by permission of the Controller of H.M. Stationery Office from "Deterioration of Structures in Sea Water". Crown copyright reserved.

On the whole, there was found to be little to choose between the wrought irons and the ordinary carbon steels used in the research, as regards their mean resistance to the various types of corrosion studied; and increasing the carbon content of ordinary steel from about 0·24 to 0·40 per cent did not appear appreciably to affect the resistance of the metal against corrosion. The addition of 0·6 and 2·2 per cent of copper to mild carbon steel markedly increased the resistance of the metal to aerial and freshwater corrosion, but this advantage did not appear to be maintained in the half-tide and complete immersion tests in sea water. The addition of chromium proved beneficial in the tests above high-water mark, but in the half-tide and complete immersion tests it resulted in excessive pitting. The best results were obtained by adding a proportion of nickel to the steel, an addition of 36·6 per cent rendering the material exceptionally resistant under all conditions. The cast irons resisted aerial corrosion exceedingly well and fresh-water reasonably well, but in the half-tide and complete immersion tests in sea water, corrosion frequently penetrated to the middle of the bars through pores and casting flaws. It is to be noted that the corrosion of the test bars was complicated by the occurrence of marine growths, including barnacles and oysters (Fig. 2).

The preservative effect of paints and other coatings on a number of mild steel plates (2 ft. long by 6 in. wide by about 0·1 in. thick) was studied, and the tests under the supervision of Dr. Newton Friend yielded results of much interest. The advantage of removing the mill-scale prior to coating, either by pickling or sand-blasting, was brought out clearly. Immersion in sea water and subsequent scraping was not so satisfactory. The plates were treated with red iron oxide paint (adopted as the standard for comparison) and with ordinary red lead paint with various Pb_3O_4 contents. The red lead paints showed distinct superiority in the aerial and half-tide experiments, but not in the total immersion tests. A series of plates were galvanized and a further set covered with tar and bituminous mixtures. Galvanizing proved very successful with a coating of about 20 oz. of zinc per square yard. Coal tar gave excellent results and proved in all circumstances much better than iron oxide and lead paints. Bituminous solution gave poor results in aerial tests, but excellent results in the half-tide and complete immersion tests.

The experimental investigation of the durability of reinforced concrete in sea water has been conducted by Dr. R. E. Stradling. The experiments have involved the preparation of 474 reinforced concrete piles and 5,388 cylinders of different composition and treatment. The longest period of exposure experienced by any of these series as yet is only 5½ years, and it is therefore premature to draw other than merely tentative conclusions therefrom. As further examination may lead to modified views, it is scarcely advisable at this stage to do more than record the continuance of the exposure tests under various conditions at stations at Sheerness, Watford and the Gold Coast.

The volume, which is well illustrated and accompanied by diagrams and tables of great interest, will be of value to all who are in any way responsible for the maintenance of structures in a marine environment. It should be added that the research is now being carried on by means of the financial assistance received from a large number of dock and harbour authorities. There is a good index.

In connexion with the foregoing review, it is appropriate to notice a paper on "The Corrosion of Iron and Steel" by Sir Robert Hadfield and Mr. S. A. Main which was read at a meeting of the Institution of Civil Engineers on April 7. The paper was essentially an extension and amplification of the Committee's Report, in that it surveyed more completely the field of investigational activities in regard to the corrosion of ferrous metals since 1922, the date of a previous paper on the subject by Sir Robert Hadfield. Emphasis was laid on the importance of the study of corrosion from the testimony of Dr. F. N. Speller, director of research at the National Tube Company, Pittsburgh, U.S.A., who had made a careful estimate of the total amount of steel in use in the world and found it to be about 1,200 million tons, of which 700 million tons is probably in use in the United States. Dr. Speller further estimated that about 75 per cent of the steel requires protection in order to be used.

Alluding to the work of the Committee, it was stated that altogether 1,350 specimens of carbon and special steels were prepared by Messrs. Hadfields of Sheffield for experimental purposes, and that in regard to exposure to air, the order of increasing severity for general wastage at the stations selected for observation was invariably Halifax (Nova Scotia), Auckland, Plymouth and Colombo. Climatic temperature, which is highest at Colombo and lowest at Halifax, evidently must have a definite influence in promoting aerial corrosion. This factor, however, did not operate to the same extent under half-tide conditions or for total immersion: presumably, therefore, the local character of the sea water may be of more importance than its temperature. The evidence of the behaviour of iron and steel under half-tide conditions is especially instructive, being contrary to the widely accepted idea that exposure "between wind and water" is particularly favourable to corrosion. In the great majority of cases among ordinary steels and rolled irons, the wastage at half-tide is intermediate between that experienced under aerial and total immersion conditions.

The authors gave some examples of the severity of the corrosion experienced in the Gulf of Paria, where the United British Oilfields of Trinidad, Ltd., reported that a 5/16 in. mild steel plate, forming the bottom of a storage tank, was eaten through in nine months. Among the protective measures discussed, special mention was made of oxide films, not more than 1·6 millionths of an inch in thickness, yet capable of providing an armour, or first line of defence against corrosion. In most cases of general wastage of steel, the removal of the rolling-mill scale, prior to exposure, had the effect of increasing the amount of corrosion, but, on the other hand, as regards pitting, its influence was almost entirely favourable. The wastage of cast iron was generally very much less than that of the rolled irons and steels, and the pitting in a five-year test was negligible.

BRYSSON CUNNINGHAM.

Insect Life of Temporary Rain Swamps in British Guiana

By F. A. Squire, Department of Agriculture, British Guiana

TWICE a year, during the months immediately preceding and following the solstices, the low-lying, badly drained grasslands of the coastal belt of British Guiana are converted into temporary swamps by the heavy rains which fall during those periods. This condition naturally varies a good deal in extent and duration, but generally lasts for at least several weeks. In that time the swamps become the home of innumerable insects of diverse species, some of them of the greatest concern to mankind, and all of them very interesting.

The following account is based on observations made during the mid-year rainy season of 1935. The rains commenced on May 16 and continued with daily precipitations and frequent heavy downpours up to the end of June, when dry spells began to intervene. Up to this point the season was typical, but an opportunity to prolong the investigation was afforded by an unusually wet July and August. The rainfall recorded at the Botanic Gardens, Georgetown, for the months in question was: May, 11·56 in., June, 14·37 in., July, 8·12 in. and August, 13·78 in., totalling 47·83 in. With the cessation of the rains, the swamps drain off and vanish almost as suddenly as they appear, so that there is never any stagnation.

Bearing in mind the abruptness of the onset of the rains, it is perhaps scarcely necessary to labour the point that when these aquatic conditions arise, there is a complete and somewhat sudden change in the savannah population—the dry season dwellers evacuating their territory with a good deal of haste and panic, and often with considerable loss of life. This is quite commonly observed in the case of *Solenopsis*, the red stinging ant. This notorious insect infests, and often monopolizes, the countryside—especially low-lying grasslands. Here it establishes its colonies in ever-increasing numbers, and it would, in a short time, surely become a terrible scourge but for the blessed ruthlessness of Nature. With the advent of the rains and the flooding of the savannahs, these colonies are promptly inundated. How the ant meets this parlous situation by forming living rafts for the purpose of salvaging the brood and fertile queens is well known. But how many of these castaways ever reach safety, and what is the extent of the subterranean mortality ?

Even more disastrous is the effect of the floods on other underground insects, especially the larvæ and pupæ of humous and root-feeding Coleoptera. These frequently have no aquatic adaptations, and are consequently easily overcome by excessive moisture. These inhabitants of the soil have, presumably through natural selection, come to pass their more defenceless stages during the dry seasons. But this arrangement is precarious, for the weather is often capricious, and unseasonable deluges not infrequently occur, creating very unfavourable conditions for the soil fauna. The Dynastids, *Dyscinetus geminatus* and *D. bidentatus*, in particular, are very adversely affected, and may be prevented from making their appearance in pestilential numbers for several years by such an occurrence. Tangible evidence of the havoc caused is not lacking, for the receding waters leave behind them innumerable dead grubs scattered over the countryside.

Above the ground another story is told. The rather populous Orthoptera and Hemiptera that may, in dry weather, be swept up from any patch of grass, are better equipped for flight to higher levels ; yet many are trapped, and may be seen clinging to a hopeful blade of grass or making sorry efforts to swim with ill-adapted limbs. There is, indeed, one local grasshopper which, I believe, must be unique, whose life is normally passed in semi-aquatic surroundings and whose hind-tibiæ are curiously suited to this element, being flattened and expanded to form paddles.

The disappearance of the dry season population with the advent of the rains is soon followed by the appearance of a number of bizarre water dwellers, the life of which, for the few weeks of the duration of the swamps, is a fierce internecine war. Among the first to colonize this new environment are the mosquitoes. The females continue to oviposit throughout the season, thus keeping the swamps well supplied with larvæ and pupæ of all ages. Yet this apparently ideal breeding ground is but a death trap for the species. The vast majority never reach maturity, but fall a prey either as larvæ or as pupæ to predacious insects. By far the most numerous species is *Culex similis* Theo. Also present, though in decidedly fewer numbers, is *Urotaenia lowii* Theo. *Anopheles tarsimaculata* Goeldi is found here and there in shady spots.

Chief among the natural enemies of the Culicidæ are dragonfly larvæ, of which about six different species were found. They are the most successful of the swamp fauna. This is due to their great agility, their cryptic patterns, their curious habit of camouflaging themselves with débris when at rest, and perhaps to their repulsive, spidery appearance. That they are not far more predominant is probably due to their deplorable cannibalism. While the young nymphs content themselves with mosquitoes, the larger instars are inclined to disdain this exiguous diet and go for members of their own family, which they disembowel with the movable hooks of their mask. Their cannibalism is, however, facultative; in fact, they have a catholic palate, and their diet includes tadpoles, two species of which swarm in the temporary swamps, young grubs of water-beetles, tabanid maggots and Belostomatidæ.

It is a noteworthy fact that these Odonata pass through their life-cycle quite comfortably during the short duration of the swamps. It seems that the long life-history ascribed to them in text-books is largely a laboratory fiction, as they do very poorly in captivity, even when natural conditions are closely simulated.

Two species in particular, *Erythrodiplax umbrata* Linn. and *Leptothemis vesiculosa* Fabr. were kept under observation in an aquarium. By far their most striking peculiarity is their habit of camouflaging themselves. They kick up the sediment, which settles in a fine shower on their limbs and body, and covers them like a mantle. In this manner they not only escape the unwelcome attentions of their enemies while resting or during moulting, but are also better able to seize their prey unexpectedly, thus securing an initial advantage in combat which may be sorely needed when the object of their designs is a well-matched nymph or a robust *Hydrous* grub.

Full-grown larvæ of *Hydrous* are never attacked, as they would be rather unmanageable, and a discreet preference is shown for harmless fare like tadpoles. These make easy prey, and are simply seized under the jaw and gnawed to pieces without being able to offer any resistance beyond an ineffectual wriggle. With this defenceless pabulum the dragonflies make merry, and for our immunity from at least one of the seven plagues of Egypt we owe a good deal to the Odonata.

In their turn, however, the Odonata are beset by rapacious foes. Among these the most fearsome is the silver water-beetle *Hydrous smaragdinous*. The adult is an inoffensive vegetarian, so that it is all the more surprising to find the larvæ equipped with a pair of huge crescentic jaws. Dragonfly nymphs, despite their superior agility and cryptic colouring, fall easy prey to these slug-like creatures which, covering themselves with fine mud, and moving slowly but quietly, are able to approach unobserved within striking distance of their quarry. Their favourite food is the tadpole, which is secured in an interesting manner: the tadpole, having the advantage of speed and elusiveness, is first of all rendered *hors de combat* by being deprived of its tail. In many cases this is accomplished by a single sweep of the great jaws, but where the victim is more robust, the amputation is not quite so artistic.

The life-history of the silver water-beetle is of unusual interest. The egg mass is approximately hemispherical and about ¾ in. in diameter. It consists of dry froth, with an outer impermeable crust. The flat side has a hardened, triangular pad which floats vertically with the apex up, and is invariably attached to a straw which serves to camouflage it. The eggs are pale yellow and about 4 mm. in length, and are placed vertically in the side of the hemisphere in a single layer of about three hundred. The rest of the space being taken up by froth, the centre of gravity is low, thus stabilizing the egg mass. More remarkable is the rapidity of the embryology: the eggs are laid within a day or two of mating and are quite undeveloped at oviposition; yet within three days the larvæ emerge. The outer envelope is ruptured round the base of the triangular pad and the grubs swim out. There are three casts, the first taking place two days after eclosion, the second about four days later, and the last before pupation, seventeen days after that. By this time the grub has attained a length of two inches. There is a quiescent prepupal stage of six days, followed by a pupal instar of five days. Thus the total life-cycle occupies about thirty-one days. Another water-beetle with similar biology occurring in the temporary swamps is *Tropisternus lævis* Sturm.

Other insects of interest in this association are the Belostomatidæ, of which several species occur. Their prey consists of mosquito, dragonfly and tabanid larvæ, which they seize with their prehensile forelegs.

In conclusion, attention may once more be directed to the rapidity with which the temporary swamps are colonized, and the intense and incessant competition among the colonists and its effect on the mosquito population. The comparative paucity of mosquitoes during the thick of the rains is a common experience in British Guiana, and is generally attributed to the destruction of larvæ by excessive flooding. While there may be something in this, there is little doubt that it is due in a far greater measure to the mosquito's aquatic associates. These are slower at colonizing at the onset of the rains, and cannot establish themselves at all in the ephemeral puddles that result from the intermittent showers towards the end of the season. This suggests a reason for the prevalence of mosquitoes at the beginning and at the end of the rains, and their scarcity when the rainy season is in full swing.

Obituary

Dr. W. J. S. Lockyer

THE sudden death of Dr. Lockyer has deprived astronomical circles of a familiar and welcome figure. While walking down to his house from the Norman Lockyer Observatory on July 15 he was seen to fall on his face; and when some men close by went to help him up, he was found to be dead. About two years ago he was laid up for several months on account of phlebitis, and his death seems to have been a sequel to this attack.

To all his friends, Dr. William James Stewart Lockyer was affectionately known as 'Jim', and by all of them he will be greatly missed. He was the fifth son of Sir Norman Lockyer and was born on January 3, 1868. His mother died when he was eleven years of age, and the present Lady Lockyer was married to Sir Norman in 1903. The stages of Dr. Lockyer's education at Cheltenham College, Trinity College, Cambridge, the Royal College of Science, South Kensington, and the University of Göttingen, all led naturally to a scientific career and to his carrying on the astronomical studies of his distinguished father. The subject of the thesis for which he received his doctorate at Gottingen in 1896 was the variable star η Aquilæ, all the available observations of which he submitted to full discussion with some interesting conclusions. Among the results obtained was that the epoch of maximum luminosity oscillates to and fro to the extent of five hours on either side, with a period comprising four hundred maxima. The minima are also subject to a similar oscillation, and four secondary undulations were revealed on the curves representing the variability of the star's magnitude, recurring at intervals of forty-three hours, or one-quarter of the main period.

Variability of another kind, namely, that of the spectrum of the star γ Cassiopeiiæ, was the subject of Dr. Lockyer's most recent papers to the Royal Astronomical Society. This star has a constant magnitude of 2·25, and its spectrum was also believed to be constant until a close examination of photographs taken by Dr. Lockyer proved it to change in a very peculiar manner. The spectrum contains hydrogen lines each made up of double emission lines superimposed on a broad absorption line. The two components of each of the double emission lines undergo regular changes of relative intensity; and in his last paper on this star, contributed to the Royal Astronomical Society a little more than a year ago, evidence was presented of some very remarkable variations of this character.

This paper was one of forty dealing with spectroscopic work carried out at the Norman Lockyer Observatory, Sidmouth, since 1920, nearly all of them by Dr. Lockyer himself. The Observatory was founded by Sir Norman with the help of sympathetic friends in 1912, after the decision to transfer to Cambridge the Solar Physics Observatory in which he had carried on astrophysical and astrochemical work continuously since 1875. It was first called the Hill Observatory, but was given its present name after Sir Norman's death in 1920. Four years earlier, the Norman Lockyer Observatory had been formed into a Corporation under the Companies (Consolidation) Act, 1908, with Sir Robert Mond, who was a school friend of Dr. Lockyer's at Cheltenham College, as chairman. Dr. Lockyer succeeded his father as director of the Observatory in 1920, and though he usually had only one assistant observer, the amount of original work done has been remarkable, with the result that the Observatory now possesses as fine a collection of photographs of stellar spectra as any observatory in Great Britain. Such a record is particularly good for an institution maintained entirely by private benefactors and without any State aid.

Both in association with his father, and separately, Dr. Lockyer took part in a number of total solar eclipse expeditions. Among these were Government expeditions to observe the Vadso (Lapland) eclipse of 1896; Viziadrug (India), 1898; Alicante (Spain), 1900; Palma (Majorca), 1905; and Vavau (Tonga Islands), 1911, when he was the chief of the expedition. Other eclipses observed by him were those of 1912 (France); 1921 (Scotland); 1927 (England);

and 1932 (Canada), and whenever weather conditions were favourable he was successful in adding something to our knowledge of solar phenomena revealed during totality. His skill as a photographer, and familiarity with astronomical instruments, made him particularly valuable to every eclipse expedition of which he was a member.

While certain problems relating to the constitution of the sun can only be studied during the brief moments of total eclipse, there are many others which require for their solution the collection of observations over a long period. Among these is the relation between solar changes and terrestrial weather, to which subject Sir Norman and his son contributed some notable papers. Upon the initiative of Sir Norman, a committee for the study of such changes was appointed by the International Meteorological Committee in 1903, and Dr. Lockyer became secretary of it. Periodic plus and minus 'pulses' of rainfall in India were described by Sir Norman and Dr. Lockyer in a paper read before the Royal Society in November 1900, and were shown to be related (sometimes inversely) to similar variations at Mauritius, Cordoba (South America), the Cape of Good Hope, and other places. Attention was afterwards devoted to an examination of the variations of pressure over the Indian and other areas, and a period of 3·8 years was found in the mean variation over the whole of India and the other areas. An inverse variation was found in the pressures at Cordoba ; in fact, there was a 'see-saw'. The area affected by this barometric see-saw was extended in a later paper before the Royal Society to Java, Ceylon, Mauritius and Australia.

These studies of periodic variations in the earth's meteorological elements are closely related to solar conditions. It was shown by Dr. Lockyer that, underlying the ordinary solar cycle of eleven years, there is another of greater length, namely, thirty-five years, or about three cycles of solar activity. This corresponds to Brückner's well-known climatic cycle of about thirty-five years, and thus associates weather changes on the earth with periodic variations of solar phenomena. What exactly is the relationship between the two sets of changes has yet to be determined, and the criterion of correlation coefficients has taken the place of that of curve parallels, but Dr. Lockyer's studies of the problem are still important contributions towards its solution.

Dr. Lockyer was keenly interested in aeronautics, and he made his first ascent in a balloon in 1907, with the late Hon. C. S. Rolls as pilot. For the next few years he was in the air in balloons and aeroplanes as often as his work or chance permitted, invariably accompanied by his camera and frequently with other scientific instruments, such as experimental direction finders and similar gadgets. During the Great War he was commissioned in July 1915 as a lieutenant in the Royal Naval Volunteer Reserve, attached to the Royal Naval Air Service, and two years later was promoted to the rank of lieutenant-commander. He served as commanding officer at several anti-Zeppelin stations and also in other capacities, such as intelligence officer to H.Q. Manston and Westgate R.N.A.S., ground instructor Netheravon (Wilts), and meteorological officer at Burnham Newton (Norfolk) and Orfordness (Suffolk). He became full major in the Royal Air Force in 1918 and was demobilized in August 1919, when he again took up his astronomical work.

Dr. Lockyer served on the Council of the Royal Astronomical Society from 1927 until 1929, and again from 1931 until the present year ; he was also a vice-president of the Society in the period 1933-35. He was honorary lecturer in astronomy at University College, Exeter, but most of his active life was devoted to observational work at South Kensington and later in the Observatory founded by his father on the top of Salcombe Hill, overlooking Sidmouth. He was married, and his widow survives him, but he leaves no children to continue or extend the work which has given the name of Lockyer a permanent place in the history of astronomical science. He will, however, not only be remembered in these records, but also by a large circle of personal friends, who will long cherish his memory with affection and esteem.

Baron Axel von Klinckowström

THE death of Baron Axel von Klinckowstrom, which occurred in the month of May at his home, the family estate of Stafsund on the island of Ekerö near Stockholm, removes one of the few remaining links with Nordenskiold, the explorer. Klinckowstrom, who was born in 1867, accompanied Nordenskiöld to Spitsbergen in 1890 as a young zoologist, and in 1891 himself undertook a zoological expedition to Surinam. After his return, he devoted himself to biological research first at Stockholm and later at Wurzburg under Sachs and Boveri. During these years he published a number of contributions to embryology, anatomy, variation and inheritance.

In 1895 Klinckowstrom was appointed University lecturer at Stockholm, and later undertook a number of expeditions to the Arctic and Antarctic. On his return he enriched the museums of Sweden by the presentation of his valuable collections. In his later years he devoted himself to bacteriological research carried out in his private laboratory at Stafsund. His many-sided interests embraced poetry and the history of art, and he was well known in Sweden as a writer of books of travel and adventure. His many friends will cherish the memory of a charming personality.

E. KLIENEBERGER.

WE regret to announce the following deaths :

Dr. Charles E. Johnson, director of the Roosevelt Wild Life Station at the New York State College of Forestry, on June 6, aged fifty-six years.

Prof. A. P. Karpinsky, president of the Academy of Sciences of the U.S.S.R., well known for his work in geology and palæontology, on July 14, aged eighty-nine years.

Prof. J. H. Muller, professor of chemistry of the University of Pennsylvania, an authority on the chemistry of germanium, on June 18, aged fifty-three years.

News and Views

The Medical Profession and Chemical Warfare

WE are glad that the British Medical Association, during the session held at Oxford on July 17–25, gave consideration, at the annual representative assembly on July 17, to the subject of chemical warfare. The Council of the Association reported that the question of the protection of the community against the effects of poison gas is being examined in connexion with the Air Raid Precautions Department of the Home Office before any definite proposals are made. After discussion of a resolution submitted by the North Glamorgan and Brecon Division of the Association, the following amendment was adopted: "That this meeting condemns unreservedly the use of poison gas in warfare as inhuman in its results and degrading to civilization, and relies upon the council to do everything in its power with a view to securing the co-operation of the medical profession in all countries in order to prohibit the use of poison gas." In the course of the discussion, an appeal was made to men of science generally, as well as to members of the medical profession, to protest collectively against the destruction of civilian populations through the use of poison gas, and to try to secure international co-operation with this end in view. Even though politicians may consider it impracticable to do anything to prohibit the destruction of human life by indiscriminate chemical warfare, yet scientific workers should let the community know that they dissociate themselves from the use of such methods. We hope therefore, that at the forthcoming meeting of the British Association at Blackpool the lead given by the British Medical Association will be followed; so that science may not be understood by silence as acquiescing in the application of its discoveries to the degradation of civilized life.

Native Territories and the Union of South Africa

QUESTIONS in the House of Commons on July 16 indicated that no little consternation had been aroused in certain quarters by Mr. Pirow's statements on his return to South Africa as to the trend of opinion in Great Britain on the question of the future of African mandated territories. To some extent, this was allayed by the Prime Minister's assurance that Mr. Pirow's opinions are personal and that in any event, the question falling outside the scope of his mission, his view has no basis in official discussion. The House further elicited from the Under-Secretary of State for the Colonies an explanation of a somewhat cryptic statement by General Hertzog in the Union Parliament in making provision for an expenditure of £35,000 for "development and improvement in native territories", which has been taken, not unjustifiably, as pointing to the transfer of the native territories of Bechuanaland, Basutoland and Swaziland to the Union Government at no distant date, although the precedent condition of native consent, to which the British Government is pledged, is not yet fulfilled. Mr. MacDonald's reply clarified the situation. General Hertzog, it would appear, was defending an offer of the Union Government to contribute towards certain development schemes as a step towards the co-operation with the native authorities which has been agreed upon as a desirable policy. On July 15, Mr. MacDonald stated in a written reply that the offer of the Union Government is directed to three objects: (1) anti-soil erosion work in Basutoland, (2) provision of water supplies in Bechuanaland, and (3) conservation of water in Swaziland. Notwithstanding assurances that acceptance of the offer would not impair the pledges of His Majesty's Government in the United Kingdom, the uneasiness of the native authorities in the Protectorates is such that this offer is now in abeyance; but Mr. MacDonald stated that the question of assistance out of United Kingdom funds is under consideration by the Colonial Funds Development Committee.

World Fellowship

A GENERAL meeting at Caxton Hall, Westminster, on July 18, concluded the proceedings of the World Congress of Faiths, which had been in session in London since July 3. On a broad view of the numerous contributions to discussion of world fellowship made by the delegates from the various faiths, it is evident that there is in each a body of opinion which is prepared to build upon the foundation of a common ethical element in an effort to co-operate in the solution of problems of a wider general application in present-day conditions. A spirit of good will and general agreement was perhaps more marked than any movement towards specific application at the moment; but it is, in any event, a distinct gain that an opportunity has been afforded a mixed assemblage to appreciate at first hand the distinctive outlook on, and approach to, the problems of the organization of life under different creeds and in various environments. Neither pious enthusiasm, however, nor even profound conviction, such as usually finds expression on these occasions, necessarily leads to tangible results; and to keep alive and give effect to the spirit of which the Congress has been a manifestation demands some channel through which it may be directed in order to avoid waste of energy. This aspect, happily, has not been overlooked in the present instance; and, at the last general meeting, the delegates decided to institute machinery to continue the work of spreading world fellowship through religion. It was agreed that all who presented papers, acted as chairmen, or led discussion, should form a council, and that a continuation committee should be appointed. The members then elected included Sir Francis Younghusband, Sir Herbert Samuel, Sir Sarvepalli Radhakrishnan, Mr. H. N. Spalding and Sir Abdul Qadir, with Mr. A. Jackman as secretary.

New Heating Laboratory at the Building Research Station

A NEW laboratory for research on the heating of buildings has been completed at the Building Research Station of the Department of Scientific and Industrial Research so that work can go on all the year round, instead of only in the winter. The laboratory was opened on July 22 by Sir Frank Smith, Secretary of the Department of Scientific and Industrial Research, on the occasion of the annual visit to the Building Research Station of the Institution of Heating and Ventilating Engineers, which is providing a sum of £1,500 to enable the studies, at the Station, of heating problems to be speeded up and extended. The laboratory is one room within a larger room. The smaller room, which is 18 ft. × 12 ft., is the test-room which is to be heated in all the different possible ways. It has a ceiling which can be screwed up or down so that both low rooms and high rooms can be studied. The larger room in which the test-room is situated isolates it completely from outside weather effects. The various walls of this outer enclosure can each be refrigerated and their temperatures can be controlled to 0·1° F. Modern heating methods have been utilized in the control of the outer enclosure. Every surface is panel-heated or panel-cooled by brine which circulates in pipes in the walls, floor and ceiling. For cooling the brine which refrigerates the walls, a $4\frac{1}{2}$-ton ammonia compressor is installed in the engine-room at one end of the laboratory. At the other end of the laboratory is an instrument room, where records are made of the conditions in the test-room and its enclosure. The new laboratory provides unique facilities for research and will undoubtedly mean a great speeding up of heating research.

Research and Finance

IN the leading article in NATURE of July 11, there were, we regret to say, two inaccuracies which should be corrected. The system of grants in aid of the research associations and styled "the datum line system", described on p. 52, was superseded, some two years ago, by another system which, for the sake of brevity, may be called "the block grant system". The Department of Scientific and Industrial Research now makes an annual block grant to an association, provided that a definite sum is assured, in the form of subscriptions, by the industry concerned. The block grant and the industrial income have no rigid mathematical relationship ; the ruling principle being that, added together, they must provide such a sum as will, in the opinion of the Advisory Council of the Department, form an adequate financial nucleus for a co-operative research organization for the industry in question. In order to encourage further expansion, the Department offers £ for £ on sums subscribed over and above the initial industrial income, up to a stated maximum, which, again, is fixed on the advice of the Advisory Council. This new system was the outcome of the big appeal made to industry a few years ago to play its part in expanding the operations of the research associations. The other inaccuracy was the parenthetical statement, on p. 52, that the woollen industry raises its contributions to co-operative research by means of a statutory levy. It is a fact that for some years now the woollen industry has been conducting propaganda in favour of the institution of such a statutory compulsory levy, but no measure for the attainment of this object has yet been introduced into Parliament. On the other hand, it may be remembered that a Rubber Industry Bill, having for its object the institution of a statutory levy, was introduced into Parliament and finally dropped owing to the defection of a prominent firm in the industry.

Chamberlain Memorial at the University of Birmingham

IN connexion with the centenary celebrations of the birth of Joseph Chamberlain, the first Chancellor of the University of Birmingham, Sir William Waters Butler has given £10,000 to provide scholarships, to be known as the Joseph Chamberlain Memorial scholarships. The University has also received a generous benefaction from Sir Charles Hyde, Bart., who has offered £10,000 towards the museum of the new Medical School, with the suggestion that this part of the new building should be known as the Chamberlain Memorial Museum. It is felt that this gift, like that of Sir William Butler, is very appropriate to the occasion ; for it is well known that the University, of which Mr. Chamberlain was the founder and first Chancellor, occupied a foremost place in his regard, as being an essential part of the city for which he had done so much. His foresight in placing the new buildings in Edgbaston, where there would be ample room for expansion, has been notably justified in the event. It may well be that the most enduring monument to his name will be the University of Birmingham. Mr. Chamberlain's interest in medical research was made evident in the part he took in the establishment of the London and Liverpool Schools of Tropical Medicine.

Roman Sites and the National Trust

A NEW museum of Roman antiquities from Hadrian's Wall at Housesteads Camp, north-west of Hexham, was opened on July 23 by Prof. G. M. Trevelyan, vice-chairman of the National Trust. The cost of the building has been defrayed out of funds which have accumulated as a result of the greatly increased number of visitors, who now go to inspect the camp. In 1935 they numbered no less than 15,000. Housesteads, or Borcovicus, which on its north side abuts on the Wall, covers an area of five acres. It is not only one of the finest sites on the wall, but it is also one of the most completely excavated Roman camps open to view in Great Britain. During the excavations, a number of important finds were made, and these, with other antiquities, will be housed in the new museum. The site of five acres, a milecastle and three quarters of a mile of the wall itself were presented to the National Trust in 1930 by the owner, Mr. J. H. Clayton, a well-known Northumbrian antiquary. The site is now under the management of a committee, the members of which include Prof. G. M. Trevelyan and Mr. J. A. Richmond, who for some years has been one of the most active of excavators on Roman sites in Britain. In this connexion may be mentioned another addition to the Roman sites held by the National Trust. Segontium, a Roman fort in Caernarvonshire, has been bequeathed to that body by Mr. John Roberts of London, a native of Caernarvon. The antiquities, pottery, coins and implements, which were found when the fort was excavated by Dr. R. E. Mortimer Wheeler in co-operation with the Office of Works, are housed in a museum which is bequeathed with the site.

The National Trust

THE forty-first Annual Report of the National Trust for Places of Historic Interest or Natural Beauty for the year ending June 30, 1936, again chronicles a record increase in its work. Two years ago the Council reported a record addition to the properties of the Trust, and although the properties added to the holding this year are less spectacular in acreage, they are more numerous. In the two years taken together, the acreage owned or protected by the Trust has increased by nearly fifty per cent. While it may be concluded that this expansion in the operations of the Trust is an indication of an increase in public interest in the preservation of the natural beauty and historic interest of England, it is unfortunately also a gauge of the rapidity with which the threat of modern development is advancing over the countryside. Although it is true that many properties come to the Trust as the result of private benefaction by far-sighted owners, those which are acquired as the result of public appeal almost invariably are face to face with a threat of early destruction. As the Trust is able under its constitution to acquire and hold properties which are still in occupation, a sphere from which the Office of Works is barred by statute in the exercise of its function in protecting ancient monuments, the work of the National Trust is a very necessary supplement to official action, while the Trust itself is the most important, and in some cases the only, organization through which a national appeal can be launched effectively. It is gratifying to note that the Council is able to report the initiation of a scheme for the preservation of historic country houses and their contents, which adapts to English conditions the main principles of La Demeure Historique for the preservation of châteaux in France and Belgium.

The Science Museum, South Kensington

THE Report of the Advisory Council of the Science Museum for 1935 has recently been published (London: H.M. Stationery Office. 1*s.* net). For the first time, the Report is signed by Sir Henry Lyons, who succeeded the late Sir Richard Glazebrook as chairman. Sir Richard served on the Council for twenty-three years and was chairman from 1931 until 1935, and the Report contains a tribute to the work he did for the Museum. There are to-day perhaps few Government institutions doing more within the scope of their activities, for education, scientific research and industrial progress, than the Science Museum, which has become a recognized centre for special exhibitions and scientific gatherings, and a place of popular instruction. During 1935, the total number of visitors rose to 1,327,190, the highest ever reached; 25,337 persons attended the public lectures, and 8,682 the special lectures, while in the galleries were held at various times excellent exhibitions relating to rubber, welding, noise-abatement, electro-deposition and air transport. The Report contains much evidence of the thought and work devoted to the acquisition and arrangement of the exhibits and of the logical illustration of the developments of physical science in all its branches. A special feature of the Report for 1935 is a detailed review of the collections in Division V, which include objects relating to physical phenomena, the structure of matter, magnetic, electrical, thermal and acoustical instruments, and the many branches of geophysics. Once again, the Council emphasizes the need for more accommodation, and the reconstruction of the central block. The present buildings in this portion of the Museum were built so long ago as 1862, and then only formed part of the temporary buildings for the Exhibition of that year. They are quite out of date, and their replacement is a matter of urgency if the Museum is to continue to make progress as it has done in the past.

A New Fruit Juice Factory

FOR the past four years, intensive research work has been carried out at the University of Bristol Agricultural and Horticultural Research Station at Long Ashton into the possibility of utilizing surplus fruits from the various varieties of soft fruit grown in Great Britain by means of their conversion into liquid fruit products. The research work, which has been under the direction of Mr. V. L. S. Charley, B.Sc., has resulted in the production of a series of attractive products. H. W. Carter and Co., Ltd., of The Old Refinery, Bristol, 2, and 52 Queen Victoria Street, London, have now equipped the first factory of its kind in the country at North Street, Bedminster, Bristol, 3, to prepare these fruit syrups from English fruits, and a representative gathering met on July 15 to view the factory. The retention of the fresh flavour of English soft fruits when processed into a liquid form has been shown at Long Ashton to be largely a question of the amount of sugar which is incorporated with the juice. Fruit syrups with 65 per cent of sugar have been shown to be stable and to retain to a remarkable degree the true flavour of the fresh fruit. Such syrups, however, are not of general utility on account of their excessive sweetness, but if the sugar content is reduced to any appreciable extent, grave risks of fermentation and mould growth are incurred. However, it has been shown that pasteurization at 160° F. for half an hour, a treatment which is essential to obtain stability, does seriously affect the attractiveness of the finished product.

A PROCESS has therefore been evolved in which the fresh fruit juice is incorporated with sugar until

50–55° Brix is registered, and this unstable syrup is then preserved with 200–300 parts per million of sulphur dioxide in the form of potassium metabisulphite. The present syrups are intended for use primarily with milk, and it is necessary to avoid an excessively sweet product as this detracts not only from the milk flavour, but also tends to mask the fresh flavour of the fruit. The question of curdling is not serious until any addition of acid is carried out. Even with the highly acid juices of the loganberry and blackcurrant there is very little fear of curdling when the normal concentrations, which are generally acepted in the milk bars, are used. A further process of interest is the adaptation of the carefully controlled fermentation in the fruit. This fermentation is effective first in completely disintegrating the cells which thus yield a richer, sweeter juice and, secondly, in decomposing a certain amount of pectin which would otherwise be deposited in the filtered product. Remarkable results have recently been obtained by the use of pectin-decomposing enzymes in which an addition of 0·2 per cent of enzyme has reduced the calcium pectate content of the juice from 0·134 per cent to a mere trace.

The Kauri

A SMALL pamphlet, Leaflet No. 26, on "The Properties and Uses of Kauri", *Agathis australis*, by A. R. Entrican, has been issued (Government Printer, Wellington, N.Z., 1935). This timber is one of the most useful of the coniferous softwoods, and has been known in international trade for more than a century. The kauri is the monarch of the New Zealand forests, dwarfing all other species. The bole in mature trees has singularly little taper; thus, although it does not attain the height of the North American redwoods (*Sequoia*) and the Australian eucalypts, it ranks among the largest timber-producing species in the world. It is said that in yielding flawless timber of exceptionally large size, the tree is unsurpassed by any other known species. The extensive virgin forests of the early European occupation have been severely depleted, but it is of good hope for the future to hear that the remaining stands are being placed under a system of forest regulations whereby a sustained yield of this valuable softwood will be assured. Owing to its evenness of texture and ease of working, to its small shrinkage powers, medium density and excellent strength properties and high durability, the timber is able to meet the most exacting requirements. It is made use of in all classes of building and general construction, in shipbuilding, car and wagon construction, tank and vat manufacture, military bridging, and the production of dairy and agricultural machinery and so forth. It is not surprising, as has been the case with fine species in other countries, that the brunt of the fellings for ordinary utilization by the increasing population of the country fell upon this beautiful tree.

The National Institute of Agricultural Botany

AT the annual general meeting of fellows of the National Institute of Agricultural Botany at Cambridge on July 16, the chairman of the Council, Sir Daniel Hall, in the course of his address, stated that one of the primary objects of the Institute is to serve as a medium for introducing new varieties of farm crops to the public. For this purpose its trials are organized so as to provide an accurate measure of the relative merits or de-merits of each variety tested. These trials extend over three years or more, in order to level out weather differences, and are carried out at six different centres in order to eliminate differences due to soil variations. The improvements already effected in the yield of cereals make it unlikely that any new variety will show a 20 per cent improvement upon the existing varieties. Improvements in the nature of 5–10 per cent are more probable, but even a 5 per cent improvement would make a considerable financial difference to farmers. Farming is never at a standstill, and the Institute meets the changing agricultural situation by extending the scope of its trials. Trials of picking peas and chicory are now being carried out, and it is hoped that useful information will be derived from them. The potato trials at Ormskirk have done much to check the spread of wart disease by the encouragement given to the introduction of new immune varieties. Sir Daniel went on to say that close co-operation with the seed trade would be beneficial to both bodies. In serving the farmers, the Institute also serves the best interests of the seed trade, which has the highest degree of confidence in the Official Seed Testing Station. This is testified by the fact that the number of samples tested by the Official Seed Testing Station is steadily increasing year by year, and nearly 30,000 samples have been tested in the current year. In conclusion Sir Daniel expressed concern at the shrinkage in the number of fellows of the Institute: he hopes the Institute will never become a purely bureaucratic body, reponsible only to the Government.

Prevention of Tuberculosis

SIR KINGSLEY WOOD, the Minister of Health, inaugurated the twenty-second annual conference of the National Association for the Prevention of Tuberculosis at the County Hall, London, on July 16. He stated that great progress has been made in the fight against tuberculosis. For the first time on record, the total number of deaths in England and Wales from all forms of tuberculosis fell in 1935 below 30,000. The standardized death-rate from tuberculosis has fallen from 1,915 to 687 per million in less than forty years. This striking record of progress is due in the first place to remarkable improvements in methods of treatment. Much also is due to the example given by the establishment, as a result of greater knowledge and active propaganda, of voluntary sanatoria and dispensaries. It is significant that no sanatorium in the modern sense existed in Great Britain before 1898. Improved standards of living and hygiene, better housing, better nutrition, purer milk supply and general public health measures have played and will continue to play a considerable part in the attack upon this disease. But there are many opportunities for further advance. There is a great need for encouraging those who were suffering or suspected to be suffering from tuberculosis to take advantage at the earliest possible stage of the facilities provided for diagnosis and treatment. The importance also of eliminating tuberculous cattle from the herds of Great Britain is obviously very great. Bovine tuberculosis is responsible in Great Britain for a large number of deaths, probably more than 2,500 per annum, and for a still larger amount of serious illness. Much remains to be done before we can be satisfied that the whole of our milk supply is safe.

British School of Archæology at Athens

ON October 13, the British School of Archæology at Athens will celebrate the fiftieth anniversary of its foundation by holding at the Royal Academy of Arts, Burlington House, an exhibition to illustrate the discoveries in Greece and Crete which have resulted from the work of the School, together with a special exhibit devoted to the Minoan civilizations of Greece, and the excavations of the School's honorary student, Sir Arthur Evans, at Knossos, in which the School's architects took part. This exhibit is being prepared by Sir Arthur Evans himself, with facilities kindly given him by the Keeper and Visitors of the Ashmolean Museum. It is understood that the exhibition will be inaugurated by His Royal Highness the Duke of Kent, on October 13 at 3 p.m., and will be open to the public from October 14 until November 14. In connexion with the jubilee of the School, it is proposed also to raise a special fund to enable the School to increase its staff, improve its library and accommodation, and provide for the needs of the graduate students who, in increasing numbers, are sent to Greece for advanced study by the universities.

Indian Vital Statistics for 1933

THE chief vital statistical figures for British India for 1933 are: (1) total births, 9,678,876, giving a crude birth-rate of 35·5 per mille, (2) total deaths numbered 6,096,787, giving a crude death-rate of 22·4 per mille, (3) infantile deaths numbered 1,650,973, an infantile death-rate per 1,000 births of 170·5 (Ann. Rep. of the Public Health Commissioner with the Government of India for 1933. Government of India Press, New Delhi. Rs.6 as.4 or 10*s*.). The birth-rate is more than double, the death-rate nearly double, and the infant mortality about two and a half times, the corresponding figures for England and Wales. It is remarked that, contrary to some recent statements, the population of India is increasing at an alarming rate, and by 1941 will probably reach 400 millions. The total land area of British India amounts to only 2·44 acres per head of the population, but allowing for forest, uncultivated and fallow lands, only 0·72 acre per head is under food crops—quite insufficient for even the present population. Birth-control is viewed sympathetically, but only seven hundred medical women are available to instruct Indian women about it. Cholera deaths (68,318) and plague deaths (43,000) are not nearly so high as in some years, but smallpox deaths numbered 103,000, compared with 45,000 during the previous year—a disconcerting rise.

Anti-Rabic Treatment in Southern India

THE Annual Report of the Director, Major Iyengar, of the Pasteur Institute of Southern India, Coonoor, states that during the year ended December 31, 1934, 414 persons underwent the complete, and 77 an incomplete, treatment at the Institute after bites by animals supposedly rabid. For the second time in the twenty-eight years of the Institute's existence, there were no deaths from hydrophobia among those treated. Paris fixed virus was in use in the form of Semple's carbolized five per cent sheep vaccine, and at the end of the year was in its 937 passage. The vaccine was also issued from several out-centres—12,316 courses for nearly 13,000 cases, with 26 deaths from hydrophobia. In addition, anti-rabic vaccine was issued for the prophylactic treatment of 259 animals. In spite of what the Institute is doing, 412 deaths from hydrophobia were recorded in the Madras Presidency during 1934.

Northern Lights

PROF. CARL STØRMER has directed attention to a prevalent confusion between the north magnetic pole and the point on the earth where the magnetic axis meets the surface. Thus, in the supplement to NATURE of May 16, 1936, it is stated on p. 813 that "It is the distance from the magnetic axis of the earth that counts, and that axis meets the surface of the earth at the north magnetic pole, which is in the island of Boothia in Canada"; this should read as follows: "It is the distance from the magnetic axis of the earth that counts and that axis meets the surface of the earth about midway between the north magnetic pole and the north pole". This point is near North-Western Greenland, and it might be named the north axial pole. The zone or belt of greatest auroral display has this point for centre on the earth.

The Night Sky in August

THE nights during August are still rather short to afford much opportunity for a close scrutiny of the rich fields about the galactic equator, which in the British Isles passes overhead from north-east to south-west about midnight at the beginning of the month. Even at nightfall, however, the sky is distinctive with Arcturus still fairly high towards the west: Jupiter a brilliant object in the south-west: Vega, Deneb and Altair not far from the meridian: Saturn rising with Pisces in the east, whilst Capella may be picked out towards the northern horizon. Full moon occurs on August $3^{d}\ 3^{h}\ 47^{m}$ and new moon on August $17^{d}\ 3^{h}\ 21^{m}$. The brightest star to be occulted this lunation is κ Piscium (magnitude 4·9)—the reappearance may be observed on August $6^{d}\ 1^{h}\ 59{\cdot}7^{m}$ (U.T.) at position angle 267° from the north point of the lunar disk. Other occultations of stars, ranging in magnitude from 6·3 to 6·7, may be observed on August 5, 6, 10 and 13. Between August 9 and 12 occurs the maximum of the Perseid meteor shower, the radiant of which is in Perseus at R.A. $3^{h}\ 0^{m}$ and Dec. 57° N. The meteors of this shower are yellowish in colour and move with medium velocity. The orbit of the shower is well determined and coincides with that of Tuttle's Comet of 1862. On August 4, Peltier's comet (discovered on May 15 last by Mr. L. Peltier of Delphos, Ohio) is at its nearest approach to the earth at a distance of 15¼ million miles. Its computed position on August $4^d\ 0^h$ is R.A. $21^h\ 45^m\ 10^s$: Dec. 4° 8′ S., which places it in the constellation Aquarius, but the moon being full will prevent its being easily observed; otherwise it should be faintly visible to the naked eye. The comet is then travelling south rapidly and will reach 70° S. on August 24. Nova Lacertæ, which was discovered on June $18^d\ 21\frac{1}{4}^h$, probably reached its maximum brightness of about mag. 2·2 on June 20 and is now slowly fading. Its magnitude on July 17 was 6·3 according to Steavenson, so that the nova can be seen with binoculars; its position (R.A. $22^h\ 11^m\ 5^s$: Dec. 54° 59′ 42″ N.) is about 2° south of ε Cephei. The character of the nova's spectrum suggests a more rapid progress than is normally the case through the typical evolution stages of a nova.

Announcements

IN view of the Coronation festivities next year, the dates of the Royal Society soirées have been fixed well in advance. The men's soirée will be held on Tuesday, May 4, and the ladies' soirée on Thursday, May 6; it is possible that a third soirée will be arranged, but the date is not yet fixed.

IN connexion with the Second International Congress for Microbiology being held at University College, London, on July 25–August 1, an exhibition of scientific instruments has been arranged at the College. The exhibition will be open to all scientific workers, irrespective of whether they are members of the Congress or not, on July 27–29, from 10.30 a.m. until 5 p.m.

AT the Annual Summer Conference of Advisory Plant Pathologists at the University of Leeds, Dr. Geo. H. Pethybridge, mycologist to the Ministry of Agriculture and Fisheries for the last twelve years, and previously for many years in the Department of Agriculture in Ireland, was presented with a wireless receiving set, etc., as a mark of appreciation on the occasion of his approaching retirement from official service.

THE Jones-Bateman cup of the Royal Horticultural Society, which is awarded triennially for researches in the growing of hardy fruits, figs, grapes and peaches in the open or under glass, is available for award in 1936. Candidates should submit accounts of their work by October 31 to the Royal Horticultural Society, Vincent Square, Westminster, S.W.1. The work dealt with must have been carried out by the candidate in the United Kingdom mainly during the past five years.

THE thirteenth Annual Conference of the Association of Special Libraries and Information Bureaux (ASLIB) will be held in Oxford on September 18–21. On September 18, at 8.30 p.m., the president-elect, Dr. Cyril Norwood, will deliver his address entitled "The Library in the School". On September 19, at 9.30 a.m., a symposium on "Library Instruction for University and Research Students in America" will be held. Further information can be obtained from the General Secretary, ASLIB, 31, Museum Street, London, W.C.1.

PROF. E. ABDERHALDEN, professor of physiology in the University of Halle, has been nominated an honorary member of the Society of Biological Chemists at Bangalore.

THE following have recently been elected members of the Imperial Leopold Caroline German Academy of Science at Halle: Dr. Paul Buchner, professor of zoology at Leipzig; Dr. Hermann Loescheke, professor of pathology at Greifswald; Dr. C. Gósta A. Forsell, professor of medical radiology, and Dr. S. E. Patrik Haglund, professor of orthopædics at Stockholm; Dr. Knud Faber, professor of medicine at Copenhagen; Dr. A. H. M. J. Van Rooy, professor of gynæcology and obstetrics at Amsterdam; Dr. E. Leclainche, director of the international office of epizootics in Paris; and Dr. Karl Wegelin, professor of general pathology and morbid anatomy at Bern.

THE following scientific awards have recently been made by the American Medical Association: Gold Medal to Drs. Charles B. Huggins, S. W. J. Noonan and B. H. Blockson of the University of Chicago for their work in connexion with increasing blood production in the arms and legs by means of increased temperature; Silver Medal to G. C. Supple and S. Ansbacher of the research division of the Borden Company for their method of obtaining lactoflavine from milk; Bronze Medal to Dr. Alvin L. Barach of the Presbyterian Hospital, New York, for his method of providing an artificial light air in which helium is substituted for nitrogen.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A teacher of engineering (mechanical) in the Norwich Technical College—The Principal (July 28).

A lecturer in civil engineering in Armstrong College, Newcastle-upon-Tyne—The Registrar (July 30).

A statistician for a War Department establishment—The President, Royal Engineer Board, Regent's Park Barracks, London, N.W.1 (August 5).

Chemists at the Royal Gunpowder Factory, Waltham Abbey—The Principal Clerk, Central Office, Royal Gunpowder and Small Arms Factories, Enfield Lock, Middlesex (August 7).

A senior lecturer in physiology in the University of Aberdeen—The Secretary (August 15).

A technical editor at the Technical Institute, 16 St. Mary's Parsonage, Manchester, 3—The General Secretary (September 7).

An assistant lecturer in the Department of Electrical Engineering, Mathematics and Physics (with engineering degree) in the Natal Technical College—Mr. H. W. Gray, 17 Claydon Avenue, Southsea.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 169.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Order of Affinity of Metals for Copper, Iron, Cobalt and Nickel

EACH of the metals aluminium, zinc, cadmium, tin, mercury and lead is known from X-ray and thermal data to form intermetallic compounds with copper. Some of these may be prepared also by obtaining the two metals in dilute solution or suspension (1–4 per cent) at the ordinary temperature in mercury and removing excess of the more reactive metal by oxidation and the mercury by filtration and distillation[1]. In mercury, under such conditions, there is in each system a binary compound much stabler than the others, namely, $AlCu_6$, Sn_4Cu_5, ZnCu, $CdCu_4$, Hg_3Cu. The question arises: Suppose we have two of the above metals competing for copper in the medium of mercury, do both combine with copper or does one only? Or, suppose we add one metal to the compound of another metal and copper, is there a partial reaction, or does the reaction go either completely or not at all?

The analytical difficulties of this problem are not serious, and it is possible to obtain unambiguous answers to these questions. There seems to be a definite order of the above metals with respect to their power to combine with copper. It is aluminium, tin, zinc, cadmium and mercury, lead. If copper be competed for by two of these metals, the one earlier in the list combines with it, the other remains uncombined. If a metal earlier in the list be added to a compound of copper and another of these metals, the former displaces the latter completely. If the positions are reversed, no reaction occurs. Thus, when aluminium is added to any tin, zinc, cadmium or lead compound of copper, in mercury, it combines with the copper and sets the other metal free. The resulting binary is $AlCu_6$ or, more often, the stabler ternary $Al_2Cu_3Hg_6$. From neither of these can the aluminium be displaced by any of the metals mentioned. So for the action of tin on zinc-copper compounds. Ternary and even quaternary complexes are temporarily formed[2], but in the end the zinc is wholly displaced and the tin combines with the copper. Ternaries throughout complicate the issue.

Similar experiments have been done with these metals and the metals iron, cobalt and nickel, with which each of them is also known to combine. With iron the stablest compounds formed are $AlFe_3$, $SnFe_2$, $ZnFe_7$ and $HgFe_4$ (cadmium and lead do not readily combine in mercury with transition elements). The order here is aluminium, tin, zinc, mercury, cadmium and lead. Thus, neither tin nor zinc can displace aluminium from $AlFe_3$, whereas the easiest way of preparing this compound is by adding aluminium to a tin-iron or a zinc-iron compound in mercury. With cobalt the stablest compounds formed are AlCo, $SnCo_2$, ZnCo and HgCo; with nickel the stablest compounds are AlNi, Sn_4Ni_5, ZnNi and HgNi. With both these metals the order is that obtained with iron and slightly different from that obtained with copper. The corresponding experiments with manganese and silver have still to be done. The inverse problem—How does one of the metals aluminium, tin and so on, distribute itself among the other metals of the class copper, silver, iron and so on?—is analytically very hard and has not yet been solved.

The order of metals obtained in these experiments is not, and would not be expected to be, that of the electrode-potential series, because in entering into intermetallic combination the atom does not undergo the simple process of ionization of the type $X \rightarrow X^+$. It is likely to be connected with atomic diameters and interatomic distances and forces in the crystal patterns formed.

A. S. RUSSELL.

Christ Church, Oxford.
July 4.

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[1] Russell and others, *J. Chem. Soc.*, 841, 852, 857, 2340 (1932); 1750 (1934).

[2] Russell, NATURE, **133**, 217 (1934).

Formation of Carbon Dendrites

PARTICLES of colloidal graphitic oxide dispersed in water have a negative charge, and under a potential gradient move relatively rapidly towards the anode[1]. Under certain conditions, however, reduction of the oxide occurs at the cathode, with the formation of long carbon dendrites. This phenomenon was shown in striking manner under the following conditions.

Graphitic oxide was prepared from finely divided Ceylon graphite by treatment with the usual sulphuric, nitric acid, potassium chlorate mixture and the product washed with water. After five washings, the colloidal, supernatant, slightly viscous, brown opalescent solution (*p*H 2·88) was decanted into an inclined glass tube provided with two platinum electrodes (see Fig. 1). On applying a potential of approximately 200 volts between the electrodes, the disordered micellar lamellæ orientated themselves so that their faces were at right angles to the path between the electrodes (cf. Thiele[1]), and immediately thin carbon dendrites commenced to grow from the cathode, and the colloid started to collect round the anode.

These effects are clearly shown in Fig. 1 (*A*), which was made one second after switching on the potential. They have become much more pronounced 25 sec.

later, as is shown in *B*. *C* is a reproduction of a photograph of another tube through which current has passed for five minutes. The region of high colloid concentration can now be seen extending from the anode to the deposited carbon. Soon after this phase, the region of high colloid concentration assumed an almost rope-like appearance, connecting anode and cathode. Dendrite growth then became extremely rapid and in a few seconds the colloidal mass was reduced to carbon. *D* shows the final phase; some of the deposited carbon has floated to the top of the tube. During the whole process the potential across the tube did not vary by more than 20 volts, nor did the current exceed more than a few milliamperes. A few small bubbles of gas were liberated at both electrodes during the experiment. *E* shows carbon dendrites which have been formed in a vertical tube.

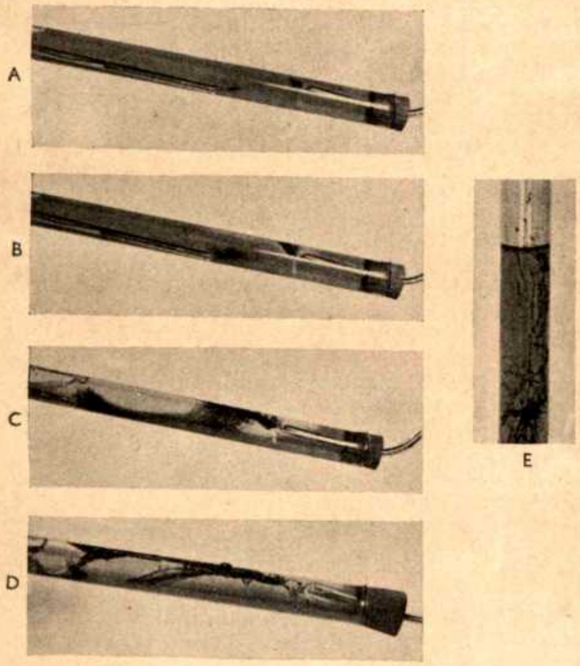

FIG. 1.

It is remarkable that in spite of the high repulsive force which the cathode must exert on the graphitic oxide particles, the latter can remain for a sufficiently long period in contact with the electrode for reduction to occur and for the resulting carbon to attach itself to the electrode. A more detailed examination of the phenomenon is being made.

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Armstrong College,
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[1] H. Thiele, *Z. anorg. Chem.*, **190**, 145 (1930); *Koll. Z.*, **56**, 129 (1931).

A New Process of Negative Ion Formation

WHEN a stream of electrons is passed through a monatomic gas, negative ions are supposed to be formed by direct electron attachment to atoms of the gas with radiation of the excess energy. When the gas is molecular, the process generally presumed to occur is simultaneous dissociation of the molecule and attachment of the electron to one of the products of dissociation, the energy of the electron in excess of that necessary for dissociation together with the electron affinity of the atom being carried away in kinetic form by the products of dissociation.

Process	Probability × 10^4	Process	Probability × 10^4
$Hg^+ \rightarrow Hg^-$	6·4	$CO_2^+ \rightarrow CO_2^-$	2·31
$H_2^+ \rightarrow H^-$	0·104	$CO_2^+ + CO^+ \rightarrow CO^-$	10·8
$N^+ \rightarrow N^-$	1·07	$CO_2^+ \rightarrow O_2^-$	2·51
$O_2^+ \rightarrow O_2^-$	0·42	$CO_2^+ + CO^+ \rightarrow O^-$	3·37
$O_2^+ \rightarrow O^-$	1·10	$CO_2^+ + CO^+ \rightarrow C^-$	0·1

I have made an investigation of negative ion formation in mercury vapour, hydrogen, nitrogen, oxygen and carbon dioxide, and I find that the large majority, if not all, the negative ions detected are formed by a new process, and not by either of the processes mentioned above. The negative ions are formed from positive ions which extract two electrons from any negatively charged electrode, including the filament, to which they are driven. This process is energetically possible provided the sum of the ionization potential of the positive ion and the electron affinity of the negative ion that is formed is greater than twice the work function of the surface upon which the conversion takes place. The excess energy is probably dissipated by a collision of the second kind with an electron or atom of the surface.

Sometimes the positive ion is dissociated by its collision with the surface. The negative ion then formed is one of the products of dissociation. For example, the negative ions detected in carbon dioxide are CO_2^-, CO^-, O_2^-, O^- and C^-. In oxygen, both O_2^- and O^- are found. Mercury vapour, hydrogen and nitrogen gave only the atomic negative ion.

The probability of conversion of positive ions into negative ions on a nickel surface has been measured as a function of the kinetic energy of the positive ions. In each gas the probability increases as the energy of the positive ion is increased. The probability of conversion of a 180-volt positive ion into a negative ion is given in the accompanying table in units of 10^{-4}.

The negative ions come off the surface on which they are formed with a wide range of energy. From the energy distribution curves, values of the mean and the minimum accommodation coefficients for positive ions have been obtained. The energy distribution curve itself represents the probability distribution of the accommodation coefficient.

The fact that positive ions are converted into negative ions on negatively charged electrodes with the comparatively high probability shown in the above table introduces a serious, and hitherto unrecognized, source of error into many experiments, such as the recent work of Davies[1] on ionization produced by positive ions.

A complete account of this work will be published in the *Proceedings of the Royal Society*. The work on mercury vapour is already in the press, and should appear shortly.

F. L. ARNOT.

University,
St. Andrews.

[1] A. C. Davies, *Proc. Roy. Soc.*, A, **155**, 123 (1936).

The Form of Nuclear Levels

RECENT experimental work has proved the existence of selective absorption for neutrons the kinetic energy of which amounts to a few volts by certain nuclei[1-5]. Bohr[6] assumes that in these cases the kinetic energy of the captured neutron is equal to the difference between the energy of a level of the newly-formed nucleus and the mass defect for a neutron with zero velocity. This provides an ideal compensation method for the determination of the distance[7], breadth[5,7] and form of nuclear levels. The total energy of the level, which amounts in all these cases to some millions of volts, does not interfere with the determinations in question, since only the kinetic energy of the absorbed neutrons is measured.

When working with the cadmium filtered radiation of a source of slow neutrons, we observed big deviations from the exponential law for the absorption of resonance neutrons of rhodium (45 sec.) by rhodium and of resonance neutrons of iodine by iodine. In the accompanying table, μ means the mass absorption coefficient for the total absorption, μ' the mass absorption coefficient for each additional absorbing sheet :

	Detector Rh (45 sec.), absorber Rh					Detector I, absorber I				
Absorber gm./cm.^{2}	0·01	0·02	0·04	0·08	0·18	0·2	0·5	0·8	1·8	3·1
Absorption per cent	16	24	31	44	52	27	45	53	58	62
μ	17	14	9	7	4	1·6	1·2	1·0	0·5	0·3
μ'	17	10	5	5	1·6	1·6	0·9	0·5	0·1	0·07

Since the cross-sections of boron for radiation filtered by 0·2 gm./cm.^{2} of rhodium and detected by rhodium (45 sec.) or filtered by 3 gm./cm.^{2} of iodine and detected by iodine, were identical with the cross-sections for the unfiltered radiations, the observed deviations cannot be explained by the existence of a second level for selective neutron absorption, as in the case of silver[1,7]. We think the explanation lies in the self-reversal of the nuclear line. When both the absorption coefficient and the intensity of emission have a maximum for exactly the same energy, the middle of the line will be totally extinguished after passage through a sufficient layer of the absorber, that which penetrates consisting only of the weakly absorbable tails. By determining the absorption coefficient for each additional layer of the absorber, the whole range of values for the absorption coefficient between the middle of the line and the tails is obtained. We are thus able to determine the form of the nuclear levels. A detailed analysis and a comparison with the theoretical results of Breit and Wigner[8] will be given later. Qualitatively, the intensity distribution in the line is already obtained by plotting μ against A'/μ', A' being the fraction of the total radiation which is absorbed by each sheet. Fig. 1 shows the result for rhodium (45 sec.) plotted in this way. The real form of the line shows somewhat bigger differences of intensity. The half-value breadth amounts, as was shown by other experiments, to about 0·25 volt.

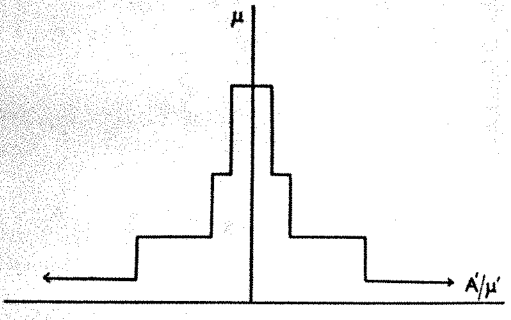

FIG. 1.

Errata : There was a mistake in the calculations for μ_B and the energies of the levels iodine and bromine (18 min.) in our letter in NATURE of May 30, p. 905. The correct values are : Iodine, $\mu_B = 0{\cdot}7$, energy $= 75 \pm 15$ volts. Bromine (18 min.) $\mu_B = 0{\cdot}35$, energy $= 300 \pm 80$ volts. The results for silver and rhodium are correct.

PETER PREISWERK.
HANS VON HALBAN, JUN.

Institut du Radium,
Laboratoire Curie,
Paris.
June 6.

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[1] Amaldi and Fermi, *Ric. Scient.*, VI, **2**, 346 and 443 (1936).

[2] L. Szilard, NATURE, **136**, 950 (1935).

[3] Frisch, v. Hevesy and McKay, NATURE, **137**, 149 (1936).

[4] Frisch and Plazcek, NATURE, **137**, 357 (1936).

[5] v. Halban and Preiswerk, *Compt. rend.*, **202**, 133 and 849 (1936). NATURE, **137**, 905 (1936). *Helv. Phys. Acta*, **318** (1936).

[6] N. Bohr, NATURE, **137**, 344 (1936).

[7] E. Amaldi and E. Fermi, *Ric. Scient.*, VII, 1, n. 7–8.

[8] G. Breit and E. Wigner, *Phys. Rev.*, **49**, 519 (1936).

The Crystal Photo-effect and Rectifying Action in the Bulk of the Crystal

ATTEMPTS have been made to discover how far a rectifying action is connected with the crystal photo-electric effect (Dember effect). A. and A. Joffé have already suggested[1] asymmetry of the photo-electric current due to the illumination of one electrode.

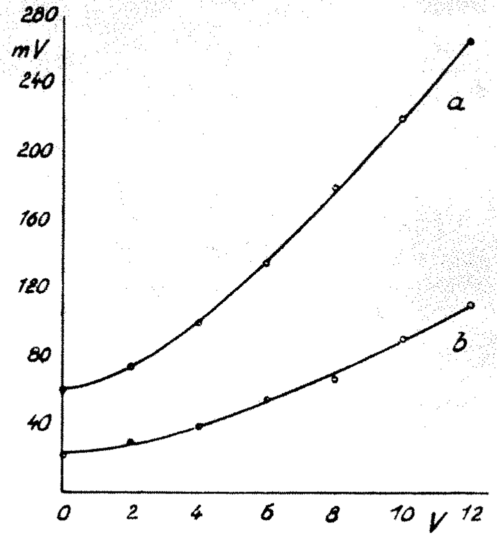

FIG. 1.

In our investigations, two electrodes, free from any obstructing layer, were attached to a cuprite crystal so that by the illumination an E.M.F. appears on them in consequence of the Dember effect. These electrodes were connected through two condensers with an alternating current source; the current flowing through the crystal caused an additional direct voltage as soon as the crystal was illuminated. In darkness, however, the alternating current did not cause any direct voltage. By exchanging the direction of the light both the Dember effect and the direct voltage, caused by the alternating current, changed their direction.

In Fig. 1, the resulting voltage, measured with an electrometer, is shown in relation to the alternating voltage applied to the crystal. In curve *b* the intensity of illumination was a quarter of that of curve *a*. Hence the intensity of the new appearance is related to that of the Dember effect. The value of direct voltage at the alternating voltage zero corresponds to the crystal photo-effect.

Several trials have proved that this appearance is caused by events in the bulk of the crystal (bulk-rectification) and not by the obstructing layers between the planes of the crystal and the electrodes. Moreover, rectifying action, caused by exposure to light, could not be formed in synthetic cuprous oxide, in which the Dember effect does not appear.

GERHART GROETZINGER.
JOSEF LICHTSCHEIN.

Third Physical Institute,
University,
Vienna.
May 14

[1] *Z. Phys.*, **82**, 754 (1933).

A Protective Action of Progesterone on the Genital Organs of Male Mice

IT is recognized that œstrone and progesterone are mutually antagonistic in some of their biological capacities. A fresh example of this antagonism has recently been observed at this Institute. Sixteen male mice, eight of which had been previously castrated, were given œstrone twice a week by cutaneous applications of a 0·01 per cent solution in benzene. On every day following these applications, progesterone was given to some by subcutaneous injections of 0·1 c.c. of a 0·1 per cent solution in sesame oil, to others by the application to the skin of a 0·1 per cent solution in benzene. The mice died or were killed at intervals from the 28th to the 120th day of the experiment.

After death, all the castrated mice showed the usual effects of œstrone, namely, keratinization of the coagulation gland, with arrest of secretion and epithelial hyperplasia in the seminal vesicle and prostate. The eight non-castrated mice, with one exception, showed none of these characteristic effects of œstrone. Spermatogenesis was in progress, the coagulation gland, seminal vesicle and prostate were normal in appearance, and in two instances normal ejaculation plugs were observed at death. In the exceptional case the mouse, which had been treated by cutaneous applications of progesterone, was killed on the 73rd day, and showed defective spermatogenesis, keratinization of the coagulation gland and loss of secretory function with epithelial hyperplasia in the seminal vesicle and prostate.

The difference between the results in the castrated and the non-castrated mice may perhaps be attributable to a combined effect in the latter of progesterone plus the testicular hormone. However this may be, it seems clear that progesterone can protect the genital organs of non-castrated mice from the injurious effects of excessive dosage with œstrone. In this connexion the similarity of molecular structure between progesterone and testosterone will be recalled.

For the progesterone used in this experiment we have to thank Prof. Schoeller of the Schering-Kahlbaum, A.G. of Berlin.

HAROLD BURROWS.

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The Royal Cancer Hospital (Free),
London.
July 3.

Determination and Excretion of Flavins in Normal Human Urine

KOSCHARA[1] has demonstrated the presence of flavins in urine, and has been able to isolate a crystalline flavin (uroflavin). I have carried out an investigation to determine if large doses of flavins (ox liver), similar to vitamin C (Harris[2] and van Eekelen[3]) and B_1 (Harris[4]), caused an increased urinary output.

The quantitative determination of the flavins in urine was carried out in the following way (details will be published elsewhere):

(1) Adsorption with lead sulphide. The lead sulphide was previously prepared, washed out and added to the urine. This was found to be preferable to the method generally used (addition of lead acetate to the flavin solution and introduction of hydrogen sulphide).

(2) Elution with a mixture of water-pyridine-glacial acetic acid (8 : 2 : 0·2).

(3) Oxidation with potassium permanganate in acetic acid solution and determination of the resulting colour with the stuphometer (*S* 47).

In normal urines (males), a daily urinary output of 819–1250 γ was found. The excretion per hour during the different periods of a day was found to vary between 30 γ and 50 γ.

Two subjects *A* and *B* (analysts) consumed cooked ox liver (100–140 gm.). Subject *A* took 5710 γ flavin[5] and excreted during 24 hours after the intake 3283 γ (normal excretion 952 γ), whereas subject *B* took 4240 γ and excreted 1797 γ (normal excretion 885 γ). The largest excretion per hour was observed two to three hours after the intake of the liver (subject *A*, 378 γ; subject *B*, 139 γ).

From these investigations, which took place in June, it follows that an increased excretion of flavins in urine took place after consumption of liver, probably caused by a 'saturation' of the subjects with flavins.

Further investigations are in progress.

A. EMMERIE.

Laboratory of Hygiene,
University,
Utrecht.
June 22.

[1] *Z. physiol. Chem.*, **232**, 101 (1935).
[2] *Biochem. J.*, **27**, 2011 (1933).
[3] Dissertation, Utrecht (1936).
[4] *Lancet* (1936).
[5] *Acta Brev. Neerl.*, **5** (1935).

Ultracentrifugal and Electrophoretic Studies on Antibodies

MANY attempts have been made to obtain from immune sera, substances carrying the antibody function. Protein solutions specifically precipitable to the extent of 40–60 per cent (nitrogen precipitated by pneumococcus specific polysaccharide/total nitrogen) have thus been prepared by the Felton method[1]. By dissociation of specific precipitates with strong sodium chloride, antibody solutions precipitable to the extent of 90 per cent have been prepared[2]. An investigation of the physico-chemical properties of these systems, especially of those bearing upon chemical homogeneity and the relation to the components of normal sera, would seem to be of interest.

To this end, preparations of horse and rabbit antibodies against pneumococcus type specific polysaccharides, as well as rabbit antibody against crystallized egg albumin, have been studied by ultra-centrifuge and electrophoresis methods[3,4], together with whole and fractionated normal sera. The simplest behaviour was shown by a horse serum preparation of type I pneumococcus anticarbohydrate[2] in which 61 per cent of the nitrogen was specifically precipitable. This showed almost homogeneous sedimentation, with sedimentation constant $s_{20} = 17 \cdot 2 \times 10^{-13}$ as compared with that of normal globulin from mammalian sera, s_{20} about 7×10^{-13}, previously found at Uppsala. However, normal sera regularly contain small amounts of a minor component of sedimentation constant about 17×10^{-13}. The electrophoresis of the above antibody preparation was homogeneous, with an isoelectric point as acid as *p*H 4·8.

In the case of rabbit sera, homogeneous sedimentation was found with no appreciable difference between the sedimentation constants of the globulin fractions of normal serum and immune serum, or of normal globulin and immune globulin containing up to 50 per cent of anti-egg albumin, or of antibody to the type III pneumococcus polysaccharide containing 90 per cent of precipitin[2], all showing s_{20} about 7×10^{-13}. Only the last mentioned preparation was investigated electrophoretically, giving inhomogeneous migration and an isoelectric point of about *p*H 6·6.

Preparations from antipneumococcus I horse sera (Felton) showed the same principal component as did the horse antibody above, together with varying amounts of slower and faster sedimenting components; whereas a Felton solution from *normal* horse serum was quite different, with a predominating component of $s_{20} = 7 \cdot 8 \times 10^{-13}$. Electrophoresis was rather inhomogeneous, with isoelectric points of about *p*H 5–5·2 for the immune and *p*H 5·7 for the normal preparations.

In a few runs with horse antibodies, the centrifuge was stopped when all of the heavier components had settled to the bottom, although a considerable amount of the lighter substances were still in solution. Samples taken out indicated that almost all specifically precipitable protein was on the bottom, showing that the antibody function is connected with the heavy component. This is also in accordance with previous experiments[5,6].

Preparations made from antipneumococcus horse sera, preserved with phenol and ether, although containing up to 87 per cent specifically precipitable nitrogen, were characterized by their inhomogeneity both in the ultracentrifuge and in their electrophoretic behaviour. The isoelectric point was *p*H 5·9, but a component of an isoelectric point of about *p*H 4·9 was also present.

From these data it is evident that protein preparations from immune sera carrying a high percentage of the antibody function may show all the signs of being chemical individuals, so far as the methods referred to are decisive. Nevertheless, methods of preparation and preservation may considerably influence the result (by denaturation ?) and give rise to less uniform systems, which, however, may still show a very high specific precipitability. It is also clear that different fractions of the serum proteins carry the antibody function in the horse and in the rabbit. It would thus appear that the rabbit produces antibody from the principal globulin component, while the horse develops pneumococcus I anticarbohydrate, at least, from an otherwise minor component.

The analytical methods for determining the antibody content of the solutions have been described in earlier publications[7]. Details of the experiments will be given and some of the many questions raised by this work will be discussed in forthcoming communications.

MICHAEL HEIDELBERGER.
(John Simon Guggenheim Memorial
Fellow, Spring of 1936.)
KAI O. PEDERSEN.
ARNE TISELIUS.

Institute of Physical Chemistry,
University,
Uppsala.
Presbyterian Hospital,
New York.
June 22.

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[1] L. D. Felton, *J. Immunology*, **21**, 357 (1931), and other papers.

[2] M. Heidelberger and F. E. Kendall, *J. Exp. Med.* (Aug. 1936).

[3] See for example, T. Svedberg, *Chem. Rev.*, **14**, 1 (1934); *Kolloid Z.*, **67**, 2 (1934).

[4] A. Tiselius, *Nova Acta Reg. Soc. Scient. Upsaliensis*, Ser. IV, **7**, No. 4. See also Pedersen, K.O., *Kolloid Z.*, **63**, 268 (1933).

[5] M. Heidelberger and F. E. Kendall, *J. Exp. Med.*, **61**, 559 (1935); p. 570.

[6] W. J. Elford, P. Grabar and W. Fischer, *Biochem. J.*, **30**, 92 (1936). As this goes to press we note also very similar sedimentation constants obtained by J. Biscoe, F. Herčik and R. W. G. Wyckoff, *Science*, June 19, 1936.

[7] M. Heidelberger and F. E. Kendall, *J. Exp. Med.*, **50**, 809 (1929); and subsequent papers.

Two Unusual Modifications of Eye Colour in *Drosophila melanogaster*

IN the course of a series of investigations now in progress concerning the modification of eye colour in the fruit fly *Drosophila melanogaster* under X-irradiation, undertaken in connexion with an attempted determination of the volume of the locus 'white', two changes of colour have been observed which seem of sufficient interest to be worthy of a note at the present time.

The first change involves an apparent reverse genovariation, under X-irradiation, similar to those observed by Timofeef-Ressovsky[1], the change being from white to red eye.

The white stock concerned was obtained by suitable breeding from a few white individuals arising as spontaneous mutants in a pure culture of Florida wild-type *Drosophila* obtained about two years ago through the courtesy of Dr. Demerec. It has been bred for three months in this laboratory in pure culture, and has behaved in every way like typical white. It is, characteristically, completely recessive.

In the course of an investigation of morphological effects arising under X-irradiation, eggs and young larvæ from this white stock were exposed in considerable numbers to the unfiltered radiation of a Coolidge X-ray tube operated at 85 kvp. and 10 ma., the focal distance being five inches, with a wood backing. The tube was of lead glass with a thin sodium-glass window. The output of the tube was determined as 79·0 r./min. at the point of exposure of the material, a Victoreen dosimeter being employed. We are indebted to Dr. J. C. Hudson, of Cruft Laboratory, for this dosage measurement.

A total of 786 flies was examined from irradiated eggs and young larvæ. Among these were found two full reversions to Florida wild-type. It is believed that sufficiently elaborate precautions were observed in the technique adopted for irradiating and culturing the flies, so that the possibility of contamination from wild-type individuals was eliminated with reasonable certainty. No such reversions were observed in more than five thousand control individuals.

The second modification of interest arose in the stock of a culture of eosin *Drosophila* obtained from Turtox Service. Among more than 30,000 individuals examined, four were found in which a mutation to a colour considerably darker than eosin, but lighter than wild-type, was observed. We do not feel competent to name the colour modification. A single individual of the four constituted a mosaic representing a change which must have occurred very early in the development of the optic *anlage*, one eye of the fly being completely modified to the darker colour, the other typically eosin. Three of these individuals occurred in stock which had been irradiated under the same conditions as those stated above, but one was obtained from control populations grown on very old and highly infected molasses – corn meal agar medium. A very similar modification was independently observed by Dr. A. G. Richards, of the University of Rochester, and one of us, in control stock of a pure culture of eosin, obtained through the courtesy of Dr. Pincus, of Harvard University, and similarly held over old, depleted and infected banana – agar medium.

The modification seems of considerable interest in its further confirmation, not only that changes of whole eye colour may proceed from lighter to darker shades, but also that the wild-type condition is not necessarily the end-point of such a change. Again, sufficient care was used in handling the cultures, it is believed, to have eliminated the possibility of any contamination from an outside source with reasonable certainty. The change, indeed, was detected independently in three laboratories, at Rochester, Cambridge and Schenectady, and in none of these were stocks of similar eye colour present.

E. V. ENZMANN.

C. P. HASKINS.

Biological Laboratories,
Harvard University,
Cambridge, Massachusetts,
and the
Haskins Laboratory,
Schenectady, New York.
June 1.

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[1] Timofeef-Ressovsky, N.W., *Nachrichten von Ges. d. Wiss. Göttingen*, N.F., 1, 190.

The 'Road Runner' of North America

ONE of the most remarkable and interesting birds of the arid portions of North America is the road runner (*Geococcyx californianus*), a ground cuckoo, which is often seen running in the road, sharing this habit with the killdeer plover (*Oxyechus vociferus*). The genus extends southward to Nicaragua, being represented in that region by another species (*Geococcyx affinis*). The accompanying illustration (Fig. 1) of a road runner attacking a rattlesnake, was furnished by Mr. G. A. Pearl of Garden City, Kansas. He got it from a travelling photographer whose name he does not know. Mrs. Merriam Bailey states that in the stomach of a single road runner, taken in New Mexico, were a large black cricket, a number of big grasshoppers, remains of a caterpillar and some beetles, a centipede six inches long and a garter snake a foot long.

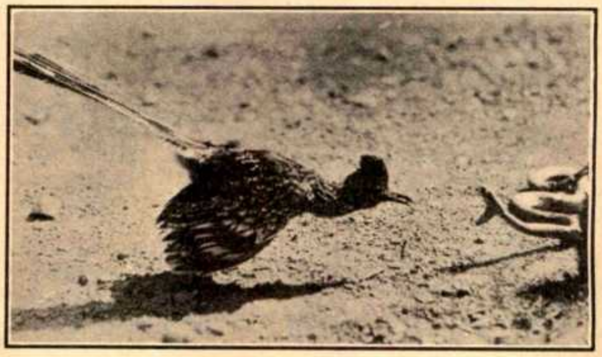

FIG. 1.

The road runner was described by Lesson in 1829, but Pike in 1810 refers to a strange new bird, which from his vague account must apparently have been the road runner.

T. D. A. COCKERELL.

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Ascent of Air in Cyclones

A RECENTLY completed investigation on cyclones has led, amongst other results, to one which throws an interesting light on a long-standing problem. One of the deductions of W. H. Dines from soundings of the upper air was that the air in the troposphere in depressions, particularly between 4 km. and 9 km., is on the average cold for its level, though this air is, on the whole, ascending. The paradox is to explain by what agency the ascent of relatively cold air is maintained. Dines's results related to depressions crossing the British Isles or Western Europe, that is, to depressions which as a rule were in the later stages of their existence.

The present investigation shows that in a number of such depressions the structure comprises an outer region in which the average air speed varies inversely as r (r being distance from isobaric centre), and an inner region (at least in the polar air part) in which air speed varies directly as r. The existence of the outer simple vortex region is consistent with motion developed by convergence towards a central area :

the mathematical theory of the motion developed in this way was given by Rayleigh[1] in 1917, in explanation of the model cyclones devised by Aitken[2]; the mathematical theory was extended by Brunt[3] in 1921 to apply to motion on a rotating earth.

The inner regions generally are found not to be examples of 'solid spin', at least in the lowest 2 km. of the atmosphere, but rather, in certain parts, regions of specially marked convergence. In brief, it is found that—below the 2 km. level—convergence towards the centre goes on, roughly with complete conservation of moment of momentum up to a certain distance (which in different cases varies from 300 km. to 500 km.) from the centre, and then—in place of conservation—there is, instead, as the air enters the inner region. a gradual fall of speed with closer approach to the centre.

The total inward flux of kinetic energy across the periphery of the inner region is so considerable—speeds at this periphery being commonly of the order of 40 m.p.h.—that a question naturally arises as to what work is being done to account for the loss of kinetic energy by the air in the course of its closer approach to the centre. The obvious explanation is that here is the work required in the later stages of the depression's life to raise bodily the large central core of troposphere which, by reason of continued ascent, has become colder, level for level, than its environment. Calculation in a typical case indicates that about half the probable inward flux of kinetic energy below the 2 km. level would suffice to keep the core above this level moving upward until it had become on the average about 7° C. colder, level for level, than surrounding regions. This result, therefore, explains the manner in which depressions can continue in being until they acquire temperature characteristics which have hitherto seemed paradoxical, more especially in regard to any theory of origin in which convection may have played a part.

In one exceptional case—a vigorous and still developing system with a long course still to run—the feature characteristic of the inner regions of the other depressions was not developed, at least at the time when the depression crossed the British Isles. In this depression by contrast, a high wind speed was found up to relatively near the centre.

A. H. R. GOLDIE.

Meteorological Office,
Edinburgh.

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[1] *Proc. Roy. Soc., Lond.*, A, 93, 148 (1917).

[2] *Trans. Roy. Soc., Edin*, 40 (1900–01); *Proc. Roy. Soc., Edin.*, 36 (1915); and *Proc. Roy. Soc., Lond.*, 94 (1917–18).

[3] *Proc. Roy. Soc., Lond*, A, 99, 397 (1921).

Transmission of High-Voltage Impulses at Controllable Speed

SIR J. J. THOMSON[1] first observed that if a difference of potential was applied to the ends of a long discharge tube (by an induction coil) the luminosity traversed the tube with a finite velocity. When either a positive or negative impulsive potential is suddenly applied to one end of a discharge tube while the other end is maintained at ground potential, one of us[2] found that the luminosity traversed the tube from the high-voltage electrode to ground. Immediately following this, a luminosity frequently traversed the tube from the ground back to the high-voltage electrode. A similar type of propagation of luminosity has been observed in a million volt spark between point and plane by Allibone and Schonland[3] and by Schonland and others[4] for certain types of lightning flashes. In order to obtain more information about the initial breakdown in gases, we have undertaken an investigation of the propagation of potential in long discharge tubes when impulsive voltages are applied to one end of the tube while the other end is earthed.

By means of a high-speed cathode ray oscillograph, it was found that in the case of both positive and negative applied impulses, a definite potential wave traversed the tube from the high-voltage electrode to the earthed electrode, immediately followed by a much faster return wave from ground back to the high-voltage electrode. In the case of the initial impulse, the wave velocity, wave form, voltage attenuation and energy carried in the wave front were measured and found to vary with both pressure and applied potential. A few values for the speed of the initial impulse in a 5 mm. glass tube containing air are shown in the accompanying table.

Applied Voltage (kv.)	Pressure (mm. Hg.)	Speed of Impulse (cm./sec.)
+127	0 08	9×10^8
+127	0 24	43×10^6
−125	0 08	15×10^8
+171	0 17	27×10^8
+ 74	0 017	$5{\cdot}4 \times 10^8$
+ 74	0 24	14×10^8

For the greater applied potentials the voltage wave showed no observable distortion or attenuation, at least for lengths of tube less than 10 metres. However, at 74 kv. and the higher pressure (0·24 mm.), the voltage wave was very much flattened. For the 170 kv. and 74 kv. applied impulses with 0·025 mm. pressure in the tube, the maximum current during the initial wave was 429 amp. and 146 amp. respectively. In addition to the information the above results give as to the nature of the initial breakdown in gases, they show that a discharge tube may be used as a transmission line in which the velocity of propagation of the voltage wave is easily controllable over quite wide ranges. This type of transmission line should be of use in many problems[5] where it is necessary to transmit high-voltage impulses from point to point at predetermined velocities less than that of light.

The detailed results of this experiment will be submitted for publication elsewhere. We wish gratefully to acknowledge a grant from the American Philosophical Society, which has made this work possible.

L. B. SNODDY.
J. W. BEAMS.
W. T. HAM, JUN.
H. TROTTER, JUN.

Rouss Physical Laboratory,
University of Virginia.
June 20.

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[1] "Recent Researches", 115 (1893).

[2] Beams, *Phys. Rev.*, 36, 997 (1930).

[3] Allibone and Schonland, NATURE, 134, 736 (1934).

[4] Schonland, Malan and Collins, *Proc. Roy. Soc.*, A, 152, 595 (1935).

[5] Beams and Snoddy, *Phys. Rev.*, 44, 784 (1933).

Narrow Continuous Band of Potassium in the Extreme Red

ALTHOUGH the absorption bands which appeared, as reported by Kuhn[1] and Datta[2], near the principal series lines of potassium at high vapour pressures were interpreted on the assumption of polarisation of the molecule, the bands which may have appeared near the resonance lines λλ7699, 7665 were not observed.

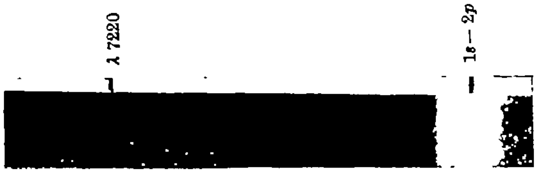

FIG. 1.

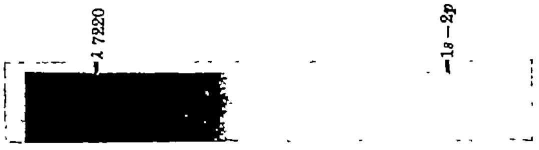

FIG. 2.

With the view of searching for these bands, the extreme red absorption spectrum of potassium vapour was investigated. By heating the potassium metal in a steel tube filled with hydrogen to a pressure of about 10 cm. mercury, spectral photographs of the potassium vapour were taken at the first order region of the 1·5 m. concave grating. When the continuous light from a carbon arc passed through the vapour, keeping the temperature sufficiently high, a remarkable broadening of the resonance lines, as shown in Fig. 1, was observed. At higher temperatures a narrow continuous band appeared at about λ7220 (Fig. 2), while Fig. 3 shows its photometer curve. In the absence of hydrogen this band was also observed, but with difficulty.

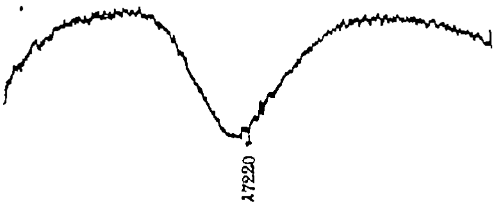

FIG. 3.

Wurm[3] reported a narrow band of sodium appearing on the shorter wave-length side of the *D*-lines, explaining it by assuming polarization of the molecule. Hamada[4] observed the fluctuation of a continuous band in the same region, considering its origin as the sodium quasi-molecule. The potassium λ7220 band may be interpreted in the same manner.

Though the longer wave-length side of the potassium resonance lines was also photographed, the absorption of the $A^1\Sigma \rightarrow B^1\Sigma$ band was so strong that any narrow continuous band was difficult to observe.

T. OKUDA.

Department of Physics,
Osaka Imperial University,
Japan. May 12.

[1] H. Kuhn, *Z. Phys.*, **76**, 782 (1932).
[2] S. Datta and B. H. Chakrovarty, *Ind. J. Phys.*, **7**, 273 (1932).
[3] W. Wurm, *Z. Phys.*, **79**, 736 (1932)
[4] H. Hamada, *Phil. Mag.*, **15**, 574 (1933).

Liquids of High Refractive Index

IN a previous letter to NATURE[1] under this title, we gave values for the refractive index of phenyldi-iodoarsine as measured by us. Our attention has now been directed to the fact that the properties of this compound had already been accurately measured and published in a valuable paper on "The Optical Properties of Arsenic" by Gryszkiewitz-Trochimowski and Sikorski[2] which had appeared six years previously. We had unfortunately overlooked this paper owing to the fact that in none of the abstracts or collective indexes which we consulted as a guide to the relevant literature was there any mention of the above compound in connexion with these authors. The figures for phenyldi-iodoarsine given by the Polish workers ($n_D^{14\cdot5}$ 1·8527 ; $d_4^{14\cdot5}$ 2·6264) are higher than those we communicated, but agree closely with those we have recently obtained with the purer samples now commercially available.

We take this opportunity to add a warning note. Though we occasionally use phenyldi-iodoarsine when refractometer readings of high index are required, the action of this liquid on the soft glass hemisphere of the instrument is distinctly deleterious. The chief usefulness of this remarkable compound will thus probably be as an immersion medium.

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C. J. PAYNE.

Laboratory of the Diamond,
Pearl and Precious Stone
Trade Section of the London
Chamber of Commerce,
55 Hatton Garden, E.C.1.

[1] NATURE, **133**, 66 (1934).
[2] Gryszkiewitz-Trochimowski and Sikorski, *Roczniki Chemji*, **8**, 405 (1928).

Structure of Bromine III

IN a previous letter[1] it was reported that the structure of Br III was detected, the intervals of the fundamental term 5*s* ^4P being 2589 cm.$^{-1}$ and 2253 cm.$^{-1}$. A further comprehensive investigation, carried out particularly to distinguish between the lines of Br II and Br III, has led to a considerable extension of the scheme, which consists of doublets and quartets of the 4*p*, 5*p*, 5*s*, 4*d* and 5*d* configurations. On account of the large intervals of the 4*d* and 5*d* configurations, it is difficult to assign the *L*-values to these terms. Assuming an arbitrary value of 300,000 cm.$^{-1}$ for 4*p* $^4S_{1\frac{1}{2}}$, some of the chief term values are :

5*p* $^4D_{\frac{1}{2}}$	126823	5*p* $^4P_{1\frac{1}{2}}$	121875
5*p* $^4D_{1\frac{1}{2}}$	126165	5*p* $^4P_{2\frac{1}{2}}$	119751
5*p* $^4D_{2\frac{1}{2}}$	124095	5*s* $^4P_{\frac{1}{2}}$	154588
5*p* $^4P_{\frac{1}{2}}$	123335		

The intervals of 4*p* ^2D and ^2P are found to be 1259 cm.$^{-1}$. and 1665 cm.$^{-1}$ respectively. About 200 lines of Br III have been classified altogether.

The complete analysis is being communicated to the Royal Society of London.

K. R. RAO.

Andhra University,
Waltair.
May 27.

[1] NATURE, **135**, 309 (1935).

Preparation of Lithium Alum

DURING some work on the mass susceptibility of the alums, a successful attempt was made to prepare lithium alum, despite the fact that its existence and even the probability of its existence has been repeatedly denied.

Molecular proportions of the monohydrate of lithium sulphate and the octadecahydrate of aluminium sulphate were dissolved in the minimum quantity of cold water. The solution was concentrated considerably by evaporation on a sand bath and cooled in a freezing mixture of ice and salt with vigorous stirring, when it crystallized suddenly and deposited a mass of very soft small crystals, which were filtered and dried at the pump and afterwards on porous plates. The mother liquor after a further slight concentration deposited small hard transparent crystals on keeping in the freezing mixture.

Both crops of crystal contain 49·00 per cent of water ($Li_2SO_4Al_2(SO_4)_3.24H_2O$ requires 48·93 per cent water). The crystals are isotropic, a combination of cube and octahedron. On keeping at ordinary temperature, or on warming a few degrees, they decompose and the salts dissolve in the liberated water. They are exceedingly soluble in water; they lose the whole of the water at 200° C. and swell to a bulky friable mass. The mass susceptibility is $-0{\cdot}541 \times 10^{-6}$ and molecular susceptibility -479×10^{-6}. The properties of the alum are under investigation.

JAMES F. SPENCER.
G. T. ODDIE.
(Sister Mary Cecilia, O.P.)

Bedford College,
London, N.W.1.
July 3.

Points from Foregoing Letters

DR. A. S. RUSSELL describes work which suggests that metals of the class which forms compounds with metals of the copper, iron, cobalt and nickel class may be arranged in a list analogous to the electrochemical series. Any metal in this list can displace from intermetallic combination one lower in the list.

The formation of long carbon dendrites has been observed by K. D. Luke and Drs. W. M. Madgin and H. L. Riley in the cathodic reduction of colloidal solutions of graphitic oxide. Colloidal particles of graphitic oxide are negatively charged, and the reduction occurs in spite of the strong repulsive forces which must exist in the neighbourhood of the cathode.

The large majority of the negative ions formed during electric discharge in mercury vapour, hydrogen, nitrogen and carbon dioxide, Dr. F. L. Arnot finds, do not arise by the attachment of one electron to a neutral atom, but by the attachment of two electrons to a positively charged ion. The author calculates the probability of such conversion from positive into negative ions, for the gases mentioned above, at the surface of a negatively charged nickel electrode.

From the energy of the neutrons selectively captured by rhodium, Drs. P. Preiswerk and H. von Halban, jun., deduce the distance, breadth and form of the nuclear levels in that element. The data required were obtained by determining the absorption coefficient for each additional layer of rhodium.

Light falling upon a cuprite crystal in contact with two electrodes through which an alternating current is passing, produces an additional direct voltage. Dr. G. Groetzinger and J. Lichtschein submit curves showing how the resulting direct voltage varies with the alternating current, and its relation to the crystal photo-electric effect. They consider that this additional current is connected with events taking place in the interior of the crystal.

Experiments on mice carried out by H. Burrows indicate that progesterone, a substance related to the male sex-hormone testosterone, can protect the genital organs of the non-castrated animals from the injurious effects of large doses of the female sex-hormone, œstrone.

An increased excretion of the yellow pigments, flavins, in the urine, after eating cooked ox-liver, is reported by A. Emmerie.

From the rate of sedimentation and the movement in an electric field (electrophoresis) of the protein particles from horse serum carrying an anti-body, Prof. M. Heidelberger, Kai O. Pedersen and Arne Tiselius conclude that the particles are of uniform size and possibly a definite chemical compound. The sedimentation constant is $17{\cdot}2 \times 10^{-13}$, and the anti-body is apparently formed from a heavier minor component of the protein. The rabbit anti-body against crystalline egg-albumin, on the other hand, is produced from the principal globulin component.

Two unusual modifications of eye colour in the fruit fly, under X-ray irradiation, are reported by Dr. E. V. Enzmann and C. P. Haskins. In one case the change was from white to red, involving apparently a reverse genovariation; in the second case mutations in a culture of eosin *Drosophila* produced eye colour considerably darker than eosin, showing that wild-type condition is not necessarily the end-point of change from light to darker shades.

In the centre of a 'depression', in the later stages of its existence, the air at a height of 4–9 km., though colder and therefore heavier than surrounding layers, is nevertheless ascending. The energy needed to lift it, Dr. A. H. R. Goldie suggests, is provided by the winds, which give up part of their energy and slow down as they converge spirally towards the centre of the depression.

The propagation of voltage impulses in long discharge tubes has been investigated by Dr. L. B. Snoddy, Prof. J. W. Beams, W. T. Ham, jun., and H. Trotter, jun. The tube was found to be an excellent transmission line for high-voltage impulses. The velocity of propagation was easily controllable over quite wide ranges of the order of 10^8–10^9 cm. per sec.

A broadening of the resonance lines in the extreme red of the absorption spectrum of potassium vapour in the presence of hydrogen gas is described by T. Okuda, who considers it due to the polarization of the molecules.

ERRATUM. Dr. C. H. Douglas Clark, referring to the paragraph in this column (July 18) on his letter "Optical Polarization Ellipsoids of the Hydrogen Halide Gases", states that it is the polarizability along the long axis which is equal to that of the corresponding negative ion.

Research Items

Pre-Crag Flint Implements

THE evidence bearing on the age of the implements of flint which since 1909 have been found in the Suffolk bone bed has been reviewed by Mr. J. Reid Moir in the light of the conclusions to be drawn from patination, from forms and flaking, and from condition (*J. Roy. Anthrop. Inst.*, 65, Pt. 2; 1935). It is argued that just as in a Pleistocene deposit implements can be sorted out according to their types and assigned to their appropriate age, so in a Pliocene deposit it is legitimate to treat them in a corresponding way. By observing the differences in patination and the reflaking of the pre-Crag flints, it is possible to divide them into five groups; and this classification is supported by an examination of form. Group 1, for example, is rich in implements of the Harrisonian eolithic type, made chiefly from primitive and coarsely shaped implements; but being made from primitive flake implements, they show an advance in technique on the true Harrisonian eolith, which was made from pieces of naturally broken tabular flint. In all the other groups, implements of this type are rare, showing that the production of artefacts of eolithic character ceased after the epoch in which implements of Group 1 were made. Of the rostro-carinates, the same proportion is present in Groups 1, 2, 3, but in 4 the proportion is much less, while in Group 5 none appears. In Group 2, where rostro-carinates occur in the same proportion as Group 1, the eolithic form, which is rare, is replaced by a whole series of racloirs, points, scrapers, choppers and other types. Group 5 is remarkable in being composed of 50 per cent racloirs and 50 per cent unclassifiable specimens. In the 363 specimens, only eight hand-axes are present, though the presence of one specimen in Group 1 shows that the knowledge how to make the hand-axe goes back a very long way. Taking the evidence as a whole, it is maintained that there are few who would deny that Group 1 is of very great antiquity but cannot represent the first attempt of man to shape flints; while Groups 2, 3 and possibly 5 are the most advanced. Group 4 seems to show a slight but very definite regression.

Fishes from the *Pawnee* Second Oceanographic Expedition

FOLLOWING his first and second reports (1928 *a* and *b*) in the same publication, Mr. C. M. Breder, jun., deals with the Heterosomata to Pediculati from Panama to Lower California (Scientific Results of the Second Oceanographic Expedition of the "Pawnee" 1926. *Bull. Bingham Oceanographic Coll.* Peabody Museum of Natural History, Yale University, 2, 1936). There is much interesting matter in this report, which includes many new species and observations. The new genus *Hubbsiella* is created to include *Menidia clara* Evermann and Jenkins, which differs from *Menidia* proper in several important characters, as has already been noticed by Jordan and Hubbs. Remarks on *Alectis hopkinsi* (Jordan and Starks) suggest that the Pacific representatives may lose their juvenile filaments of the dorsal fin normally by breakage, the stubs simply healing up and not regenerating. A useful key to the Eastern Pacific Hæmulidæ is given, containing twelve species belonging to nine genera.

Land and Freshwater Molluscs of Colorado

PROF. JUNIUS HENDERSON has enlarged greatly and corrected his original report of 1924 on this subject, and the present monograph, "Mollusca of Colorado, Utah, Montana, Idaho, and Wyoming—Supplement" (*Univ. Colorado Studies*, Vol. 23, No. 2, 1936), includes much new material. Careful work has been done upon Rocky Mountain molluscs during the past decade, resulting in a better understanding of many species and the addition of a number to the fauna, some of them new to science. In the comprehensive work now before us, we find a very large number of both land and freshwater forms listed and criticized, with valuable notes and, in some cases, figures and plates. All workers on mollusca in these districts will benefit by the publication of this most useful paper.

Animal Products

CHAPTERS vii and viii of the second part of the first volume of "Die Rohstoffe des Tierreichs" (Berlin: Gebrüder Borntraeger, 1935. 21.50 gold marks) deal with the hard substances produced by animals, ranging from fish scales, otoliths, tortoise shell and bird's claws to rhinoceros horns, antlers, bone and ivory. The second chapter treats of glue, gelatine and slime. Each product is considered historically, and its characteristics and treatment given. The data concerning its trade and the uses to which it is put are discussed. The full bibliography at the end of each chapter is subdivided into sections for each product. It is a most useful source of information.

Pathogenic Actinomyces

"THE Pathogenic Aerobic Organisms of the Actinomyces Group" is the title of a report by Dagny Erikson (Medical Research Council. Special Rep. Series, No. 203. London: H.M. Stationery Office. 1*s*. net). The study of fungi of medical importance has been hindered in the past by inadequate examination and description and by confused nomenclature. In this report, Miss Erikson has examined a number of strains of *Actinomyces* collected by Dr. A. G. Gibson from enlarged spleens in various clinical conditions, and a series of strains—variously labelled *Actinomyces*, *Streptothrix*, *Nocardia*, etc.—contained in the National Collection of Type Cultures, maintained by the Medical Research Council at the Lister Institute, London. The cultural, morphological and biochemical characters of twenty-five species are described, including fifteen that appear to be entirely new forms.

Testing Green Karri Timber

UNDER the auspices of the Council for Scientific and Industrial Research of the Commonwealth of Australia, the Division of Forest Products is undertaking an extensive series of tests on the mechanical and physical properties of the timber of karri (*Eucalyptus diversicolor*). Several special tests have so far been carried out ("A Discussion of Special Tests on the Compressive Strength of Green Karri" by Ian Langlands, Division of Forest Products, Pamphlet No. 61—Tech. Paper, No. 19. Government Printer, Melbourne, 1936). It is shown in this paper that green karri will withstand greater stresses perpendicular to the grain when the load is applied to the tangential face than when it is applied to the radial face. The modulus of elasticity of karri is also much higher when the load is applied to the tangential face. The influence of the width of the loading plate on the compressive strength perpendicular to the grain is considered in detail. The results are given of a series of tests on green karri which were carried out to check the applicability to this species of a rational formula suggested by the U.S. Forest Products Laboratory for northern hemisphere timber. The tests showed that the formula applies very closely when the stress at 1/10 in. deflection is considered; but if the stress at the limit of proportionality is taken as the criterion, the agreement is not so good because of unavoidable eccentricities in loading.

The Japanese Earthquake of February 21, 1936

THOUGH it did not attain more than semi-destructive intensity, the Kawati-Yamato earthquake of February at 10h. 8m. (1h. 8m. a.m., G.M.T.) ranks as the strongest felt in central Japan since the Tango earthquake of 1927. It is described in three short papers published in vol. 14 of the *Bulletin* of the Earthquake Research Institute. Messrs. N. Nasu and T. Hagiwara (pp. 285–289) study the early after-shocks, of which there were 77 during the first 24 hours. A network of five seismological stations was formed around the epicentre near Mt. Hutagami, from the records at which it was found that the focal depths of five after-shocks during the first fortnight were less than six miles. Mr. N. Miyabe (pp. 297–306) remarks that earth-sounds were heard at many places, but they seemed to come as a rule from the nearest mountain rather than from the epicentre. Lights were noticed with the earthquake by several persons, but it is not certain that they were connected with it. Mr. T. Saita (pp. 307–317) examines the relation between the amount of damage and geological structure. He states that, on hard ground, heavy buildings collapsed seriously, while, on soft ground, old and poorly built houses were much damaged.

A Piezoelectric Ultra-micrometer

THE ultra-micrometer is an instrument for the measurement of linear displacements smaller than those which can be measured by optical interferometry; these are limited by the wave-length of light. Whiddington in 1920, using two oscillating electrical circuits tuned so as to produce an audible beat tone, was able to extend the sensitivity of measurement to a value smaller than 10^{-8} cm. Later on, W. G. Cady and D. W. Dye used a piezo-electric quartz plate instead of a resonant electrical circuit. In *Science* of May 15, Prof. J. C. Hubbard describes how by using a quartz plate of 600 kilocycles resonant frequency, a frequency change of one sixtieth of a cycle may be detected. This corresponds to a frequency change of about three parts in one hundred million. To test the method, a micrometer condenser has been constructed so that each plate is attached to a separate support clamped to a heavy steel rod. Adjustments are provided for making the plates parallel and for making relatively large variations of plate distance by means of a micrometer screw. A variable condenser in parallel is provided so as to operate the micrometer condenser at any desired plate distance and thus secure a wide range of sensitivities. In the experiments which have hitherto been carried out, displacements of 10^{-8} cm. have been measured with an inaccuracy less than a few per cent, although no special precautions were taken against mechanical disturbances. It is hoped that by taking such precautions, displacements of 10^{-10} cm. may be measured. The attainment of a sensitivity of this order should open a new avenue of approach to many important and interesting problems in atomic and molecular physics.

Bakelized Bearings

AN extraordinary development in the kind of bearings used in machinery intended for heavy service is described in the *Metropolitan-Vickers Gazette* of July. The provision and maintenance of bearings in rolling mills is more difficult probably than in any other industry. The pressures are high, the conditions are usually dirty, and maintenance and replacements are difficult and expensive, both in cost of spares and in time lost while repairing or changing. For the heaviest service, white metal bearings have been found quite inadequate. Bronze bearings, usually called brass, are commonly used, but the wear is very rapid. Much thought has been given to this problem, and after many attempts an apparently most unlikely solution has proved the best. It has been found that a bearing material consisting of a fibrous substance like paper or cloth bonded with 'bakelite', a synthetic resin, is far better for this service than any metal. Also, no oil is used, but the bearing is fed continuously with a stream of water. The water has a dual function; in the first place it acts as a lubricant, and in addition it fulfils a more important function by keeping the bearing cool. Cooling is specially required in bearings of this kind, owing to the fact that the heat conductivity of the bakelized bearing material is very much smaller than that of metal. A stream of water is found the best means to carry away the heat generated by friction. A very large number of these bearings are already in service and give good results. The saving in power varies from 30 to 60 per cent, the life is increased about ten times, and there is a saving in the workers' time, as there is seldom need to adjust the rolls.

Relativistic Problem of Two Bodies

THE present verifications of the general theory of relativity deal only with gravitational fields due to a single body. For example, in the case of the advance of the perihelion of Mercury, the field is considered as due to the sun alone, an approximation which is legitimate owing to the smallness of the ratio of the mass of the planet to that of the sun. Prof. T. Levi-Civita (*L'Enseignement Mathématique*, 34, 149; 1935. Paris: Gauthier-Villars), deals with the corresponding problems for two bodies of comparable mass. The equations of relative motion, to a certain degree of approximation, show that we may speak of a central force separable into a Newtonian attraction and an Einsteinian perturbation, which produces an advance of perihelion. This might have been expected, but it is strange to find that the centre of gravity oscillates slightly instead of being at rest or moving uniformly in a straight line. There seems no hope of testing this by observation, but the new formula for the advance of perihelion (slightly different from that applicable in the case of Mercury) may possibly be verified by observation of double stars.

Museums Association

ANNUAL CONFERENCE AT LEEDS

THE forty-seventh annual conference of the Museums Association was held at Leeds on July 6–10. The meetings were held in the Museum, and the usual trade exhibition and members' exhibits were in the entrance hall of the Art Gallery. The conference attracted a record attendance; more than three hundred members and delegates met under the presidency of Sir Eric Maclagan, director of the Victoria and Albert Museum.

Sir Eric, in his presidential address on "Museums and the Public", gave a summary of the various services afforded children and adults by the museums. He is not convinced that children's museums, as separate entities, are a wise ideal, and preferred that children's exhibits should constitute a bait rather than a permanent diet. He would like to see the abolition of many petty restrictions upon adults, such as the ban upon walking-sticks and umbrellas; yet, on the other hand, there is the danger of coddling the public owing to the excellent seats, gardens, refreshment rooms and guide lecturers now at the service of the visitor. Too little, perhaps, is being left to the public, and museums are not peep-shows and need not degenerate into them. In view of the little that museums do which has any real news value, Sir Eric thinks that great credit should be given to the newspapers, which are so often among the museum's best friends.

Following the presidential address, Col. Kitson Clark told the interesting story of the various Leeds museums and the persons responsible for their foundation. The morning session concluded with an address by Sir Harry Lindsay, director of the Imperial Institute, upon the various methods of visual instruction developed and used for adults and children in the Institute.

In the afternoon, Mr. F. R. Worts, headmaster of the City of Leeds School, dealt with museums and secondary schools, a subject which elicited a lively discussion, from which it was apparent that too much is expected from the museums and too little co-operation offered by the schools. The session concluded with a somewhat detailed, but important, discussion on nomenclature in natural history collections, opened by Dr. F. J. North, and a description of the new Perth Museum and Art Gallery by its director. Mr. J. Ritchie, who illustrated his remarks with lantern slides and a cinematograph film.

The opening paper on Wednesday morning was by Mr. Leigh Ashton, of the Victoria and Albert Museum, who described the display methods he used so successfully in arranging the recent Chinese Art Exhibition at Burlington House. He was followed by Mr. Philip Hendy, director of Leeds City Art Gallery, who had much to say about the lack of civic encouragement to art galleries. He deplored the lack of visual imagination at the present time and the tendency to "think in print". He regrets the decay of craftsmanship, and looks upon the art gallery as a remedy to industrialism, but he thinks that art galleries might profitably exhibit more manufactured objects. Mr. S. F. Markham followed with an account of the museums in India, based upon his recent survey, and the morning session concluded with an important discussion on the copyright of paintings in museums and art galleries.

Thursday morning was occupied largely by the annual general meeting but there was a vigorous discussion on the future of the Association. Finally Dr. Mortimer Wheeler read an account, by Mr. Iliffe of the folk museum movement in Palestine.

Excursions were made to various places of interest including Temple Newsam Mansion, Kirkstall Abbey, Harewood House and Fountains Abbey.

The new president of the Association is Alderman Charles Squire, of Leicester, and the next conference will be held at Newcastle-upon-Tyne.

Society of Chemical Industry

ANNUAL MEETING AT LIVERPOOL

THE programme of the annual meeting of the Society of Chemical Industry at Liverpool, July 6–10, in itself provides an excellent illustration of the way in which chemical industry is linked up with almost every aspect of our national life, and of the extent to which chemical science enters into questions not only of industry but also of transport, food supply and the like.

The Messel Memorial Lecture, "Works as I have seen them Grow", delivered by Sir Robert Mond on July 8, gave an impressive account of the development of the Winnington works of Brunner, Mond and Co., as well as of the Mond Nickel Co. and the Mond Gas Companies, which well illustrates the creative power of science in developing new industries or adapting old ones to changed conditions. It might also be regarded as a dissertation on the theme that the mental process of pure research, the way of asking Nature the right question and of obtaining adequate responses, is as applicable to applied as to pure science. Knowledge of progress depends on trustworthy and continuous measurements of all the many factors involved, and these measurements can be effected as well on a works as on a laboratory scale, and with intelligent designing no great or specially expensive methods are required. Acting on this principle, Dr. Ludwig Mond not only made the Solvay ammonia-soda process a commercial and technical success, but also showed by what means the science of physical chemistry could be studied practically and developed in a works instead of in a laboratory.

Sir Robert Mond suggested that this was his father's great contribution to human progress, and those who took part in the numerous visits to works and factories during the week found much to justify Sir Robert's assertion. It was equally supported by papers presented to the meeting such as Dr. R. Houwink's address to the Plastics Group on "Synthetic Resins, their Formation, Properties and Possibilities", Dr. L. H. Lampitt's on "Food Package and the Consumer" at the Food Group Congress held jointly with the Royal Sanitary Institute at Southport, or Mr. R. G. Batson's address to the Road and Building Materials Group on "Scientific Research and the Highway Engineer".

All these papers and discussions emphasized the way in which exact measurements by physical methods are laying the foundations for future advance. Dr. Houwink, discussing future developments, said that one of the most urgent requirements is for stronger, more elastic, more shock resistant and electrically improved products, and referred to the possibility of improving the properties of shellac so that competition with resins like those of the phenol-formaldehyde type become possible again. Dr. Lampitt referred to the way in which growing public appreciation of the importance of hygiene has led to fresh demands for packing materials which the chemist has been able to meet.

The address for which the Liverpool meeting will be most remembered, however, is that of the president, Mr. W. A. S. Calder, on July 7, on "The Chemist as World Citizen". Mr. Calder linked up the chemist and his training to acquire and face facts with his wide responsibilities in the world to-day. One of the chief causes of the dangers to freedom and progress is the utter ignoring of facts, and Mr. Calder protested strongly that the chemist is not the destroyer which the irresponsible Press represents him to be. It is a lamentable fact, however, that we are all susceptible to the poisonous virus of newspaper propaganda. No one capable of thought can fail to admit that no one nation is ever entirely responsible for a war, and Mr. Calder pointed out that the training of a chemist should teach him the impossibility of being always right. Chemists cannot escape the responsibility of seeing that the danger of refusing to face facts is duly impressed upon our politicians.

Another direction in which the chemist can play a part as a world citizen is that of the prevention of accidents. The chemist and engineer are qualified by their training to be of special service in anticipating risks and thus preventing accidents. Many accidents still occur which could not be possible if those in charge of affairs fully realized their responsibility. Men are even exposed to unnecessary risks which they are expected to avoid by compliance with impossible orders for their own safety, and Mr. Calder expressed the hope that the interchange of details of accidents already taking place between several countries might become world-wide.

Coral Reef Ecology at Low Isles

THIS fine contribution* to the series of reports on the Great Barrier Reef Expedition of 1928–29 is chiefly concerned with accounts of three traverses across the reefs at Low Isles. Its production is the result of a collaboration between several workers; Prof. T. A. Stephenson originally chose the traverses; physical and chemical data were provided by Mr. A. P. Orr, and level sections by Mr. M. A. Spender. The bulk of the work, however, fell to Dr. Fraser and Dr. S. M. Manton, who jointly enumerated the organisms present, while the latter is responsible for drawing up this report.

Along each traverse a strip of reef one yard in width was examined. The first traverse, more than 1,000 feet long, started from a Thalamita flat inside the reef and crossing a shallow moat, passed over a boulder tract to descend the seaward slope of the reef to the muddy sea-floor at about twenty feet below datum. The second traverse, about half the length of the first, crossed a portion of the reef where the contour of the sea-floor was rather irregular. The third traverse on the windward side of the reef could not be worked in detail on account of the roughness of the water; but such observations as were made are nevertheless of much interest.

The results of these surveys are given in a number of graphs that permit easy comparisons to be made of the distribution of corals and algæ, both as regards abundance of individuals and of species. Algæ were abundant only in the moat and on the inshore part of the second traverse; they were almost absent from the seaward slopes of all three. Coral growth was vigorous in the deeper part of the moat—where there is always nearly a foot of water at low tide—as well as on the seaward slopes of the traverses below the datum line. In the moat physical conditions were extreme, especially as regards temperature and to a considerable extent silting; the association of species living there was hence not the same as that outside. *Montipora ramosa* was the dominant coral in the moat, indeed being restricted to that situation, whereas the *Acroporas*, species sensitive to heat and silt, were almost entirely confined to the seaward slopes.

One of the more important points brought out is the influence of silt on the distribution of corals. It seems clear that whereas some species are well able to withstand a fair amount of silting, others are killed off by very little. Silt is evidently a limiting factor, and it is in turn correlated, of course, with water movement.

In addition to the traverses at Low Isles, small isolated areas on the Outer Barrier Reef were examined and are described here for comparison.

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* British Museum (Natural History). Great Barrier Reef Expedition, 1928–29. Scientific Reports, vol. 3, No. 10: Ecological Surveys of Coral Reefs. By Dr. S. M. Manton. Pp. 273–312+16 plates. (London: British Museum (Natural History), 1935.) 10s.

The different physical conditions there are primarily responsible for the change in the character of the fauna as compared with that at Low Isles.

This report is most beautifully illustrated by a series of large-scale maps in picture form, showing in detail the distribution of corals and other organisms on small selected areas of the traverses or on portions of the Outer Barrier Reef. These maps show evidence of lavish care and attention both in the preliminary drawings and in the measurements necessary to produce them, as well as in the skilful draughtsmanship that has produced the finished plates. They should be of great value to all students of coral reef ecology.

Diesel Fuels and Engineering

AT the first overseas meeting of the Institution of Petroleum Technologists held in Holland on May 8–11, a series of papers was read on diesel fuels and diesel engineering.

Among papers presented for discussion was one by Ir. W. Hupkes on "Diesel-Electric Traction on the Netherlands Railways". Of particular interest in this paper is a clear exposition of facts leading to selection of diesel-electric trains for the frequent and regular conveyance of passengers in the Netherlands. The triple-articulated diesel-electric engine chosen was designed specifically to meet circumstances of accommodation, coupling, speed, rapid acceleration and open-air storage when not in service. Full details are given of the car arrangement ultimately decided upon, motive power, performance, braking, automatic coupling, heating and ventilation.

Ir. G. J. Lugt in his paper on the "Design of Fuel Injectors for Diesel Engines" described the two methods of fuel injection, mechanical and pneumatic, and indicated the function of the injector as being the distribution of the fuel over the air in the compression space of the cylinder. He then devoted himself to closed mechanical injectors as being almost exclusively used by diesel engineers. He concluded with the remark that there is now little need for individual design of injectors for diesel engines as they have become to all intents and purposes a standard fitting.

Mr. C. H. Barton in his paper on "Diesel Fuel Specifications" pointed out the necessity for such specifications in the classification of fuels into grades and in the indication of desirable properties in particular grades. He described tests commonly adopted in fuel specifications and indicated their significance.

A joint paper by Ir. G. D. Boerlage, Ir. J. J. Broeze, L. J. Le Mesurier and R. Stansfield, on the "Correlation of Tests on the Ignition Quality of Diesel Fuels, carried out at Delft and Sunbury", was the outcome of differences found in the two laboratories regarding the rating in terms of cetene numbers of some commercial fuels. A great deal of work was involved before agreement was reached, and the results of this collaboration are of major importance as providing a feasible technique for the accurate determination of ignition quality of diesel fuels.

Training of the Engineer in the U.S.A.

A PAPER on the training of the young engineer by R. E. Hellmund, of the Westinghouse Company, just published by the American Institute of Electrical Engineers, takes into account the changing conditions of the industry recovering from the great depression. It was discussed at the summer convention of the American Institute of Electrical Engineers at Pasadena on June 26, 1936.

The disorganization of industry brought about in the United States and elsewhere by bad times has resulted in many radical suggestions being made in connexion with engineering education, and Mr. Hellmund has noted a tendency to discard good methods with bad. Even if it were desirable for the good of humanity to retard the introduction of labour-saving devices with the object of avoiding unemployment, it would not be advisable. Every engineer employed in any competitive industrial enterprise must, if the business is to survive, reduce costs by every means in his power. Even the greatest advocates of Government control have never suggested the elimination of competition in industry. He states that the only way the engineer can help to diminish unemployment is to create new products for which there will be a demand. This will enable costs to be reduced, and at the same time the population will benefit by the improvement. He suggests, therefore, that economics be given a more prominent place in engineering education. Psychology is another subject of study that will assist the engineer in carrying on his work effectively under modern conditions. The question arises, in what way should the syllabuses of the colleges be best altered so as to accomplish this.

Mr. Hellmund has noticed that young engineers in industrial organizations frequently become so absorbed in the solution of an interesting problem that they neglect to study its economic and commercial aspects. During the depression, it was more than ever necessary to focus attention on this side of the question. In many college curricula, courses in economics are included, but they are given by the department of economics, and much of the work covered at present is far removed from the practical applications encountered by the engineer in his everyday work. He concludes that the engineering schools should offer special abbreviated courses which show how the basic laws can be applied in practice.

Psychology is another subject that in several ways can assist the engineer in carrying on his work effectively. In industrial organizations, work cannot be done efficiently without a thorough knowledge of human nature. The depression has emphasized the importance of this. Although the study of psychology will not correct all personal shortcomings, yet it seems the only practical way by which the colleges can bring about improvement. A few specific lectures on this subject would be helpful in a school of engineering, but, at least at first, they should not be made compulsory.

Graduate courses at college prior to entering industry are, in Mr. Hellmund's opinion, only of limited value. It is dangerous for an engineering student to stay too long in a college atmosphere. The profession is one which requires courage and initiative, qualities which are rarely developed in college life by the type of students who take postgraduate courses. It is true that there are a few kinds of highly technical research work which might advantageously be done at a postgraduate course at the university. If the postgraduate work is undertaken because the graduate is unable to find immediate employment in industry, it is advisable not to take courses in the specific subjects of the branch of engineering contemplated but in affiliated subjects. For example, an engineer wishing to enter research work on electrical subjects would do well to take additional mathematics, physics and physical chemistry. One intending to take up practical design would find additional work relating to the materials used in his type of engineering, such as chemistry and metallurgy, very useful. The opinion is expressed that it is generally better for the young engineer to enter industry as soon as possible after completing his undergraduate course.

During the depression, the business of many industries decreased by 20–60 per cent of previous levels. The heavy industries were as a rule the most severely affected. During the lowest level, it was difficult for engineering graduates to find employment. Now industry is increasing and the prospects are good. As a rule, employers can engage their old employees with specific experience and ability, but some of these have taken up activities outside the engineering industry and so there is a demand for young engineers. In some cases the latter have a great advantage over the older men, as they know the latest theories and methods and have not forgotten how to handle the technical details in calculations, laboratory and similar work.

Mr. Hellmund has noticed that about seventy per cent of all engineering graduates express a desire to go into power transmission work, the design of large machinery, railway electrification and similar work. As they all cannot get employment in this direction, it is necessary to persuade some of them to take up other activities. The author can recall no instance where the men who took his advice afterwards regretted their action, as they soon found that there are very interesting and important problems in almost every branch of engineering. The young engineer need not fear to enter work not entirely in accord with his wishes. He should prepare himself to handle effectively the work assigned to him.

Chemistry of Fibres

THREE papers read at the annual conference of the Textile Institute held in London on June 3–6 dealt with various aspects of the chemistry of fibres.

One of these was a comprehensive summary by G. F. Davidson of current theories of the molecular structure of cellulose. After an outline of the chemical and physical evidence in support of the molecular chain theory, the membrane theory of Hess was dealt with critically; the author, in common with most other investigators, appears to prefer the former. Six methods for the determination of the molecular weight of cellulose and its derivatives were then described, and the difficulty of correlating and interpreting the resulting values was emphasized. Thus, chemical determinations of end-groups give the 'molecular weight' of the largest unit within which the atoms are bound by primary valencies; osmotic pressure and ultra-centrifuge methods measure only particle size and, therefore, depend on the degree of aggregation of the molecules; whilst viscosity measurements must be standardized against an absolute method.

The second part of the paper described how the methods devised by the British Cotton Industry Research Association for the preparation of modified cotton cellulose by the action of acids and oxidizing agents have enabled evidence in support of the chain theory to be obtained.

A second paper, entitled "Wood Pulp for the Rayon Industries", by L. Hebbs, contained some interesting side-lights on the influence of the early work of the late C. F. Cross. Thus, it was pointed out that so long ago as 1904 a pulp with an α-cellulose content of 88·8 per cent had been produced by mercerization with alkali. Moreover, in 1906 an analytical method for the determination of α-cellulose was outlined, which is essentially the same as that used to-day. The correlation of the copper number and the cuprammonium- and viscose-viscosities with the strength and cellulose purity of pulp was then discussed, the relationships being illustrated graphically. The elimination of resinous matter in the manufacture of wood pulp is greatly assisted by removal by washing and screening of the small sacs, medullary rays and short fibres in which it is concentrated, and by bleaching the pulp in several stages. Rapid replacement of cotton linters by wood pulp is expected.

In the third paper, Dr. R. Cuthill discussed the sorptive properties of the silk fibre, which are of considerable importance both from a theoretical and a practical point of view. Gases and vapours, non-electrolytes in solution and pure liquids, suspended solids, electrolytes and dyes were dealt with in turn.

Canadian Work on Dermatophyte Fungi

A NUMBER of papers by members of the University of Manitoba form an admirable review of modern knowledge of the dermatophytes, or fungi which produce ringworm and favus diseases of human skin. The general mycologist will find many features of interest in this field of specialist endeavour, and Dr. P. H. Gregory has provided adequate summaries[1].

The outstanding characteristic of a dermatophyte is that it can utilize the highly insoluble scleroprotein *keratin* as a source of energy. This is apparently accomplished by means of a keratolytic enzyme secreted by the organism. Such fungi may be introduced to unkeratinized parts of the body ; several have, indeed, been re-isolated from the blood-stream ; but they do not seem to be able to parasitize any organ but the skin.

A very high degree of specificity is found. Some species of the genus *Microsporon* produce ringworm of the scalp in children, but not in adults ; the lesions disappear naturally at puberty. Certain species parasitize the hands and feet, whilst others attack only the hairy parts of the body. *M. audouini* infects man, but not other animals. This limited pathogenicity cannot be due to chemical differences between the various sources of keratin, for a number of species will attack that substance from all sources—scalp hair from children and adults, pubic hair, human nails, porcupine quills and snake scales—when it is dissociated from living tissues.

The localized fungal infection, known as a 'mycosis', may not be the sole effect of the organism upon the host. 'Mycids' may occur. These are secondary lesions of a non-parasitic nature, but definitely associated with the presence of the fungus in another part of the body. The very great emphasis on the need for keratin as food for the parasitic dermatophytes is rather striking, as they are also saprophytes of a taste sufficiently catholic to include such diverse food substances as tinned oysters, straw, cereal grains and a wide variety of synthetic media. Their characters are also changed in the saprophytic phase, and very numerous forms of organs appear in artificial culture which are unknown in the state of natural parasitism. The spontaneous degeneration known as pleomorphism often occurs in the saprophytic phase ; but infection of animals has been accomplished from fungi which have been grown saprophytically upon keratinized tissues *in vitro* for some time. The need for investigation of natural sources of infection raises some very interesting problems for the field mycologist. From what saprophytic substrata can a dermatophyte proceed to attack a human subject ? How is the transference to the host accomplished, and by what kind of spore ?

Classification of the 880 species of dermatophytes at present described is very difficult. Four different systems of grouping have been suggested, but the general mycologist would only be at home with that of Langeron and Milochevitch, which includes all the ringworm and favus fungi in the Gymnoascaceæ, though perhaps, as yet, with insufficient justification. The system originally proposed by Sabouraud, and revised in 1929, is still the most useful to medical men. It also possesses sufficient parallels with the classification of the Fungi Imperfecti to enable it to be adapted mycologically as future researches should dictate. The local dermatophyte floras of various parts of the world are being studied, and Drs. A. M. Davidson and P. H. Gregory have published their quota[2]. The same two authors have also helped to simplify the problem of classification by their proof[3] that the so-called 'mosaic fungus', often associated with ringworm attacks, is in reality an intercellular deposit of cholesterol crystals. Dr. Gregory discusses reports of the discovery of asci in dermatophytes, and considers their possible relationships with other fungi.

Certain species of dermatophytes cause a green fluorescence to appear on infected hairs when viewed in ultra-violet light. This is due to the presence of a water-soluble substance, and the fact is used to facilitate the diagnosis of ringworm. Dr. A. M. Davidson, S. A. Boyd and C. P. Haltalin have described a very simple and convenient apparatus for this purpose[4]. The work, which is the result of co-operation between a research worker, a physician and an electrical engineer, is typical of the determined team spirit which is very obvious in the publications of the Manitoba workers on dermatophytes, and should not fail to yield results of practical value to humanity.

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[1] "The Dermatophytes", *Biol. Rev.*, 10, 208 (1935) ; and "The Parasitic Activity of the Ringworm Fungi", *Trans. St. John's Hospital Dermatological Society*, 56–65 (1935).

[2] "The Dermatophytes of Manitoba, Canada", communicated to the Ninth International Congress of Dermatology, and appearing in the first volume of deliberations of the Congress. (Budapest : 'Pátria'-nyomda. R.-T.".)

[3] *J. Amer. Med. Assoc.*, 105, 1262–1264 (October 19, 1935).

[4] *Canad. Med. Assoc. J.*, 33, 534–536 (1935).

Educational Topics and Events

EDINBURGH.—Prof. James Ritchie, regius professor of natural history in the University of Aberdeen, has been appointed to the chair of natural history, in succession to the late Prof. J. H. Ashworth.

The degree of Doctor of Science has been conferred upon the following : A. B. Brown, for a thesis entitled : "Studies in Cambial Activity" ; Sasindra Chandra Dhar, for a thesis entitled : "On certain Investigations of the Properties of the Functions of Mathieu, Whittaker, Weber and other Confluent Hypergeometric Functions : On the Uniformization of Algebraic Curves, and on certain Electromagnetic Waves in Gravitational Fields in Relativity" ; Nancy M. Galpin, for a thesis entitled : "Biological and Statistical Studies on the New Zealand Romney Lamb, with reference to Relative Growth Gradients" ; J. M. Stagg, for papers on "Terrestrial Magnetism, with special reference to the Magnetic and Non-photographic Auroral Data brought back from Fort Rae, North-West Canada" ; J. Carmichael, for a thesis entitled : "Investigations into Tuberculosis in Uganda" ; Philippus L. le Roux, for a thesis entitled : "Observations on Schistosomiasis and Paramphistomiasis in Sheep, and Notes on the Morphology of Helminths from Mammals and Birds in South Africa".

LONDON.—Dr. W. J. Hamilton, since 1935 lecturer and deputy director of anatomy at St. Thomas's Hospital Medical School, has been appointed University professor of anatomy (St. Bartholomew's Hospital Medical College).

It has been resolved to institute a B.Sc. degree in chemical engineering for internal students in the Faculty of Engineering.

The following D.Sc. degrees have been conferred : In agriculture, on P. H. H. Gray, of the Rothamsted Experimental Station ; in botany, on W. A. Roach, a recognized teacher at the East Malling Research Station; in botany, on F. C. Steward, of Birkbeck College; in fuel technology, on R. J. Sarjant, of the Imperial College (Royal College of Science); in history, methods and principles of science, on Dr. Douglas McKie, a recognized teacher at University College; in physical chemistry, on C. F. Goodeve, a recognized teacher at University College; in zoology, on R. J. Ortlepp, of the London School of Hygiene and Tropical Medicine.

Alexander Haddow has been re-appointed to the Laura de Saliceto studentship for the year 1936–37. The Sir George Jessel studentship in mathematics for 1936 has been awarded to W. J. E. Butler, of University College.

BEIT fellowships for scientific research, tenable at the Imperial College of Science and Technology during the academic year 1936–37 have been awarded as follows: extensions of fellowships to R. Walls, for the continuation of his research on the metamorphic rocks of north-east Scotland, under the direction of Prof. P. G. H. Boswell; E. W. Hewson, for the continuation of his research in meteorology, more especially the detailed structure of discontinuities between air masses as occurring in England and Canada, under the direction of Prof. D. Brunt. New fellowships have been awarded to: E. K. Woodford, of Olds School of Agriculture, Alberta, 1929–30, and the University of Alberta, 1930–36, for research in the physiology of plants, with special reference to problems of plant growth and metabolism, under Prof. V. H. Blackman; Dr. N. Kemmer, of the Universities of Gottingen and Zurich, for mathematics research, using the ideas and formalisms of quantum theory (especially quantum electrodynamics), under Prof. S. Chapman.

A NEW handbook of information about facilities available for students from other countries at university institutions in Great Britain and Ireland has been published by the Universities Bureau of the British Empire (88a, Gower Street, London, W.C.1). In the sixty-four pages of this pamphlet are set out, succinctly but lucidly, indications of conditions of admission, costs of living, fees and other charges, courses and subjects of study, special courses for overseas students, vacation courses, social amenities, some features of university administration and notes on research facilities and open scholarships. Under the heading "Cost of Living", overseas students are strongly recommended to obtain entrance to hostels, as they provide contacts which are not readily obtainable in the seclusion of lodgings and boarding-houses or even in families where students are received as paying guests. The list of courses of study comprises those which experience has shown may be of special interest to overseas students and research workers. Among special courses for overseas students mention is made of an offer by Ashburne Hall of Residence for university women, Manchester, of places at reduced fees (£13 for the term or £1 5*s.* per week) to foreign women students prepared to give some conversational French, German, Italian or Spanish to students resident in the Hall. Other institutions which offer special courses for overseas students are: University College, London; London School of Economics and Political Science; University College, Exeter; University College, Nottingham; and University College, Southampton.

Science News a Century Ago

Progress on the Liverpool and Manchester Railway

AT a meeting of the proprietors of the Liverpool and Manchester Railway held in Liverpool on July 27, 1836, it was reported that the receipts for the half-year ending June 30, 1836, had been £109,355, and the expenses £69,953. It was also reported that the tunnel at the new station, in Lime Street, Liverpool, would be opened for public business on August 15, and that this new means of approach to the railway would prove of great public accommodation. The expense of erecting this station and the one at Edgehill, which was constructed on a most magnificent scale, amounted to about £150,000. The directors also intended, it was said, to erect a commodious station in Manchester similar to the one at Liverpool, and with that view extensive premises had been purchased in the neighbourhood of Water Street, near the River Irwell.

The Euphrates Expedition

IN a supplement to the *London Gazette* of July 29, 1836, a dispatch from Colonel Chesney to the India Office was published describing the loss of the steamer *Tigris*, the smaller of the two steam-vessels with which he was descending the Euphrates to the Persian Gulf. His dispatch was dated May 28, 1836, from the steamer *Euphrates* at Anna. All had been going well, he said, up to May 17, the survey having been carried 509 miles down the great river and "all was continued prosperity up to the afternoon of the 21st inst when it pleased God to send the calamitous event of which it is now my duty to give a feeble sketch. A little after 1 p.m. the flat boats being a little ahead, and the *Tigris* leading the *Euphrates*, a storm appeared bringing with it, high in the air, clouds of sand from the west-north-west quarter. At the moment we were passing over the rocks of Is Geria (deeply covered) and immediately after made a signal for the *Euphrates* to choose a berth and make fast. . . . The *Tigris* was immediately directed towards the bank against which she struck without injury but with so much violence as to recoil a distance of about eight yards." The wind then veered, said Col. Chesney, the water came aboard and the vessel soon sank. Col. Chesney escaped, but no fewer than twenty officers and men were drowned. The storm only lasted about 12 minutes. In spite of the disaster, which included the loss of instruments, journals and surveys, the work of the expedition was carried on by the *Euphrates* alone, "the party continuing their survey to Bussora hoping to demonstrate the speed, economy and commercial advantages of the river Euphrates".

Medicine in Denmark

ON July 30, 1836, the *London Medical Gazette* published the following note: "Every physician and surgeon in Denmark gets an education which qualifies him to maintain the dignity of his profession, as a worthy member of a class that is generally considered to be one of the most respectable and most liberal. The Danish medical men are usually held in high esteem. . . . Danish physicians and surgeons are so honoured abroad that very often Swedes come to Copenhagen in order to be treated by them. Mountebanks and quacks among the Danish medical men are rare. . . . The learning and scientific intercourse among the medical men in the Danish capital are supported by two medical societies. In their general methods of cure the Danish medical men do not commonly use but rather shun heroic remedies: as true sons of Hippocrates they follow his maxims in studying Nature and in endeavouring in all their treatment to obey it and to sustain the *vires medicatrices* not disturbing them by too active medicine".

The Siamese Twins

The British and Foreign Medical Review for July 1836 gives the following account of this interesting pair, who were then in Paris: "The connecting band united them at first face to face, but constant traction has so changed its direction that they are now side by side. Its length above is two inches, below nearly four; from above downwards it measures three inches, and its greatest thickness is one and a half inch. . . . The band is formed superiorly by the xiphoid appendix and by some of the cartilages of the ribs, and presents inferiorly the cicatrix of the umbilicus: the cavities of the two chests do not communicate, but the abdominal cavities do. . . .

It has been proposed to divide the band, but, if this description be correct, any incision would open the peritoneum; such a proposal is very disagreeable to the twins, who have often said they have never seen any single individual so happy as they are united. Their names are Eng and Chang, and they were born in May 1811 in a small village on the coast of Siam, twenty leagues from Bankok, of Chinese parents. They have the Chinese features; the internal angles of the eyes slightly drawn down, skin yellow and hair very black; they are extraordinarily alike, only Eng is a little larger and stronger, and Chang appears to rest more willingly on his brother. They are five feet in height, well proportioned and of great muscular strength; they are very agile, they walk and run rapidly, and can swim as well as a single person. Their intellectual faculties are well developed. They understand English and speak it perfectly, but they have forgotten their native tongue, which is not to be wondered at, as they never speak to each other except sometimes asking a question. They have both an equal knowledge of English. Two persons have endeavoured to converse separately with each at the same time, but both turn invariably to one speaker, and converse alone with him. They suffered from ague in America; the attack commenced at the same time in both, and the stages of the disease exactly corresponded, so that they experienced rigors, heat and sweating at the same moment. Chang also had pain in his side, during which his brother was uncomfortable, and when Chang was being bled, Eng felt indisposed.

Their taste for food, for persons and things is similar, what pleases one, pleases the other; they both experience hunger and thirst, go to sleep and wake at the same instant; one is never awake while the other sleeps, and to wake them it is only necessary to touch one. During sleep they often change their position by one rolling over the other without waking. There is the utmost uniformity in their motions, as if both were influenced by one will. They have never been known to be angry with each other; the one who wishes to perform any act, makes no sign to the other, who, notwithstanding, concurs without the slightest hesitation".

Societies and Academies

Edinburgh

Royal Society, July 6.

B. G. SHAPIRO and H. ZWARENSTEIN: Relation of the pituitary gland to muscle creatine. The creatine content of the thigh muscles of *Xenopus lævis* is about 400 mgm. per 100 gm., the extreme limits for normal animals, male or female, being 40 mgm. above or below this figure. Six months after total removal of the pituitary gland, the muscle creatine content is found to be about 320 mgm. per 100 gm. The same result follows the removal of the anterior lobe alone. The drop does not follow immediately after operation, and is still comparatively slight after three months have elapsed. Injection of anterior lobe extract into normal toads of the same species raises the muscle creatine level by thirty per cent. This effect is tissue specific.

EDITH A. T. NICOL: The fauna of the brackish water lochs of North Uist. These lochs lie at different levels and show all conditions between lochs entered by every tide with a salinity of more than thirty per mille and those entered by only the highest tides with a salinity of about two per mille. The pH varies between 7·8 and 9·9 in spite of the low pH of the fresh-water and the alkali reserve is often below 0·0010 N. The fauna is unusually rich owing to the varied conditions of salinity and substratum, and consists of 59 marine, 24 fresh- and 25 brackish-water species, as well as 5 euryhaline forms. *Sphaeroma hookeri* is recorded for the first time in Scotland.

P. C. KOLLER: The chromosomes of the male grey squirrel. The diploid chromosome number of the grey squirrel (*Sciurus carolinensis leucotus* Gapper) is 28. The sex chromosomes exhibit very little difference in size. The sex bivalent during meiotic metaphase is invariably asymmetrical, which indicates an obligatory pre-reduction. A deviation of metaphase chiasma frequencies, found in different individuals, is brought about by a different degree of terminalization of diplotene chiasmata. The ultimate cause of the deviation is either genetical or environmental.

F. WALKER and C. F. DAVIDSON: A contribution to the geology of the Faeroes. The eighteen islands of the Faeroes archipelago, 540 square miles in area, are formed of a great sequence of Tertiary basalts and tuffs, 14,000 feet thick. Small volcanic vents, sills and dykes are present, and thin seams of sediments, including lignite, are intercalated with the basalts. Traverses show that the lowest exposed horizons of the plateau, the base of which is not seen, are formed of tholeiitic basalts. These are succeeded by olivine-basalts, and in turn by a vast thickness of porphyritic feldspathic and tholeiitic basalts, capped by ankaramites and olivine-rich lavas at the highest levels. Composite flows, dyke-feeders to lavas, and other phenomena are described, and an extensive bibliography is given. Seven 'superior' chemical analyses of Faeroes rocks are now available.

F. A. E. CREW and P. C. KOLLER: Genetical and cytological studies of the intergeneric hybrid of *Cairina moschata* and *Anas platyrhyncha platyrhyncha*. The two genera are fertile *inter se*, but the hybrid is infecund. The characterization of the hybrid differs according to which way the cross is made. The male hybrid ex *Anas* (male) × *Cairina* (female) is normally equipped sexually but infecund; the female has a rudimentary ovary, infantile oviduct, exhibits no sex behaviour and in size equals the male. The male hybrid out of the reciprocal cross is infecund and much larger than the female, which has a functional ovary, an oviduct and normal sex behaviour. She lays small eggs which are infertile. The chromosome number of the two genera is probably the same and the larger chromosomes are morphologically alike. In the male hybrid no viable gametes are to be found. Spermatocytes undergo dedifferentiation and nuclear condensation. Multinucleate giant cells in which vacuoles develop and nuclei degenerate are plentiful. The spindle is normal. The sterility of the hybrid would seem to be due to the action of complementary genetic factors which do not affect chromosome pairing but which disturb the relationship of this with spindle development.

Harold Jeffreys: Note on fracture: a note on Dr. E. M. Anderson's paper "The Dynamics of the Formation of Cone-Sheets, Ring-Dykes, and Caldron-Subsidences".

Paris

Academy of Sciences, June 15 (*C.R.*, 202, 1953–2020).

Vito Volterra: The equations of biological fluctuations and the calculus of variations.

Henri Devaux: The determination of the thickness of the albumen membrane formed between water and benzene, and the properties of this membrane. The interfacial membranes of albumen between water and benzene are monomolecular.

Hugo Steinhaus: The curve of Peano and independent functions.

M. Kac: Some remarks on independent functions.

R. de Misès: The energy of acceleration of a solid.

Pierre E. Mercier: Oscillatory phenomena in suspensions.

Louis Couffignal: The use of binary numeration in calculating machines and nomomechanical instruments.

Jean Lagrula: The method of simultaneous pupillary regions. Application of Charles Fabry's method of stellate photometry. Taking four exposures on each plate, by successive rotations of a right angle, relative magnitudes have been determined with an accuracy of 0·005–0·01 magnitude.

L. Chadenson: A functional space of quantic mechanics.

Gabriel Duch: Some relations between the functions of the cohesion forces of liquids and their chemical function at the boiling point under constant pressure.

J. Serpe: The K-radiation of boron. Boron prepared by Moissan's method gives a K-radiation which has at high temperatures three conductivity electrons per atom. The maximum kinetic energy of these electrons is $20 \pm 2{\cdot}5$ v.

Jean Roig and Jean Thouvenin: The variation of the optical density of photographic plates with the dryness conditions. A photographic plate, uniformly exposed, never gives uniform darkening. One of the causes of this variation is moisture variation, and results of a quantitative study of this effect is given.

Mlle. Arlette Tournaire and Etienne Vassy: The influence of the wave-length of the light on the evolution of the latent image. The evolution of the latent image, in plates in which it occurs, is shown to be a function of the wave-length of the incident light.

René Delaplace: Atomic hydrogen and the disappearance of hydrogen in discharge tubes. If the discharge tube is freed from traces of water vapour by cooling with liquid nitrogen for twenty-four hours, the hydrogen does not undergo irreversible contraction, and traces of methane and carbon monoxide are no longer produced by prolonged discharge.

Pierre Spacu: An argento-mercuric compound. From an X-ray study it is shown that Wohler's substance $Hg(CN)_2.AgNO_3.2H_2O$ is a definite compound and not a mixture.

Etienne Canals, Max Mousseron, Louis Souche and Pierre Peyrot: The Raman spectra of some substituted epoxycyclopentanes.

Pierre Brauman: A new type of vanadylsalicylate.

Paul Couturier: The action of mixed organo-magnesium compounds on the aromatic N-diethylamides with phenolic function.

René Truchet: Heavy chloroform, $CDCl_3$. This was prepared by the action of heavy water on a suspension of quicklime in chloral, and contained only a small proportion of ordinary chloroform, shown by the Raman spectrum.

Georges Denigès: The constant formation of carbonyl derivatives (aldehydes and ketones) of the same condensation in the explosive decomposition of nitric esters.

V. Agafonoff: The soil types of Tunis.

Jean Marçais: The geological constitution of the region to the north of Taza and of Guercif (Eastern Morocco).

Maurice Roques: The cristallophyllian series of the Lespinouse massif, in the neighbourhood of Lacaune.

Waclaw Moycho: The independence of the production of proteases and the development of the cell in *Bacterium prodigiosum*. By varying either the pH or the amount of phosphate, the development of the bacterium and the production of proteases can be influenced differently. The two processes, at least in this organism, appear to be independent.

René Souèges: The embryogeny of the Campanulaceæ. The development of the embryo in *Campanula patula*.

Mlle. Marie Louise Verrier: The purple and visual cells of the fovea of the nocturnal birds and of other vertebrates.

Paul Chabanaud: The interbranchial opening of the unsymmetrical teleosteans.

Georges Brooks: Researches on the fluorescence of the skin of the frog, *Rana esculenta*. Study of the mineral substances. The mineral fluorescent substance of the skin of the frog is composed of a complex mixture of mineral salts containing manganese and zinc.

Constantin Levaditi and Perez Haber: The affinity of the virus of bird plague for the neoplasic (epithelioma) cells of mice.

Cape Town

Royal Society of South Africa, April 15.

F. G. Cawston: Some observations on *Opuntia* used as a larvicide. The mucilage of *Opuntia maxima* was tested in various concentrations, and the effect studied on four different anophelines and *Culex*. The majority of the larvæ rapidly succumbed, but the mucilage had little effect on those which had reached the pupal stage. There was also an arrest of development of those which were afterwards removed to clean water. The effect of the juice is largely mechanical, and a preservative is needed to prevent decomposition.

VIVIEN ELLENBERGER: History of the Ba-ga-Malete of Ramoutsa. The traditional and historical movements of the Malete tribe, Bechuanaland Protectorate, collected from native tribal sources and from official records. Notes on the social structure, regimental system, national praises and the tribal territory are included.

I. SCHAPERA: Acculturation among the BaKxatla.

FLORENCE RICH: Some diatoms from the Victoria Falls. An account of diatoms contained in the washings of a collection of Dicraea (Podostemaceæ) made just above the Falls, on the rocks at the east side, where these plants are covered by rapid-flowing water in the rainy season. About sixty different species have been identified, most of which proved to have been previously recorded from South or Central Africa. One new species and several new varieties are described and figured.

W. S. S. LADELL: Use of serum as an accessory medium in tissue culture.

H. ZWARENSTEIN: A revised simple technique for the frog test.

V. SCHRIRE and H. ZWARENSTEIN: The pancreas and blood inorganic phosphorus. The normal plasma inorganic phosphorus content of *Xenopus* is 7·1 mgm. per 100 ml. (average of 58 estimations). Temperature has no effect. Pancreatectomy caused a 30 per cent increase six hours after operation. Injection of insulin into normal animals caused a 50 per cent drop four hours after injection.

Cracow

Polish Academy of Science and Letters, April 6.

W. ORLICZ: The L^M spaces.

K. ŠTEINS: The technique of astronomical calculations according to an international inquiry. Some conclusions based on a questionnaire sent out to twenty-two countries relating to various points in astronomical calculations.

S. PIOTROWSKI: A star, probably new, in Gemini.

K. GUMINSKI: The luminescence of barrier anodes of aluminium. A study of the influence of the nature of the electrolyte, of the anode and the electrical conditions on the light emission of the anodes. The results are discussed from the point of view of the current theories of this luminescence.

I. ZLOTOWSKI: The structure and properties of the insulating layers formed on aluminium electrodes during anodic polarization.

K. DZIEWONSKI and J. MOSZEW: The reactions of methyl-*m*-xylyl ketone with compounds of the thiocarbanilide type.

A. KOCWA: The reactions of the alkyl-aryl-pyrazolones and their derivatives of the anil type with carbanil and thiocarbanil.

MLLE. J. BURTAN: The stratigraphy of the Silesian Beskide.

J. CUNGE: The cyto-architectonic of the cerebral cortex in Japanese waltzing mice.

T. VETULANI: The forest tarpan recently introduced into the forest of Bialowieza.

Official Publications Received

Great Britain and Ireland

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1602 (T. 3503): Influence of a Uniform Jet on the Lift of an Aerofoil. By H. Glauert. Pp. 14+3 plates. 1*s*. net. No. 1679 (1835): Stability of a Monocoque in Compression. By Dr. J. L. Taylor. Pp 9. 6*d*. net. No. 1681 (1810): Experiments on a Small-Chord Flap on a Clark YH Aerofoil in the Compressed Air Tunnel. By D H. Williams and A. F. Brown. Pp. 14+8 plates. 1*s*. net. No. 1683 (1926): Cooling of Aircraft Engines, with Special Reference to Ethylene Glycol Radiators enclosed in Ducts. By F. W. Meredith. Pp. 13. 9*d*. net. No. 1684 (2094): Two-Dimensional Flow of Compressible Fluids at Sub-Sonic Speeds past Elliptic Cylinders. By Dr. S. G. Hooker. Pp. 16+4 plates. 1*s*. net. No. 1686 (2038B): Flutter Experiments on a Model Wing fitted with a Dead-Centre Aileron Control. By V. M. Falkner, W. P. Jones and C. Scruton. Pp. 10+7 plates. 1*s*. net. No. 1694 (2018): A Routine Method of Stressing for Three-Ply Covered Fuselages, with Special Reference to some Mechanical Tests on a Particular Fuselage. By H. Davis. Pp. 4+8 plates. 6*d*. net. (London: H.M. Stationery Office.) [306

Report on the Phenological Observations in the British Isles from December 1934 to November 1935. By Ivan D. Margary. (No. 45.) Pp. 299–358. (London: Royal Meteorological Society.) 3*s*. [77

London Shellac Research Bureau. Technical Paper No. 9: Plasticising Lac Films, Part 1. By Dr. Lal C. Verman and Dr. R. Bhattacharya. Pp. 29. (London: London Shellac Research Bureau.) [87

Other Countries

U.S. Department of the Interior: Office of Education. Vocational Education Bulletin No. 182 (Home Economic Series No. 19): Consumer-Buying in the Educational Program for Homemaking; Suggestions for Teachers of Homemaking in Secondary School and Adult Classes. Pp. xiii+205. (Washington, D.C.: Government Printing Office.) 20 cents. [246

U.S. Department of Agriculture. Circular No. 386: The Wax Moth and its Control. By Warren Whitcome, Jr. Pp. 14. (Washington, D.C.: Government Printing Office.) 5 cents. [246

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 88. The Occurrence of Flints and Extinct Animals in Pluvial Deposits near Clovis, New Mexico. Part 3: Geology and Vertebrate Palæontology of the Late Quaternary near Clovis, New Mexico. By Chester Stock and Francis D. Bode. Pp. 219–241. (Philadelphia, Pa.: Academy of Natural Sciences of Philadelphia.) [246

Suomen Geodeettisen Laitoksen Julkaisuja: Veröffentlichungen des Finnischen Geodätischen Institutes. No. 22: Beobachtungsergebnisse; Winkelmessungen in den Jahren 1932–1935. Pp. iii+148. (Helsinki: Suomen Geodeettisen Laitoksen Julkaisuja.) [296

Report on the Zoological Survey of India for the Years 1932–1935. Pp. iii+ix. (Delhi: Manager of Publications.) 1.2 rupees; 2*s*. [296

Memoirs of the Indian Museum. Vol. 11, No. 3: Studies on Indian Jassidæ (Homoptera). Part 3: Descriptions of some New Genera and Species, with first Records of some known Species from India. By Dr. Hem Singh Pruthi. Pp. 101–131+plates 8–9. (Calcutta: Zoological Survey of India.) 1.10 rupees; 2*s*. 9*d*. [296

Allahabad University Studies. Vol. 12 (Arts and Science). Edited by the Vice-Chancellor and the Heads of Departments. Pp. v+188+5 plates. (Allahabad: Senate House.) 7.8 rupees. [296

Memoirs of the Geological Survey of India. Palæontologia Indica, New Series. Vol. 21, Memoir No. 4: Fossil Algæ from the Uppermost Cretaceous Beds (The Niniyur Group) of the Trichinopoly District, S. India. By L. Rama Rao and Dr. Julius Pia. Pp. v+49+6 plates. (Calcutta: Geological Survey of India.) 4.10 rupees; 7*s*. 9*d*. [296

Indian Forest Records, New Series. Vol. 1, No. 3: The Distribution of Sesquioxides, Silica and Organic Matter in Forest Soil Profiles of the Kulu Hill Area. By R. C. Hoon. Pp. ii+347–365. (Delhi: Manager of Publications.) 12 annas; 1*s*. 3*d*. [296

Smithsonian Miscellaneous Collections. Vol. 95, No. 12: The Dependence of Terrestrial Temperatures on the Variations of the Sun's Radiation. By C. G. Abbot. (Publication 3392.) Pp. ii+15. (Washington, D.C.: Smithsonian Institution.) [296

Studies from the Connaught Laboratories, University of Toronto. Vol. 7, 1935. Pp. v+46 papers. (Toronto: University of Toronto Press.) [286

Commonwealth of Australia: Bureau of Meteorology. Results of Rainfall Observations made in Tasmania, including all available Annual Rainfall Totals from 356 Stations for all Years of Record up to 1934, with Maps and Diagrams, and Record of Severe Floods. Published under the direction of W. S. Watt. Pp. 143+4 plates. (Melbourne: Government Printer.) [296

Advisory Department of the Imperial College of Tropical Agriculture. Report of the Agricultural Department, Dominica, 1935. Pp. vi+19. (Trinidad: Imperial College of Tropical Agriculture.) 6*d*. [306

Nyasaland Protectorate: Geological Survey Department. Colonial Development: Water Supply Investigation: Progress Report (No. 5) for the Year 1935. Pp. 20+5 plates. (Zomba: Government Printer.) 2*s*. 6*d* [306

Catalogues

The Gardener's Library: a Comprehensive List of Books on all Branches of Modern Horticulture and a Selection of the Early Literature. (New Series, No. 39.) Pp. 44. The Gardener's Library, 1936 Supplement. Pp. 8. Books, Periodicals and Pamphlets on Geology, including Palæontology, Mineralogy and Mining, with a Supplement of Recently Published Books. (New Series, No. 40.) Pp. 44. Books and Periodicals on Zoology and Botany, including Publications of the British Museum and Works on and by Linnæus. (New Series, No. 41.) Pp. 58. Cryptogamic Botany. (New Series, No. 42.) Pp. 36. Books on Ornithology. (New Series, No. 43.) Pp. 50. (London: Wheldon and Wesley, Ltd.)

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Electrical Interference with Broadcasting

ONE of the difficulties in ensuring the good reception of broadcast programmes is that many of the various electrical appliances and plant in common use emit radiation which travels to neighbouring radio receivers, and there produces a noisy disturbance mixed with the broadcasting programmes. Some three years ago, the Council of the Institution of Electrical Engineers set up a committee, representative of all sections of the electrical and radio industry, to study this problem, and to make recommendations as to the steps, if any, to be taken to secure the elimination or mitigation of electrical interference with radio reception. This committee, under the chairmanship of Mr. C. C. Paterson, has recently issued its report, copies of which are now available from the Institution of Electrical Engineers (price 6*d.* post paid).

Even before the formation of this committee, the Post Office had commenced the investigation of complaints of interference received from the general public. This work has been continued, and at the present time the appropriate staff deals with about 40,000 complaints a year. As a result of this activity, a considerable measure of radio interference correction has taken place by the voluntary application of the indicated remedies by the owners of the plant or apparatus concerned. The Post Office has no powers in this matter, however, and it has been found that in a small proportion of cases the owners of the offending apparatus refuse to do anything to remove the trouble.

The Committee has expressed the opinion that the desirable objective is defined by the statement that with the field strength of the wanted radio signal of 1 millivolt per metre, when the modulation is 80 per cent, the maximum permissible interfering field strength should be 40 decibels below this value. With this objective in view, a method of measurement has been agreed upon, and instruments have been developed which are capable of indicating with sufficient accuracy the amount of interference caused by much of the electrical apparatus creating trouble. Such apparatus comprises lifts, trolley-buses and trams, household electrical appliances, small electric motors, neon signs, rectifiers and electro-medical apparatus. While at the present time automobile and aircraft ignition systems produce no appreciable interference with broadcast reception on its present wave-lengths, it is possible that trouble may be expected from such systems if they remain uncorrected when television service begins.

During the work of the main committee, a considerable amount of investigation of the problem has been conducted by four sub-committees working in co-operation with the British Broadcasting Corporation, the Post Office, the British Electrical and Allied Industries Research Associations, the British Electrical and Allied Manufacturers Association and various supply authorities and transport undertakings. Also, in view of the necessity of catering for the interests of export trade, representation was obtained on a special international committee set up by the International Electrotechnical Commission in 1934. The British Standards Institution has also set up committees to draft various specifications for components, apparatus and measuring instruments, and these are now in course of publication.

As a result of all this work, the committee now considers it necessary to ensure that all electrical appliances should conform to these specifications and be sold as being free from interference. It therefore suggests first, that the Electricity Commissioners should be given powers to draw up regulations in respect of any apparatus or plant, new and existing, which may cause interference with radio reception; and secondly, that the Post Office should be given powers to enforce these regulations. No special difficulty is seen in applying the regulations to new apparatus, and the cost of the mitigating devices is in most cases only a small percentage of that of the appliance. In the case of appliances already in use, the question of who is to meet the cost of suppression is considered to be a matter for the legislature to decide.

The report shows that a somewhat complicated subject has been explored in a very thorough and fruitful manner by the co-operative effort of representatives of all the parties concerned, and the conclusions reached and recommendations made will, in general, be regarded as very satisfactory. It will probably be some considerable time before legislation and regulations can be made effective, and in the meantime, the Institution of Electrical Engineers appeals to the general public to continue the goodwill on which the Post Office has been enabled to build up its very successful work in suppressing interference with broadcasting.

The Medical Curriculum

AT a meeting on May 29, the General Medical Council adopted certain resolutions in regard to professional education. These will come into operation on January 1, 1938, and include the following:

In the pre-registration requirements, it is laid down that every applicant for registration as a student by the Council or for admission to the medical curriculum proper should have passed (*a*), a recognised preliminary examination in general education as laid down in the Regulations of the Council; and, in addition (*b*), an examination or examinations conducted or recognized by one of the licensing bodies.

The subjects to be included under (*b*) are:

(1) One *or* two subjects of general education, other than chemistry, physics, or biology, at a standard higher than that of the preliminary examination, for those who have received their instruction in these subjects before entering universities, university colleges, or medical schools.

(2) Chemistry (theoretical and practical), the elementary principles of general and physical chemistry, and of the chemical combination of elements, including carbon.

(3) Physics (theoretical and practical), the elementary mechanics of solids and fluids, the elements of heat, light, sound, electricity and magnetism.

The examination in biology (theoretical and practical) may be taken either before or after registration as a student.

It will be remembered that about a year ago a conference of representatives nominated by the Universities of Oxford, Cambridge and London; the Royal College of Physicians of London; the Royal College of Surgeons of England and the Society of Apothecaries of London published a report on the medical curriculum (see NATURE, July 20, 1935, p. 90, and Nov. 2, p. 706). The report stressed the need for a continuance of the general education of intending medical students of post-School Certificate stage, and therefore recommended that "the Licensing Bodies consider the possibility of allowing and encouraging exemption from the 1st M.B. examination by means of a Higher School Certificate Examination conducted by any recognised Examining Body in which, in addition to the three principal scientific subjects, a subsidiary non-scientific subject be taken".

The Higher School Certificate Examination is the normal objective of the post-School Certificate student in public and secondary schools, and if the licensing bodies would recognize for the purpose of exemption from the second examination stated in pre-registration requirements those subjects in which a student has passed a Higher School Certificate Examination (chemistry, physics, biology to 'Group' standard and non-scientific subjects to 'Subsidiary' standard), they will impart to the Higher School Certificate examination a value which has been questioned in the past by so many intending medical students. The recognition would also lead to greater uniformity in the education of post-School Certificate students in the schools, and would go a long way towards removing the evil of segregation of intending medical students from the rest of the school.

Teaching Elementary Physics

(1) College Physics

By Prof. C. E. Mendenhall, Prof. A. S. Eve and Prof. D. A. Keys. Pp. xi + 592. (Boston, New York, Chicago and London: D. C. Heath and Co., 1935.) 3·76 dollars.

(2) A Complete Physics written for London Medical Students and General Use

By W. H. White. Pp. vii + 848. (London: Richard Clay and Sons, Ltd., n.d.) 15*s.*

(3) Experimental Electricity

By M. M. Das. Pp. xvi + 334. (London: English Universities Press, Ltd., 1935.) 4*s.* 6*d.*

(4) Light and Sound

By H. G. Lambert and P. E. Andrews. (Elementary Science Series.) Pp. vii + 183. (London: University Tutorial Press, Ltd., 1935.) 2*s.* 3*d.*

(5) School Certificate Examples in Physics

By Dr. W. G. Davies. Pp. vii + 176. (London: Edward Arnold and Co., 1935.) 2*s.* 6*d.*

(6) Laboratory Manual in Physics

By Prof. A. A. Knowlton and Prof. Marcus O'Day. Second edition. Pp. xi + 137. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 7*s.* 6*d.* net.

(7) Praktische Physik:

zum Gebrauch für Unterricht, Forschung und Technik. Von F. Kohlrausch. Siebzehnte vollständig neu bearbeitete Auflage. Herausgegeben von F. Henning. Pp. x + 958. (Leipzig und Berlin: B. G. Teubner, 1935.) 32 gold marks (inland); 24 gold marks (abroad).

THE present system of examinations has recently been subjected to much adverse criticism, and the possibility that good may have arisen from the system seems rarely to be considered. This system in general has led to systematic teaching, and the results of this are clear in the present standard of training in elementary physics compared with that of twenty years ago. Physics was then in many schools rather a neglected subject, whereas there is now a reasonably high general level of attainment. Of course, it is always possible to sacrifice the teaching so that passing an examination becomes its main purpose; but the examination can scarcely be held wholly responsible for this evil.

The need for systematic teaching has in turn produced the need for suitable text-books, and while most of these keep an eye on some examination, they generally contribute something to the advancement of the subject. A general need has been created for the production of books of an elementary nature calculated to help beginners in the subject. The frequent publication of new books and fresh editions indicates a lively interest in teaching the subject. The variety shown in their methods of treatment assures us that the subject will not become too standardised in character, each teacher bringing some fresh ideas to the subject as the result of his own enthusiasm. No one but an enthusiast who has at least a few new ideas to communicate is likely to embark upon the task of writing a text-book of physics. Thus each of the books now considered should in its own way add something to the teaching of the subject, and particularly to the originality of the treatment.

(1) "College Physics" by Prof. C. E. Mendenhall, Prof. A. S. Eve and Prof. D. A. Keys provides an introductory course in the subject, and its most striking feature is the logical and clear development of physical ideas throughout the work. It is surprising how much ground is safely covered in a book which is not unduly bulky. The authors rightly recognise that there can be no real distinction between 'classical' and 'modern' physics, and do not hesitate to introduce new ideas which take their place naturally with the rest. The effort which the authors have made to show that many of the basic ideas of modern theory are not essentially more difficult to follow than those of the older physics has certainly been worth while. There are interesting chapters on the constitution of matter, vibrations and waves, radio, photoelectricity, radioactivity and atomic structure, and the whole is written from a modern point of view. The readable section on thermodynamics includes an account of steam and internal combustion engines and refrigerating machines.

To cover so much ground in one book has meant the careful pruning of unessential material. The result is that the book is very pleasant and interesting to read because the development of important ideas is always kept in mind. Many students who have taken more advanced courses in physics would do well to read and master this fundamentally simple account, so as to obtain a connected view of the subject. Although it is the work of three authors, the outlook and method of treatment are very uniform. The book is attractively printed with many valuable diagrams.

This book, which tells what physics is about, is easier and more interesting to read than many popular works on the subject, so that the general reader could profit from its perusal. There seems little doubt that it will obtain a well-deserved success.

(2) "The Complete Physics" by Mr. W. H. White is essentially different in character, and has been written chiefly for the use of London medical students, frequent references being made to their examination requirements. The book covers the usual ground of an elementary text, but the many references to practical applications have been chosen to be of special interest and of value to the one class of students. Although it has clearly been written for examination purposes, nothing could be less like a typical 'cram' book on the subject. Any student who passes his examination under its friendly guidance will deserve his success. The author has tried to recapture something of the attractions of the old natural philosophy and many interesting applications show that he brings this attitude to bear on the whole subject. It is written with the unconcealed enthusiasm of an experienced teacher with a fresh and youthful outlook. The writing is in a frank and conversational style unusual in scientific text-books, and this may prove rather bewildering to the weaker students who are seeking to obtain the simple essentials of the subject. It seems likely that the book will serve those best who have already a fair elementary knowledge of physics, and it should be invaluable in enabling such students to apply their knowledge to medical purposes. Every teacher of medical students should read the book, as he cannot fail to extract much new matter from it. It brings an attitude to the subject differing greatly from that generally produced by examination requirements.

Many of the references are of a recent character and the book deals adequately with the modern developments of the subject. The author clearly recognises the dangers of his style and at the end says "maybe I have told you twice too much". Maybe he has, but much of the material is of an unusual character which cannot easily be found elsewhere. This unusual book ends with a photograph of the author at the end of the last chapter. It is a fitting way of ending a work essentially personal in character, the writing of which has clearly been a labour of love.

(3) The work of Mr. M. M. Das is suitable for students in technical colleges and secondary schools. The author makes it clear that the book has not been written with the sole object of enabling students to pass examinations; but the matter is intended to be adequate for matriculation, professional entrance, and most technical college examinations. If the book is read with the help of a teacher who will stress the fundamental principles, it should serve to excite the curiosity of the student and create enthusiasm by the variety of the practical applications of the subject. Thus there are notes on the manufacture and heat treatment of iron and steel, interesting chapters on electromagnets with practical applications, on electrolysis and its applications, and on the use and care of electrical apparatus.

It seems a pity even in an elementary book to express the units of resistivity in "ohm per cm. cube", after it has been correctly defined; but no doubt the author will think fit to change this in a later edition. The book contains rather more technical information than is generally required in a secondary school, but this would probably cause it to have added interest to many boys.

(4) The book on "Light and Sound" by Mr. H. G. Lambert and Mr. P. E. Andrews is intended as a first course for the lower science forms of public and secondary schools, and for those preparing for the general science examination of the School Certificate. It deals with the theoretical principles, and gives a series of experiments which might be performed. This suggests that it is intended for the book to be worked through systematically by both teacher and pupils. Whether any experienced teacher would be willing to submit to such restrictions in his methods is very doubtful. At such an early stage, it is inevitable that pupils will be more interested in practical cases and applications of the subject rather than in the logical presentation of general principles. If it is necessary for the pupil at this stage to have a text-book giving a clear and concise account of the subject, then this book meets the case admirably. But are such text-books really required ? The excellent and interesting scientific information now available in children's magazines seems to offer greater attractions.

As a means of summarizing and revising what has already been taught, this book would serve a very useful purpose. It would also be of value for a young teacher who is mapping out such a course of elementary lessons.

(5) Dr. W. G. Davies's book contains more than nine hundred examples including both numerical and descriptive exercises of the type usually set in School Certificate examinations. No one wil question the value of numerical exercises even in the elementary branches of the subject. Experience shows that the candidate who can work out such examples correctly has a firm grasp of the subject The experienced teacher will generally have a set of suitable exercises with which to illustrate and drive home the principles of the subject, but this book cannot fail to provide some new ideas.

Some of the questions are in the form of exercises on laboratory work, which may assist in avoiding the common fault of the student who knows al about the experimental details while failing to understand the underlying purpose. Of course if such exercises are used instead of laboratory measurements they would constitute an evil which is certainly not contemplated by Dr. Davies.

There is doubt as to what extent such a book of examples should be left in the hands of the student. Care will be required in the selection of examples by the teacher, and no student will be subjected to the lifeless drudgery of working through the whole book. Many text-books do not give suitable examples so that this book of exercises, many of which are of considerable physical interest, cannot fail with proper care to be of real service.

(6) The "Laboratory Manual in Physics" by Prof. A. A. Knowlton and Prof. Marcus O'Day provides a series of experiments suitable for a first-year university course. Every laboratory tends to have its own rather specialized apparatus which has gradually grown up with it. This constitutes a difficulty when considering the general adoption of any text-book of practical physics. The extent to which such a book would be useful to the student depends upon how far the available apparatus corresponds to that actually described. The book, however, would be of considerable assistance to any teacher arranging an elementary course.

The authors have aimed at producing more than a mere collection of experiments. They have tried to give a selection of exercises covering the more important concepts, and rightly stress the ideas involved, more than the manipulative details of the exercises.

The book covers all the ordinary branches of physics, including exercises on the balance and on electrostatics which are frequently omitted. It is well produced and pleasant to read.

(7) The publication of the seventeenth edition of Kohlrausch's "Practical Physics" is a matter of importance. The general editor, Dr. F. Henning, and his numerous collaborators have produced a new and thoroughly revised work. This book is different in character from those which we have been considering, as it can scarcely be said to deal with elementary physics. It is suitable for advanced students, and as a general reference book for those engaged upon research in either pure or technical physics. In addition to the detailed descriptions of certain experiments, it contains valuable general summaries of experimental methods and numerous recent references to original papers. Such references would be of the greatest help to those beginning a new line of investigation. The book opens with a general introduction on units and measurement, and then deals with mechanics and sound, heat, optics, electricity and magnetism, corpuscles and energy quanta, and concludes with a reasonably comprehensive series of tables. There seems no doubt that this edition will be as successful as its predecessors.

T. L. I.

Mycoses of Man and other Mammals

Medical Mycology:
Fungous Diseases of Men and other Mammals. By Prof. Carroll William Dodge. Pp. 900. (London: Henry Kimpton, 1936.) 42*s*. net.

IN this work, for which Prof. C. W. Dodge is to be congratulated, the dermatologist will find a mine of information on the technical mycological details of the causative organisms which underlie that immense number of diseases of the skin and other regions of the body grouped under the generic term 'mycoses'. These are subdivided into sub-groups, such as the dermato-mycoses, etc.

In the opening chapter, the author gives a good description of the different elements which comprise the several types of fungi. In dealing with the physiology of fungi, the importance of the hydrogen ion concentration of the media and the action of buffers is stressed. The discussion of the exact meaning of both these terms, somewhat baffling to the average medical man, is clear and understandable.

The author takes a wide view of the different species described under the various genera. He indicates that many of the former may eventually be proved to be synonymous: nevertheless, the worker in mycology is given the benefit of all the published views of many authors to guide him in his studies without obtruding the author's personal views to the exclusion of the general knowledge of the subject.

Another prominent feature of this book is the extensive bibliography given after each section, which is particularly useful in following up research on an individual organism.

The reviewer is struck by the clear unbiased discussions concerning each type of infection: a good example is the preliminary dissertation on malassezia. After a general résumé of the accepted facts of distribution of lesions, embryology, age and sex incidence, etc., the author shows how the different varieties of malassezia attack the sebaceous glands, and exposes many fallacious schisms perpetrated by some of the less recent authors, who did not realise the importance of fungi in so many of the diseases under review. This is followed by the reference to some 1,375 articles bearing on the subject—a truly comprehensive and international bibliography.

Another section of the work of particular interest to the dermatologist is that on the Trichophytoneæ. The different clinical types are described with methods of prophylaxis. Many cultural methods are given to suit the various types of specimen and organism, and the therapeutical agents in common use are enumerated from two points of view: first, the drugs used by dermatologists in practice, and secondly the result of many inhibitant substances used *in vitro* in laboratories. These do not coincide, because of the differences of the conditions *in vivo* from those obtaining *in vitro*. This is attributed largely to differences in the pH value of the horny layer of the skin to which the lesions are confined, temperature of this layer and of the media, and the oxygen pressure present. The Trichophytoneæ are frequently carried in the blood stream, but do not develop in tissues other than the horny layer of the skin. The experiments proving this contention are well described, as are the allergic phenomena in infections with the Trichophytoneæ.

Aspergillaceæ and Actinomyceteæ are dealt with in the same complete and thorough manner.

In the reviewer's opinion, this work is a very important contribution in which an immense amount of the relevant bibliography is quoted and collected in its appropriate place to assist the student and research worker, and further it epitomizes the available modern knowledge of the subject. Apart from the botanic interest and classification, the ever-increasing appreciation of the medical profession of the importance and frequency of the incidence of these fungous infections in the human subject demands that every dermatologist should read this valuable book.

C. CRAWFORD-JONES.

Society and the Institution of Marriage

The Future of Marriage in Western Civilisation

By Dr. Edward Westermarck. Pp. xiv+281. (London: Macmillan and Co., Ltd., 1936.) 12*s*. 6*d*. net.

PROF. WESTERMARCK has applied his world-wide knowledge of the institution of marriage and his life-long experience in analysing its various forms and manifestations to the practical question of the present position and the future of marriage in modern Western civilization—a question indeed which has been much discussed of late years, but at present, momentarily perhaps, seems less insistent. He examines the question here from all sides. Its defects, real or alleged, and the suggested remedies are taken seriatim and discussed with a broad-minded tolerance befitting the impartial attitude of the man of science and the philosopher. This is a point which it is not otiose to make, as Prof. Westermarck has been accused by some of his critics of a bias which makes the monogamous marriage the touchstone of his conclusions as the ultimate and highest development of the institution—in other words, that his arguments have an ethical rather than a scientific background.

History, we are often told, repeats itself. It is interesting to note that whatever the problem under consideration, whatever the remedy which has been tried or is being discussed, Prof. Westermarck has an apposite parallel to cite from the vast store of his knowledge of primitive, barbarian or extra-European culture and from all time. Yet with all this wealth of detail at his command, no mechanical citation of parallels, as he explains in summing up his thesis, has been allowed to offer a speciously facile solution of the problem. He probes more deeply, seeking the underlying causes, that is, the emotional urges which, persistent and perennial, have moulded and will continue to mould the union of the sexes in their chief function, that is, the continuance of the species.

In other words, Prof. Westermarck believes the continued existence of the monogamous marriage as an institution, whatever subsidiary relaxations may be admitted for more aberrant or special needs, is assured as the permanent, and in the long run predominant, form of union. This depends mainly, if not completely, upon its function as the bond of the family, into which children are born and in which they are reared—this only, however, while there is no change in the fundamental urges of human nature as they have existed and persisted up to the present day.

To some it may seem that this conclusion begs the question and leaves the problem unresolved. To Prof. Westermarck, with his world-wide outlook, however, present discontents are but as transient ripples on the pool.

Foundations of Physics

By Prof. R. B. Lindsay and Prof. H. Margenau. Pp. xiv+537. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 22*s*. 6*d*. net.

THERE is a type of theoretical physics which consists in the mechanical use of mathematical apparatus; it is to be met with at all stages. The intermediate student develops a fatal facility in the handling of $1/v + 1/u = 1/f$, knowing little and caring less about the physics that is involved. Later, his theoretical physics is summed up in certain differential equations of the second order and, arrived at the boundaries of his subject, we may see him later still employing the most recent technique in matrix theory and in vector algebra, finding in this technique an instrument for saving, rather than for stimulating, thought.

The authors of this most valuable volume by no means despise mathematical aids, but mathematics is always the servant, and there is no danger of losing the physical argument in a maze of mechanically handled mathematical symbols. The book is a real study of the foundations of physics, and whether the authors are engaged in the exposition of the bases of classical mechanics, or in explaining the statistical point of view, the electron theory and special relativity, or the latest developments in quantum mechanics, they are clear, critical and stimulating.

It is not too much to say that the book is one of the best attempts that have yet been made to survey the foundations of modern physics in a manner at once thorough and yet not over-detailed. It may be unreservedly commended to the notice of students in the honours schools of physical science. A. F.

Logic in Theory and Practice

By Prof. C. G. Shaw. Pp. xvii+428. (London: Sir Isaac Pitman and Sons, Ltd., 1935.) 8*s*. 6*d*. net.

AN additional text-book of logic will not necessarily improve the "low ranking in popularity" of that subject. Yet, Prof. Shaw has written one with the object of trying to make logic "as vital and interesting as its frigid forms will permit". It is difficult to say whether the author has succeeded in this undertaking, as the response has to come from the student rather than from the teacher. But in so far as the latter is concerned, he will find little in this new book to justify its substitution for other similar works. A point in its favour is the fact that the author tries to be more human in his exposition of the traditional theories: his treatment of the logic of judgment and of the hypothetical syllogism are good illustrations of this characteristic. But on the other hand, there are many points of scientific method which he has deliberately overlooked, though they have their place in the scheme of the inductive process. The additional chapters of the theory of knowledge are not at all out of process, though they raise more problems than they can attempt to solve. The writing and the production of the book show, nevertheless, that logic still has a good following and that it deserves a still greater one. T. G.

Das Grosse Moos im westschweizerischen Seelande und die Geschichte seiner Entstehung

Von Werner Ludi. (Veröffentlichungen des Geobotanischen Institutes Rübel in Zürich, Heft 11.) Pp. 344+13 plates. (Bern: Hans Huber, 1935.) 19.80 francs.

"DAS GROSSE MOOS" is the name of the extensive plain lying between the lakes of Neuenburg (Neuchâtel), Bieler (Bienne) and Murten (Morat) in western Switzerland at the foot of the Jura range. The area has been subjected to considerable floodings, to remedy which artificial drainage on a considerable scale has been undertaken and has led to the lowering of the water-level in all the lakes and an increase in cultivated land. The volume under notice includes a very full account of the existing ecology and of the history of the area.

By a combination of methods, it is shown that there have been considerable fluctuations in water-level in the lakes, and the surrounding area, during post-glacial times. These fluctuations have been mapped mainly by the construction of pollen-diagrams, based on the examination of samples from the peat deposits, and on the correlation of the variations in pollen content with archæological and geological evidence and comparison with similar results obtained in other parts of Europe.

The work is essentially a very careful and detailed account of the influence of post-glacial climatic changes, working especially through erosion, and of man, on the topography and vegetation of a limited area in Central Europe. As such it is a valuable contribution to the accumulating knowledge of the history of European plant-life. W. B. T.

A Documentary History of Primitivism and Related Ideas

Vol. 1: Primitivism and Related Ideas in Antiquity. By Arthur O. Lovejoy and George Boas: with Supplementary Essays by W. F. Albright and P. E. Dumont. Pp. xv+482. (Baltimore: The Johns Hopkins Press; London: Oxford University Press, 1935.) 22*s*. 6*d*. net.

THIS imposing undertaking, of which the first volume is under review, proposes to give direct evidence of the views held throughout Western civilization on primitivism and related ideas. Its chief interest lies in the compilation and classification of the various quotations selected by the authors; so that it is really with a source book about the conceptions of Nature as shown through the ages that we are concerned. This first volume deals with the Greek and Roman authors, of which it gives several and large extracts. Though there is little to say about the extracts themselves, it may be pointed out that half of the labour done is of little value, for each extract is followed by a translation. The latter alone would have been sufficient.

The publication of the book, which is bound to have a limited appeal, is, however, symptomatic. For it gives an encouraging background to the advanced views about the individual and society, which are held and defended in some quarters.

The Progress of Man*

THE necessity of considering a number of controversial topics can be avoided by omitting to define the term progress, but it is generally agreed that progress, like degeneration, involves change, and while progress leads upward from a starting point, degeneration takes a downward course.

The material needs and aims of man claim first attention of a technologist. They may be grouped in a relatively small number of 'types of satisfactions'. Each of these has acquired in course of time a greater and greater variety, and a more and more involved technique of means of fulfilment, comprised in part of methods and natural materials, in part of artefacts, in varied combinations. We do not perhaps estimate the level of a culture by the nature and multiplicity of its aims; but it must be recognized that progress has depended on proliferation of aims, as much as on the multiplication of means. It might gratify our self-esteem if we could think that man's progress was determined by persistence in his aims; but this is only true of civilized communities, in which directional investigation has transformed the quest of means by inflation of the aims.

Much importance must be attached to man's attitude towards the possibility of progress in a general sense; and it is necessary to emphasize the fact that the idea is not inherent in the human mind. It is a conception of future possibilities, developed from the study of past actualities, and adopted as a framework of modern thought. We are justified in assuming that, to the early discoverers and inventors, the general idea of progress was lacking. It may be justifiably asked, however, whether the lack of a general idea of progress must be fatal to progressive steps in human culture. Since man had made great material advances long before the idea was formulated, it is clear that these were not due to perseverance in an aim that he had set before himself. As in so many spheres of human thought, theory followed practice.

That the natural environment plays an influential part in the early stages of cultural progress is obvious enough. Only in proportion as the natural environment is swamped by the artificial, does man acquire a freedom which enables him to overcome the limitations of his habitat. His success in this direction has at various periods resulted in a cultural momentum, which has taken him far from his starting point. In spite of the fact that the achievement of a high material equipment, and even a domineering empire, has often been succeeded by a crash, there has always been a continuity in many cultural elements, upon which further progress could be based. The cultivation of plants, the domestication of animals, the working of iron, and much else, once learnt, have never been forgotten, and there has, therefore, been a fluctuating continuity in human progress. But although there has been this continuity in important elements of culture, there are many instances in which its absence is conspicuous. There have been numerous false starts, numerous blind ends in human progress.

Observation and applied discoveries arise out of the opportunism that takes advantage of the accident which reveals a possibility. Here we must postulate a limited amount of foresight, leading to an adaptation or combination of known processes and methods to produce a new result. But it is the habit of the discoverer and inventor to proceed along any line that gives immediate results, and he is unable to choose the route of greatest promise. The human mind has seemed to wander without guidance—though usually in the end arriving somewhere—amongst the many possibilities of discovery and invention, striking into paths that ended blindly, returning to an old starting point, creating spurious needs and multiplying superfluities, and, in general, moving forwards, backwards, or sideways in or out of control, without knowing what its destination might turn out to be.

If material progress has been of this nature, it is clear that social progress, whether in the higher or the lower grades of culture, has had no better guidance. The customs and laws of human communities are the objective, though immaterial, products of the human mind, reacting through the ages to the stresses and strains of the environment, natural and artificial. They are comparable with the more substantial products of discovery and invention. In both, there has been an evolution, which has trespassed far beyond the biological necessities, and we are entitled to inquire whether the mind of man has been moulded in response to, and in correlation with, the exuberance of his egoistic culture. It is often said that "human nature doesn't change". Does it, or doesn't it? If it does not, can it?

The conception of the nature of human progress, here set forth, makes no allowance for an expansion of man's inherited capacity for taking pains successfully. The assumption has been made that ancient man and modern man are on the average essentially alike in potential brain-power. It might seem that the remarkable control over natural materials and forces, with the resulting creation of miracles of mechanism, is evidence that modern civilized man must be born with faculties of a higher order than those of the early representatives of *Homo sapiens*. But most of our 'miracles' are the products of the last few hundred years, and the more spectacular have emerged within the present century. In the time of Queen Elizabeth, the civilization of Europe could boast of little that was much beyond the material achievements of the old civilizations of the Near East. It can scarcely be asserted that the brain of a modern Englishman is of better quality than that of an Elizabethan. Since early times, there have been no processes of artificial selection, no eugenic measures, that can have aided in fostering types with better brains. If anything, the methods of civilization often appear to have the opposite result.

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* Substance of the presidential address entitled "Concerning Human Progress" delivered by Dr. H. S. Harrison before the Royal Anthropological Institute on June 30.

The earliest and first type of *Homo sapiens* to appear on the spade of the archæologist is Aurignacian man, and the proposition may be argued that his physical likeness to ourselves was not accompanied by any innate and fundamental dissimilarity in brain-power. In the evolution of his material culture, man still relies upon the faculties that served his prehistoric ancestors, and if we feel less confident in making the same assumption as regards his innate moral and intellectual qualities, we need only look upon the stage of large parts of Europe and Africa to-day to realize that the experience and wisdom of millennia have failed to establish the brotherhood of man on a reciprocal basis.

If modern man, as compared with ancient man, has undergone a change of heart and mind, we are entitled to inquire by what biological compulsion this has come about. Since the human mind has determined human progress, we must consider whether those factors which are believed by some biologists to have been active in organic evolution in general can have been working on the human brain during the time that has elapsed since *Homo sapiens* first and finally became the man of modern type.

Of the various factors which have been suggested as responsible for the production of the highest type of tailless ape, natural selection, orthogenesis and use-inheritance alone concern us, as it is directional factors we seek. Yet of these it can be shown that, however much modern man may owe to natural selection for his neanthropic characters, since the directions in which it may have acted as regards man's intellectual and moral qualities are those determined by his artificial social conditions, the selection can scarcely be regarded as natural. We may admit that intra-communal selection, even in civilized societies, may foster the development of some qualities at the expense of others; but it is not evident that these qualities are such as can play a part in piloting man's progress along successful lines.

In like manner, if the increase in the size of the brain of mammals were due to an inexplicable momentum, which is imperfectly explained as orthogenesis—an inner urge towards a predetermined end—we cannot assume that the process has led, or will lead, to the production of human minds capable of distinguishing the side-tracks of moral and social progress from the highways. We cannot credit orthogenesis with the power of directing the social organism to a predetermined and desirable end.

Lastly, the factor which, if it could be shown to have been effective, would explain much of the past, and would open up a prospect for the future, namely, use-inheritance, is so strongly repudiated by most biologists that it can only have a speculative value. This is unfortunate, as an easy way to explain the origin of the modern type of man would be by acceptance of the view that both brain and hand were guided to the climax of their neanthropic powers by the summation of inherited ability, increasing through the generations. But if we accept the biological repudiation of this theory, it cannot be applied to man. In any event, we must be prepared to admit that in size and general structure the brain of man appears to have been at a standstill since early neanthropic times.

By way of provisional conclusion, it would seem that the progress of man of the species *Homo sapiens* cannot be regarded as resulting from a correlated and progressive change of heart and mind. What he was, he is, and what he is, he will be. As an opportunist, born and bred, he will go on building and re-building an environment for himself, the specifications for which are but little in advance of the construction. He knows what he is doing to-day, but to-morrow is out of sight. The mind of man has little sense of direction, and if it may be said to have an ultimate aim, that aim is too obscure for formulation. In the course of ages, man has coerced many of the forces and products of Nature to his will, but this has been a simple task compared with that upon which he is now more and more insistently engaged—the task of reconciling the fundamental weakness of his mind, and especially his power of foresight, with the social and material complexities in which he has involved himself. His hope is in himself, and not in any speculative prospect of a mental transmutation.

Low Temperatures and their Industrial Uses

IN connexion with the Very Low Temperatures Exhibition held recently at the Science Museum in South Kensington, a series of lectures was arranged, dealing both with the production of low temperatures, and with the services which low temperature work renders to technology and to pure science.

Several of the lecturers referred to the history of the successive reduction of the various gases to the liquid state, from the time when Faraday classified as 'permanent' those gases which failed to respond to his technique, up to the liquefaction of helium by Kamerlingh Onnes in 1908. Faraday's method was to compress the gas until it liquefied. Two different processes have since been used in the attainment of still lower temperatures. Both were invented in 1877, in which year they were applied to reduce oxygen to the liquid state. One process, due to Cailletet, uses the work done during expansion to liquefy the gas, whilst the other, originated by Pictet, depends on the Joule-Kelvin effect. Cailletet's method was used by Wroblewski and Olszewski in 1885 for the liquefaction of hydrogen, and was developed commercially by Claude for the production of liquid air. It has recently been modified by Simon for hydrogen and by Kapitza for helium. The alternative method, that of the Joule-Thomson effect, was used by Linde and by Hampson for the large-scale production of liquid air, by Dewar about 1896 for liquefying hydrogen in quantity and by Onnes for the liquefaction of helium, which occurs just above 4° K.

The attainment of temperatures below 1° K., that is, the passage to temperatures below that at which helium has a reasonable vapour pressure, is a very recent achievement, although the magnetic process which has since proved successful was suggested so long ago as 1923. In dealing with this subject, Dr. F. Simon pointed out that the conception of entropy as a measure of orderliness gives a simple physical explanation of the new magnetic technique, which has enabled experimenters to reach temperatures of the order of 0·01° K., and is available down to 0·001° K. Beyond this, there will be the possibility of using the nuclear paramagnetism—the magnetism due to the spin of the nuclei of atoms—and even this will not enable us to *reach* absolute zero. This, like the mathematician's infinity, cannot be attained, but can be approached as nearly as may be desired; in fact, as Dr. Simon pointed out, so long as there remain properties which vary with temperature, so long can we continue to use those same properties to reach lower temperatures.

In the domain of very low temperatures, where the vapour pressures of all known materials are quite negligible, the problem of insulating the cooled solid scarcely exists. There is no gas in which conduction or convection can occur, and radiation at these temperatures is extremely slight. So good, in fact, is the insulation, that the difficulty in the early experiments was to cool other bodies by contact with the paramagnetic salt which was used as 'refrigerant'. This is now overcome by making a pellet in which the substance to be cooled is in intimate contact with the cooling medium.

Turning now to the contributions which low temperature research has made, and is still making, to pure science, we must not overlook the fact that its contributions to industry are also contributions to pure science, for any material which is put cheaply on the market may be of value to the academic research worker.

In a more direct way, low temperature investigations are of value to the worker in pure science, in that they permit him to study the properties of matter under the condition where the heat motion of the atoms or molecules is reduced to a minimum, and where consequently these motions offer less of a masking effect to the actual inter-atomic forces. It is thus natural that low temperature work is more closely associated with atomic than with macroscopic physics. The phenomenon of supraconductivity is the example, *par excellence*, of the unexpected results attained in this field. It is now familiar knowledge that at sufficiently low temperatures, most metals lose their electrical resistance, but lately the subject has been pursued in more detail, and it has been found that the resistance is restored if a sufficient magnetic field is applied to the sample. The field necessary for the restoration increases as the temperature is lowered. This effect has, as a matter of fact, received no satisfactory explanation yet. Another case in which low temperature studies led to an advance in pure science was the discovery of krypton and xenon. This was described by Prof. M. W. Travers, who was present when Ramsay first fractionated liquid air and discovered them in it.

Prof. F. A. Lindemann, whose lecture dealt in the main with the theoretical aspects of low temperature research, pointed out that "low temperature" simply means "a temperature at which the atoms on the average contain very few quanta". It is thus in a sense accidental that the temperatures which we ordinarily think of as very low are so classified. For material in which the natural forces were of a different order, the sizes of the quanta would be different, and so the low temperature region might have been much higher or lower.

Prof. Lindemann also emphasized another important use of low temperature research. Nernst's theorem, or the third law of thermodynamics, states that entropy (that is, disorderliness, or probability of a state) decreases to zero as the temperature approaches the absolute zero of temperature. This gives us, what classical thermodynamics regarded as impossible, an absolute measure of entropy, as opposed to the measurement merely of entropy differences. Now to measure absolute entropy (from which reaction constants in chemical reactions occurring at ordinary or high temperatures can be calculated), we require measurements of the specific heats of materials right down to the point where these vanish, and hence must be able to carry out measurements at extremely low temperatures.

Since these results can be applied to such reactions as the synthetic production of ammonia and the hydrogenation of coal, they clearly impinge on the third heading under which the subject falls to be considered, namely, the practical or technological applications of low temperature research. Thus, the gases in the familiar street signs owe their commercial production to low temperature studies, and even the relatively common gas oxygen is now more frequently obtained by the fractional distillation of liquid air than by any chemical process.

The history of the commercial production of this gas, as outlined in the lecture by Mr. C. G. Bainbridge, makes a fascinating story. The barium oxide process only dates from about 1885, and, seen in the perspective of history, its duty appears to have been to build up a demand for the gas, and to stimulate the development of the associated needs, such as cylinders for its storage. It is interesting to note that the production in 1887 was about 150,000 cubic feet, and that it had risen in four years to 2 million cubic feet per annum. It is now about 8–10 million cubic feet per *week*. Its uses, too, have changed in the short period concerned. At first, it was required mainly for the lime-light, which essentially was a blowpipe, and for medical purposes. Now, the blowpipe, without the lime-light, provides one of the biggest markets, and is used in a vast variety of different industrial processes. With its aid, divers can cut steel as easily under water as it can be cut in the open air. Again, the medical or semi-medical purposes have themselves increased in number; in mine rescue work, in high altitude flying, and still more in stratosphere flights, the gas is essential, as it is in mountain climbing. (It is to be noted that all the Everest expeditions have been equipped with oxygen apparatus.) For all these purposes, the oxygen now manufactured by the liquid air process provides a cheap and easy source, and moreover, the gas so produced is actually purer than that obtained by the earlier methods. It is perhaps worthy of mention that in the factories of large users, it has now become possible to dispense with the need for transporting cylinders, which owing to their bulk and weight add appreciably to the cost of the gas. The oxygen is now distributed by pipe lines, only being evaporated at the point where it is to be utilized.

Turning from the familiar gas oxygen, we find that the fractional distillation of air yields also the so-called 'rare gases', argon, neon, helium, krypton and xenon. The last two are not in industrial use on any appreciable scale, but they have an interest here on account of the fact that they were first discovered, as Prof. Travers mentioned in his lecture, by the examination of the residues of liquid air, most of which had been allowed to evaporate. The other three rare gases were the subject of a lecture by Mr. J. T. Randall. He pointed out that helium has already been used for filling two large airships, and that it has been proposed to use the gas instead of nitrogen in the air supplied to divers. This would have the very great advantage of minimizing the danger of bubbles of gas forming in the blood when the pressure is released, since helium, unlike nitrogen, is not appreciably soluble in the blood. The most widely used gas of this group, however, is argon. Its chief use is in the gas-filled tungsten filament lamp, of which more than 1,000,000,000 are made annually. Its value here is that it lowers the tendency of the filament to evaporate, and so enables it to be run at a much higher temperature. This causes the lamp to require far less "watts per candle" than the older vacuum lamp, despite the conduction of heat through the gas to the glass envelope. The other type of lamp, the gas discharge, also relies on argon to start the discharge, although in many the vapour of mercury is the main agent for carrying the current after the discharge is started. The colours are, of course, dependent on the gas in the tube, and may be modified by the addition of luminescent solids in powder form.

All the industrial applications dealt with so far are indirect, in that the purchaser, though he may benefit from the low-temperature work, does not receive anything cold. The last example, the subject of the lecture by Dr. I. J. Faulkner, is direct. We have now become accustomed to the use of solid carbon dioxide for the refrigeration on the tricycles in which ice-cream is transported in the big towns. It has, however, many other industrial uses, and as many as 60,000–70,000 tons are now produced per annum in the United States. A surprising fact is that its loss by evaporation is quite moderate, being about 1–2 per cent by weight in 24 hours, on blocks of the ordinary size. It is also interesting to note that the gas itself, which surrounds the solid block, is a poor thermal conductor. This atmosphere of carbon dioxide is very useful when the solid material—'dry ice'—is used for the preservation of meat and fruit, since it prolongs the life of the latter, and tends to inhibit the growth of moulds and bacteria in the former case.

A growing, but less-known, use of 'dry ice' is in the machine shop, where it can be used for shrinking one part on to another, so that after the inner one warms up and expands, the joint is of enormous strength.

Solid carbon dioxide, like liquid oxygen, has removed the necessity for transporting heavy empty cylinders when supplies of the gas are required at a distance. By purchasing a block of 'dry ice', a customer with a suitable pressure vessel can obtain a supply of carbon dioxide gas from a cylinder which need never leave his premises. He simply inserts the block, closes the vessel and allows the carbon dioxide to evaporate. The gas so obtained is much purer than that from which the 'dry ice' was originally made, since the process has many of the features of the chemist's purification process of recrystallization.

Taken together, the seven lectures illustrate in a forceful manner the strides which have been made in the science and art of low temperature production and utilization, and also the interdependence of pure and applied science. The authorities of the Science Museum are to be congratulated on the provision of the course, which must have added very considerably to the interest of the Very Low Temperatures Exhibition itself, valuable though it would have been without them.

J. H. A.

Obituary

Sir William Hamer

By the death on July 7 of Sir William Heaton Hamer, at the age of seventy-four years, epidemiology has been deprived of one of its most zealous students.

William Hamer (he was knighted in 1923) was a scholar of Christ's College, Cambridge, and graduated twelfth wrangler in 1882. After graduating in medicine, he entered the Medical Department of the London County Council and rose to be Medical Officer in 1911, retiring in 1925.

Hamer's mathematical training showed itself in some of his earlier researches, particularly his elucidation of the periodicity of measles in London, which he attributed to rhythmic variation in the number of susceptibles in the population. His work on these lines was afterwards extended by the late H. E. Soper and, although it is now held that the phenomenon is not quite so simple as Hamer suggested, there is little doubt that changes in the proportion of susceptibles form an important element of the general problem.

Hamer was an acute critic of popular epidemiological theories, particularly those based upon bacteriological findings, and a sturdy champion of the doctrine of epidemic constitutions, to which he devoted years of study. The "English Hippocrates", Thomas Sydenham, propounded the general doctrine that all forms of acute diseases prevailing at the same time were linked together by common features in consequence of some general, possibly cosmic, influence which he was unable to define. Hamer attempted to bring this rather vague hypothesis into conformity with modern scientific results. It is generally agreed that, in pointing out the chronological relation of prevalences of obscure nervous diseases to pandemics of influenza, and in explaining the nature of such mysterious epidemics as the 'sweats' of the sixteenth century, Hamer made important contributions to knowledge. To most students, however, his later writings were difficult to follow, and he seemed to exaggerate the importance of Sydenham's views. At his best, he was a most stimulating writer, and he continued the scholarly tradition of Charles Creighton, linking modern science to the philosophical outlook of the ancient masters.

Mr. W. Newbold

The death, on June 24, of William Newbold, classical scholar, self-taught mathematician, statistician and biologist, at the age of fifty-eight years, just as he was within sight of retirement from his duties as an inspector of secondary schools under the Board of Education, and was wishing for leisure to extend his biological investigations, was a great shock to the large circle of friends to whom he had endeared himself by his ever-ready help and wise and kindly counsel.

Though Newbold never lost his delight in classical and archæological studies, his latent first-rate mathematical ability was, in his early manhood, stimulated by his desire to study astronomy; this led to the mastering of relativity and its application to cosmic theories; statistics next engaged his attention; and his work in this direction was invaluable to his colleagues. His eager avidity for knowledge of all kinds later drew him towards biology: here his love of observation and experimentation found its best outlet, and his work ranged over a wide field of natural history. Drawn by his combined interest in statistics and biology, he bred stick insects, to investigate their rate of increase, over a long period, keeping them in muslin meat safes, until they overflowed his study, his bedroom and his laboratory (a disused windmill). He was particularly interested in small insect parasites, especially those of birds.

The most modest and retiring of men, it never occurred to Newbold to publish any of the curious and interesting observations he made, though they were shared from time to time with his more intimate friends. A man of unusually powerful intellect, of the widest interests and sympathies, there can be no doubt that, with release from routine duties, he would have made valuable contributions to science. He met his end, which he knew for some months to be near at hand, with the utmost calm and fortitude. It is not so much as a potential man of science, but as one of far-seeing and disinterested judgment, whose wisdom in affairs was always freely at the disposal of his friends, that he will be missed.

Dr. H. J. Hansen

DR. HANS JACOB HANSEN, who died on June 26 at Gjentofte, near Copenhagen, in his eighty-first year, was one of the most distinguished of the long line of descriptive zoologists who have placed the Zoological Museum of Copenhagen in the very front rank of the museums of the world.

Hansen was born at Bellinge in the district of Odense on August 10, 1855, and studied at the University of Copenhagen, where he took the degree of Dr. phil. in 1883 with a thesis on the mouth-parts of Diptera ("Fabrica oris Dipterorum"). While still a student he worked at the Museum under J. M. C. Schiødte and in 1885 he was appointed an assistant in the entomological department, a position which he held until 1910, when in consequence of some changes in the staff he felt compelled to resign. At this time, when the continuance of his scientific work seemed to be in danger, a letter was addressed to him by a large number of zoologists in Great Britain expressing their high appreciation of his researches and their hope that he would be placed in a position to continue them. This letter was published in NATURE on March 10, 1910. Together with the efforts of his scientific friends in Denmark, this led to his being allowed to retire on full pay (although this was small enough, even by Danish standards) "for free scientific activity". He continued to work unremittingly, and letters received from him in the last year of his life were full of work in hand and plans for the future.

Except for an early contribution to the account of Danish fishes in Schiødte's "Zoologica Danica", all Hansen's published works deal with Arthropoda. Within the limits of that vast phylum, however, their range is wider than that attempted by any other zoologist of our time. Insects, Myriopoda, Crustacea, and Arachnida formed the subjects of numerous memoirs and monographs that for fullness and accuracy of detail and for exquisite illustration have never been surpassed.

Hansen's attention was especially attracted by those groups that by reason of their annectent affinities are of crucial importance to the morphologist. Thus he monographed the Arachnid Palpigradi and Podogona (until the other day among the rarest of animals) and the Myriopod Pauropoda and Symphyla; but it was on the Crustacea that the greater part of his work was done. When taking part in the first cruise of the *Ingolf* expedition to the seas of Iceland and Greenland in 1895, he devised a method of sifting the bottom deposits that revealed an astonishing variety of minute Crustacea, and he later published memoirs on the Isopoda and Tanaidacea in which large numbers of new genera and species were established, but the material of many groups still remains undescribed. Even now, little attention has been given to this micro-fauna of the sea-bottom, although it may conceivably play an important part in marine ecology.

Perhaps the most important of Hansen's contributions to morphology was a little paper on the limbs and mouth-parts of Crustacea and insects published in the *Zoologischer Anzeiger* in 1893. This was intended as preliminary to an extensive treatise on the subject which unfortunately never appeared, for when at length he published his "Studies on Arthropoda" in 1921–30, he confined himself to elaborating the details without developing further the broader views sketched in the early paper.

Apart from zoology, Hansen's interests lay mainly in politics and in military history. On these subjects he wrote much in newspapers and magazines, and he published a number of pamphlets mostly with the object of warning his countrymen against the increasing influence of German culture and German politics. He urged Danish science students to look to England rather than to Germany as their 'spiritual home', and was a caustic critic of the "Germanisering af Dansk Videnskab". Nearly all his scientific papers were published in English. In 1902 he was elected a foreign member of the Linnean Society of London.

W. T. CALMAN.

WE regret to announce the following deaths:

Sir Arnold Theiler, K.C.M.G., well known for his work in veterinary research and education in South Africa, on July 24, aged sixty-nine years.

Sir Henry Wellcome, F.R.S., governing director of the Wellcome Foundation, founder of the Wellcome Research Institution, and founder and director of the Wellcome Historical Medical Museum, on July 25, aged eighty-two years.

News and Views

Origins of Modern Races of Mankind

SIR ARTHUR KEITH's presidential address to the first Speleological Conference of the British Speleological Association held at Buxton on July 25 made a bold attempt to resolve a number of doubts and difficulties, which arise out of recent developments in the study of human palæontology. This, Sir Arthur was careful to point out, is a matter relevant to the purpose of the Conference in that discoveries of the remains of ancient types of man in caves have provided a great part of the material, which points to the necessity of recasting the current view that modern races, black, white, brown and yellow, evolved from a common mid-Pleistocene ancestral stock. It will be remembered that it has been demonstrated recently (see NATURE, 137, 73; 1936) that certain characteristics of the modern Mongolian are to be observed in the remains of Peking man found in the cave of Chou Kou Tien. Sir Arthur would go further. Not only does he too find resemblances to the Mongolian in Peking man, but he also observes Australian and Negro characteristics in *Pithecanthropus* from Java and the Kanam skull from East Africa respectively. From this evidence, therefore, he draws, somewhat tentatively, the conclusion that at the beginning of the Pleistocene, the ancestors of the Mongol, the Australian and the Negro were already in occupation of the continental areas now inhabited by their descendants; and that after their separation each race underwent a series of parallel evolutionary changes in teeth, jaws, brain and other features showing simian affinities.

IN his search for further evidence in support of his hypothesis, Sir Arthur reviewed present knowledge of early man in the areas of distribution of the main divisions of *Homo sapiens*, with the view of showing how far they exhibit traces of this parallel course of evolution. In China, unfortunately, fossil forms of man, which lead on from *Sinanthropus* towards the Chinaman of to-day, have not yet been discovered. For the evolution of the Australian type, he referred to the evidence afforded by Wadjak man from Java, with its resemblance to Talgai man, the earliest known form of Australian, and the fossil remains of Solo man, also from Java. In Africa the geological horizon of Rhodesian man is uncertain, but the Kanam fragmentary jaw from Kenya is not incompatible with the anatomy of Rhodesian man. The Kanjera skulls from deposits of mid-Pleistocene date, or earlier, are the earliest and most primitive form of Negro known to us, while in cave deposits of late Pleistocene date Dr. L. S. B. Leakey discovered fossil remains of a type still existing in north-east Africa. The gap, however, between Rhodesian man and the Kanjera negro still remains. A further problem discussed as needing solution for the acceptance of the theory was the origin of the Caucasian, who does not appear until found in late Pleistocene times as the Cromagnon man of the caves of France and other parts of Europe. For this type, Sir Arthur suggested a possible area of origin in western Asia. It is only when we accept some such view of independent, but parallel, evolution, Sir Arthur concluded, that we can give a coherent explanation of the facts known to us; but it serves only to deepen the mystery of human evolution, for it implies that the future of each race is latent in its genetic constitution. Throughout the Pleistocene period the separated branches of the human family appear to have been unfolding a programme of latent qualities inherited from a common ancestor of an earlier period.

Historical Memorial in Hatton Garden

AN interesting memorial, the institution of which was organized by Mr. E. Kilburn Scott, was unveiled at St. Andrew's Parochial School, Hatton Garden, on July 25, by the Mayor of Holborn. Much mechanical pioneering started in the district. An early connexion with engineering was in 1804, when Richard Trevithick erected his first steam-carriage in Felton's workshop in Leather Lane. Scientific instrument making began about 1750, when the Italian, F. Pastorelli, began to make thermometers, barometers, etc., the business he founded being still carried on at No. 46. In 1850 Negretti and Zambra joined in similar work, and when the Holborn Viaduct was built, removed to the present site of the Gatehouse, in which Sir Christopher Hatton resided. In 1817, P. Norton Johnson refined platinum and other rare metals in the building No. 79, where similar work is still carried on by the firm he founded. The district has long been famous for watch- and clock-making, and the name of Lund, who made chronometers at No. 4 in 1836, is still well known. St. Geo. Lane-Fox, a pioneer in the making of electric incandescent lamps, was at No. 75 in 1881, and the lamp factory at Hammersmith, built by the Brush Electrical Company to make his lamps in 1888, was eventually taken over by the General Electric Co., Ltd.

THE large building at the corner of Hatton Wall, now partly occupied by Marryat and Scott and by Raphael's, became a centre of pioneer engineering because in the basement there was a boiler and steam engine which supplied power to various tenants. One of these in 1884 was Dr. S. Z. de Ferranti, pioneer of high-tension electric transmission. Another was Sir Hiram Maxim, who developed his first automatic machine-gun in 1889, and he tried it in the basement where Hyde, the engineer, had his power plant. C. F. Cross and E. Bevan, inventors of the viscose process for making rayon fibres from sulphite wood pulp, demonstrated their process in the same building. In the early 'nineties Mr. R. W. Paul, maker of electrical instruments at No. 44, was asked to make kinetoscopes like those of Edison. In 1895 he made a projector to show the moving pictures on a screen at about the same time that Lumière was showing his in Paris. He gave his first public exhibition in the lecture room of the Finsbury Technical College, where he had formerly been a student. Hatton Garden is associated with Michael Faraday in that he had business relations with Johnson and Matthey of No. 79. Edward Barnard, of the firm occupying No. 54 (the old Court House), was father of Sarah Barnard who married Faraday. Miss Alice Faraday married Fred Barnard, grandson of Ed. Barnard, and a well-known illustrator of Dickens. For a century the district has been famous for skilled craftsmen, makers of optical apparatus, clocks and also of jewellery, etc., including pearls and diamonds. It is now the world centre for the diamond trade.

Russian Eclipse Measurements on the Ionosphere

WE have received some preliminary results from Prof. W. Kessenich, of Tomsk, U.S.S.R., of the measurements made there on the ionosphere during the total eclipse of June 19, 1936, at the suggestion of Prof. Bonch-Bruevich, and as part of the general scientific eclipse programme of the Russian Academy of Sciences. The main radio work was directed towards the solution of the problem of the source of the ionization of the F_2-layer, since earlier eclipses have indicated that the E and F_1 layers are mainly ionized by ultra-violet light. The daily variations in the critical frequencies of the ordinary (f_o) and extraordinary (f_x) rays for the F_2 layer were measured, by the pulse method, from June 16 until June 24: in addition, qualitative measurements were made, at a constant frequency, on the absorption changes during the eclipse. The receiving apparatus was in the same room as the transmitter, and included two cathode ray oscillographs, one for visual observation and the other for recording: this arrangement enabled critical frequencies to be measured in one or two minutes with an accuracy of 1 or 2 per cent. The interpretation of the results is unfortunately somewhat limited by the fact that a world-wide magnetic disturbance set in at about three hours before optical totality: this seems in no way connected with the eclipse.

THE observations were made near Tomsk, at a place about 5 km. north of the central line of the optical eclipse, and 4° south of the centre of the corpuscular eclipse (the corpuscular track, for three corpuscular speeds, 800, 1600 and 3200 km./sec., had previously been calculated by A. Michailov). The average critical-frequencies observed during the six days were much larger than those for preceding years observed elsewhere; this may be attributed to the influence of the sunspot cycle. The observations show a marked decrease in ionization of the F_2 layer during the optical eclipse, suggesting that ultra-violet light is an important part of the source of the ionization; the time of recombination seems to be of the order five minutes, agreeing with the quick appearance and disappearance of absorption at sunrise and sunset observed on preceding and following days. The occurrence of minimum ionization somewhat before totality is regarded as clearly demonstrating the temperature effects suggested by Appleton and Naismith. As regards corpuscular influence, the results are interpreted as indicating that solar particles with velocities of the order 1000–2000 km./sec. play an important part in ionizing the F_2 layer, while corpuscles of larger speed are without influence. The stronger eclipse effects observed on June 19, as compared with those found during preceding eclipses, can be ascribed partly to the summer conditions and partly to the increased solar activity in 1936. Taking into account this increased solar activity, and the high level of critical frequencies, which decreased markedly 2½ hours before totality, Prof. Kessenich and his collaborators Baerwald, Bulatov and Denisov are inclined to regard the corpuscular ionizing influences on the F_2 layer as established.

Sale of Newtoniana

As a result of the sale of the Newton Papers, and other articles of interest in connexion with Sir Isaac Newton, by Messrs. Sotheby and Co. on July 13–14, two gifts of scientific importance have now been made possible, and are worthy of record. That portion of the Papers which deal with Newton's work as warden, and afterwards master, of the Royal Mint, is bound in three folio volumes and contains 529 pieces. These were sold for £1,400 to Mr. Gabriel Wells who placed them at the disposal of Lord Wakefield at cost, on the understanding that they would be presented to the nation. Lord Wakefield has presented them to the Royal Mint, where they will be available for inspection. The very valuable and unique collection of Newtoniana already in the possession of the Royal Society has been enhanced by a gift from Sir Robert Hadfield which he purchased at the same sale. The gift comprises the following letters: four from Edmund Halley to Newton: four from Edmund Halley to Thomas Molyneux; two from Fontenelle to Newton; one from Philip Naudé to Newton; and one from Brook Taylor to Newton. A portrait of Sir Isaac Newton, painted in 1702 by Sir Godfrey Kneller (the most famous of the Newton portraits), has been purchased by the Trustees of the National Portrait Gallery (with a contribution of half from the National Art-Collections Fund) from Messrs. Rosenbach, of New York. The portrait was actually sold at the same sale for £800, but through the generosity of Dr. Philip Rosenbach, was re-sold to the Trustees of the Gallery at cost price.. Among the many other items of interest in connexion with Newton disposed of at the sale were the following: nine letters to Newton from Edmund Halley, containing the history of the publication of the "Principia" (£310); a note-book in Newton's own handwriting, giving an interesting and amusing list of expenses, and, at the other end, various problems in geometry and conic sections (£180); an autographed draft of about 1,000 words of a very important statement on the invention of the calculus (£210).

Presentation to M. Marcellin Boule

THE forthcoming retirement of the veteran anthropologist, M. Marcellin Boule, director of the Institut de Paléontologie humaine and professor of palæontology, after fifty years' service in the National Museum of Natural History, Paris, will be marked by the presentation to him of a medal by his friends and pupils as a token of admiration, gratitude and affection. M. Boule has long been recognized not merely as the leading authority in France on early man, but also as one of the very select few among anthropologists at large whose verdict on any matter under argument in prehistoric archæology and human palæontology comes as near finality as is possible in that ever-expanding field of science. Of his numerous contributions to the literature of his subject, "Les Hommes Fossiles" is as widely known as it is authoritative; it will always stand as a record of conclusions based upon profound knowledge and painstaking research. The arrangements for the proposed honour to this distinguished man of science have been in the hands of a committee of which the Abbé Breuil, P. Teilhard de Chardin, Prof. Verneau and other distinguished French anthropologists are members, and on which Great Britain is represented by Sir Arthur Smith Woodward and Prof. W. J. Sollas, Belgium by Prof. C. Fraipont, Holland by Dr. É. Dubois, and Switzerland by Prof. É. Pittard. A replica in bronze of the medal, which is the work of A. de Jaeger, will be presented to each subscriber to the fund, of which the secretaries are MM. J. Cottreau, J. Piveteau, H. Vallois and R. Vaufrey; treasurer, M. Georges Masson. The minimum amount of a contribution is 100 francs; and it should be addressed, 120 boulevard Saint-Germain, Paris (vi^e).

Recent Acquisitions at the British Museum (Natural History)

THE Department of Zoology has received as a permanent loan from His Majesty the King a mounted specimen of a cock scarlet-breasted parrakeet (*Neophema splendida*) which was formerly kept as a pet by His late Majesty King George V. This beautifully coloured bird, together with six other members of the same genus, is a native of Australia; it is now very rare, and the Museum possesses only a few examples. Two important collections have been acquired by the Department of Geology. One comprises a large series of Pleistocene and Quaternary mammals, chiefly from Clacton and the Lee Valley, collected over a series of many years by Mr. S. Hazzledine Warren, of Loughton, with special regard to their exact horizon and locality. The other acquisition consists of nearly two hundred type and figured specimens from the collection of Mr. J. W. Tutcher, of Bristol, of Jurassic invertebrate fossils, mostly Liassic ammonites from the Radstock district, described by the late Mr. S. S. Buckman. Mr. F. N. Ashcroft, who has long been a generous donor to the Mineral Department, has presented a further selection from his collection of Swiss minerals. The selection numbers about eighty-four specimens from twenty carefully recorded localities, and forms a valuable addition to the now extensive series of specimens from Switzerland in the Collection. The recent cliff fall between Newton and Yarmouth brought to light the existence in the Isle of Wight of gypsum. Mr. W. White has given the Museum one of the largest crystals that has been found. The most conspicuous of the purchases are a group of well-formed crystals of the beautiful emerald-green copper mineral, dioptase, from the French Congo, a magnificent group of prismatic crystals of celestine, and a large well-crystallized specimen of native copper.

Prices of Biological Books in 1935

THIS analysis of the cost of biological books in 1935 by John R. Miner (*Quart. Rev. Biol.*, Dec. 1935) is the tenth of its kind, and allows of a comparison between the current prices and those of 1926, as well as between those of 1934 and 1935. The prices are quoted in cents per page and at the current rate of exchange into United States currency. The number of pages reviewed is 143,199, an increase of 15·6 per cent over 1934 and 73·4 per cent over 1926. The cheapest of all publications are those of the U.S. Government, which are only 0·11 cents per page, a truly astounding figure which represents a reduction of 38·9 per cent on 1934 and 64·5 per cent on 1926. The next cheapest are those of the British Government at 0·50 cents per page, a decrease of 43·8 per cent from 1934. It is pointed out that there has been a reduction of 25 per cent in the export price of German publications which, as it occurred late in 1935, does not come into the calculations. Against this is to be set the fact that from 1934 to 1935 there has been an increase of 7·9 per cent. Moreover, over the ten years there has been an increase of 87·2 per cent in the price of these works, so that Germany heads the list with an absolute price of 2·04 cents per page, or nearly twenty times that of the U.S. Government or two and a half times that of British non-Governmental publications. France started the decennium with the low price of 0·35 cents per page, and in spite of a drop of 14 per cent from 1934 has a total increase over the period of 145·7 per cent. The non-Governmental publications of Britain are 0·84 cents per page, of France 0·86 cents per page and of the United States 0·90 cents per page. In considering these statistics, it is to be borne in mind that they are not based upon the whole of the biological books published by the countries chosen but upon such samples as passed through the hands of the reviewer. They are not absolute, therefore, but they may be taken as giving some approximation to the actual conditions.

National and International Health and Welfare

VOLUNTARY associations providing maternity and child welfare services, under the Local Government Act, 1929, now receive annual contributions from the county or county borough council in whose area or for whose benefit they work. The Minister of Health has accordingly issued a circular (1538) reminding county and county borough councils outside London that they must prepare schemes in order to secure the payment of annual contributions towards the expenses of such voluntary associations within their areas, copies of model schemes for their use being enclosed with the Circular. Respecting venereal diseases, the Minister of Health has issued circulars (1536 and 1536*a*) to the responsible port and local authorities in England and Wales enclosing a revised list of treatment centres in the chief sea and river ports throughout the world at which seamen can obtain gratuitous treatment for these diseases, in accordance with arrangements contemplated by the international agreement signed at Brussels in 1924.

The Lister Institute of Preventive Medicine

THE Annual General Meeting of this Institute was held on June 9, and the Governing Body presented the forty-second Annual Report, in which the activities of the Institute are surveyed. Investigations have been carried out upon vaccinia, tumour-exciting, neurotropic and other virus agents by the director, Prof. J. C. G. Ledingham, and Dr. E. W. Hurst, Dr. C. R. Amies and others. Various serological studies are being continued by Dr. A. Felix and collaborators. Dr. V. Korenchevsky is continuing his work on sexual hormones, and Prof. R. Robison with others is studying phosphate metabolism and tissue calcification. Investigations on rheumatism and the possible presence of a virus agent in this disease are being pursued by Dr. Amies and colleagues in conjunction with King's College Hospital. In the Division of Nutrition, much work upon vitamins and dietary constituents has been carried out by Dr. Harriette Chick and her associates. The Svedberg ultra-centrifuge, referred to in last year's Report, with accessory equipment is now in course of installation. At the Serum Department at Elstree, under Dr. G. F. Petrie, to which the Vaccine Department has now been transferred, work on meningococcus and gas-gangrene anti-sera and on staphylococcus toxin is in progress. This brief and incomplete survey illustrates the important research work now being carried on at the Lister Institute.

Experimental Research and Disease

THE tenth Stephen Paget Memorial Lecture was delivered by Sir Malcolm Watson at the annual general meeting of the Research Defence Society, held at the London School of Hygiene and Tropical Medicine on June 9, the president, Lord Lamington, occupying the chair (The *Fight against Disease*, 24, No. 3, 1936). In order to illustrate the importance of experimental research, Sir Malcolm surveyed the work of Manson upon elephantiasis and filarial periodicity and malaria, of Ross upon malaria and its transmission by mosquitoes, and of Reed upon yellow fever. By applying the knowledge won by Walter Reed and his American colleagues, the city of Havana was within a few months freed from yellow fever for the first time in a hundred and fifty years by exterminating the mosquitoes that convey the disease. Owing to an increase in member's and life-member's subscriptions for 1935, the Research Defence Society has commenced the current year with a small balance in hand.

A New Anthropological Publication

A NEW publication of the Section of Anthropology of the Department of the Social Sciences of Yale University, entitled "Yale University Publications in Anthropology", has appeared, which will embody the results of researches in the general field of anthropology directly conducted or otherwise sponsored by this Department of the Graduate School, the Department of Anthropology of the Peabody Museum, and the Department of Anthropology of the Institute of Human Relations (Yale University Press, New Haven, Conn.; London:- Oxford University Press). The issues, which will range from brief papers to extensive monographs, will be numbered consecutively as independent contributions, and will appear at irregular intervals. The first issue (Nos. 1–7) includes a study of population changes among the northern Plains Indians by Dr. Clark Wissler, an examination of regional diversity in sorcery in Polynesia by Dr. P. H. Buck, an account of cultural relations of the Gila River and Lower Colorado tribes by Dr. Leslie Spier, with several other communications dealing with aspects of the culture of the Indians of North America. A further issue of the publication, which will comprise six communications, is in the press. In view of the wide-spread activities in anthropological research of the institutions interested in this publication, and more especially of Yale University, the facilities which it will afford for early publication of results will be of great advantage to anthropologists. In this connexion, it may not be out of place to refer to the announcement that Dr. David G. Mandelbaum of Yale, who has hitherto specialized in the culture of the North American tribes, will be engaged during the coming year in an investigation among the hill tribes of Southern India.

History of Fire-Fighting in America

IN a paper received from the Smithsonian Institution, a brief history is given of fire-fighting in America from colonial days to the present time. It starts with the days of the 'bucket brigades'. Many of the earliest American communities required property owners to have fire buckets in their houses, which they had to throw into the street when a fire alarm was sounded. They were then picked up by the men who raced to the fire, and when the fire was extinguished these buckets were piled up on the village common, where the owners came to claim them. In an exhibition being held in the National Museum in Washington, many of these buckets are shown. They are made of leather, and in addition to the names of the owners are decorated with family devices and scenes of the time. The first hand-pumped fire engine or tub, made in 1740, is on exhibition; but the bucket brigades were still necessary in order to fill it with water. These tubs were pulled by hand, and at night runners went before them carrying torches or lanterns on sticks to light the way. Rival companies raced to a fire, and it was a sporting event which of them should be first there. Many incentives were offered to the companies, who sometimes did what they could to slow up their rivals. Cast iron plates were fixed to houses insured by those insurance companies paying bounties to fire-fighters who saved insured property. The fire-fighters were in great demand for parades and political rallies, and no celebration was complete without them. Next came the days of steam fire-engines pulled by horses, and then the motor fire-engine.

The Blue Water of Crater Lake

In the Cascade Mountains, Oregon, is the remarkable Crater Lake. It is about six miles long by four miles wide and lies within a volcanic crater the cliffs of which are 500–2,000 ft. high. Its depth in places is nearly 2,000 ft. It has no visible outlet, yet its water is fresh and is said never to freeze, although the surface is about 6,000 ft. above sea-level. It was discovered by white men in 1853, and was called the Deep Blue Lake. Seen from the rim of the crater, the water shades from turquoise blue along the shallow borders to darkest prussian blue in the deeper parts. From a boat, the colour deepens to dark indigo. Cloud shadows and wind flurries produce great variety in the appearance of the surface, but the main sensation produced in the eye of the observer is one of "unbelievable blueness". Dr. Edison Pettit, working on behalf of the National Academy of Sciences and the National Park Services, has recently completed a study of the reason for this extraordinary depth of blue (*News Service Bulletin* (School Edition); Carnegie Institution of Washington, 4, No. 4). He finds that the water has no special colour of its own, but that it is exceptionally free from suspended matter; such scattering of light as occurs in its depths is mainly from the water molecules, and is therefore deep blue. The degree of clarity is almost that of specially prepared dust-free water. The scattered light from dust-free water is blue at all angles; that from Crater Lake water is white only for a comparatively narrow forward angle, and at all other angles is blue.

Wooden Pipe Lines

The use of wooden pipes as a means of conveying water dates back almost to prehistoric times. They were much used in the Middle Ages. During recent years, traces of the water supply system of London (c. 1600) by means of hollow trunks of trees have often been found during excavations. In *World Power* of May, there is a paper by T. Pausert, telling how wooden pipes made of staves and bound with hoops are coming into modern practice all over the world. Generally, the staves are made of pine or larch wood, and are planed off to give a smooth finish after assembly. The contact surfaces are dove-tailed. When the pipe is filled with water, the wood swells and becomes water-tight. These wooden pipes are either placed on the ground or laid in the open on supports. Their diameters vary from 5 cm. to 6 metres. A great advantage is the immunity of the wood from the effects of water whether it is pure, acid, alkaline, saline or contains selinite. For this reason, wooden pipes are much used in the chemical industry. An important point is that salts are not deposited on the walls of the pipes, so that the latter do not become choked and their rate of flow affected. There is no risk of electrolysis from stray electric currents. If an increased pressure becomes necessary, it is easy to reinforce them by the addition of new steel hoops. If a sudden hydraulic surge occurs, the inherent elasticity acts as a safety valve; the staves being bound by hoops enable the longitudinal joints to let water escape in small jets. When the pressure comes back to normal, the staves resume their original position, and become water-tight again. Their cheapness, durability and the ease with which they can be transported in mountainous regions enable the power engineer to arrive at solutions to many of his problems by their use.

Safety on the Roads

The National Safety Congress was held in London on May 20–22. An account of the congress is given in *Roads and Road Construction* of June 1. At the Congress dinner, Sir Herbert Blain pointed out how much the British have learnt from the Americans in connexion with improving our roads and making them safer. In particular, he mentioned the practice of coloured traffic lights and of one-way streets. Although there is a magnificent system of roadways in Great Britain, there are no roads that can compare with some of the roads now being laid in America. These national highways are very wide and have a beautiful surface, good elevation and proper lighting. The curves are properly rounded, and there is no ribbon development. Mr. A. Matheson, the assistant secretary to the Minister of Transport, read a paper on "Danger Spots". Experiments have been carried out in London, where certain roads with black records have been selected. A study of these records showed that a large fraction of the accidents occurred to pedal cyclists and pedestrians. These roads were then inspected and improvements suggested which it is hoped will diminish the number of accidents. In two of the roads where the work recommended has been completed, a record was kept for six months.

In the Chiswick High Road, the number of accidents as compared with the corresponding six months of the preceding year was reduced by 37 per cent, and in the Fulham Palace Road to Putney Bridge the reduction has been from 88 to 48, or nearly 45 per cent. The Oxford County Council, becoming alarmed at the large number of accidents on its roads, made a detailed investigation of them over two years ending July 1934. The investigation showed that nearly one half of the fatal accidents occurred on certain main roads constituting less than six per cent of the total mileage of the county. During the first seventeen weeks after making certain improvements, it was found that, compared with the corresponding seventeen weeks of the preceding year, the fatalities were reduced 52 per cent and the number of injured 11·6 per cent. In Glasgow it was found that the installation of light signals at certain junctions reduced the number of accidents by about 75 per cent.

Farmer's Guide to Agricultural Research

FOR the past ten years, the Royal Agricultural Society of England has issued annual summaries of research work carried out in the leading branches in agriculture. The publication, known as the "Farmer's Guide to Agricultural Research", is now issued as a section of the Society's *Journal*, so that it may be automatically in the hands of all members. A few copies are published separately for private circulation, and a limited number of copies of previous issues (1925–33) are still available. The Society has now published its *Journal* for 1935 (vol. 96). The various sections of the Farmer's Guide are similar to those of the previous year, as are also the authors responsible for them. The remainder of the *Journal* consists of a number of special articles of outstanding interest, reports of the research work carried out under the ægis of the Society, together with a number of official reports. The volume may be obtained from the headquarters of the Society, 16 Bedford Square, London, W.C.1 (price 15*s*.).

"Index Generalis"

THE editor of the "Index Generalis", the 1936 issue of which was noticed in NATURE of July 18 (p. 100), asks us to state that new items for inclusion in this reference work are welcomed. They should be in the form in which they are to appear in print, and should be sent to Prof. R. de Montessus de Ballore, directeur de l'Index Generalis, Sorbonne, Paris V^e. No charge is made for insertions, and there is no obligation to purchase the volume. The only stipulations are that the information should be up to date and that it be revised annually on the request of the editor.

Announcements

MR. R. COPPOCK, general secretary of the National Federation of Building Trades Operatives, Mr. Richard K. Law, M.P., and Prof. B. A. McSwiney have been appointed members of the Industrial Health Research Board of the Medical Research Council.

PROF. A. MAIGE, professor of botany in the University of Lille, has been elected *Correspondant* of the Section of Botany of the Paris Academy of Sciences, in succession to the late Prof. H. Jumelle, professor of botany in the University of Marseilles.

THE Trustees of the Busk studentship in aeronautics, founded in memory of Edward Teshmaker Busk, who lost his life in 1914 while flying an experimental aeroplane, have awarded the studentship for the year 1936–7 to Mr. J. W. E. Clarke, Glasgow.

PROF. PAUL UHLENHUTH, director of the Institute of Hygiene at Freiburg i.B., has been nominated a foreign member of the Royal Academy of Sciences of Stockholm in recognition of his outstanding contributions to hygiene and bacteriology.

THE twenty-eighth annual Autumn Meeting of the Institute of Metals will be held in Paris on September 14–18. The fifteenth Autumn Lecture will be delivered in the Grande Salle, Maison de la Chimie on September 14, at 8 p.m., by Prof. P. A. J. Chevenard, who will speak on "The Scientific Organization of Factories". Further information can be obtained from the Secretary, Institute of Metals, 36 Victoria Street, London, S.W.1.

A PROVISIONAL programme has been issued of a General Discussion of the Faraday Society to be held in the Chemistry Theatre, University of Edinburgh, on September 24–26 on "Structure and Molecular Forces in (*a*) Pure Liquids and (*b*) Solutions". The scope of the meeting does not extend to kinetics, which will form the subject of a forthcoming meeting, or to subjects which have been dealt with at recent meetings, such as dipole moments and the theory of strong electrolytes. A general introduction is promised by Prof. J. Kendall. The introductory paper in Section A (Pure Liquids) will be by Prof. F. London (Oxford), and that in Section B (Solutions) by Prof. J. H. Hildebrand (Berkeley, California). As is usual in these discussions, a number of foreign guests have been invited to take part. Particulars of the meeting can be obtained from the Secretary, Faraday Society, 13 South Square, Gray's Inn, London, W.C.1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

An assistant for abstracting, indexing and proofreading in the Imperial Bureau of Animal Nutrition, Rowett Research Institute, Aberdeen—The Deputy Director (August 3).

An assistant lecturer and demonstrator in physics in the University of Leeds—The Registrar (August 10).

A lecturer in physiology (Grade II) in the University of Bristol—The Registrar (August 12).

A general inspector of education and research, agricultural and horticultural division of the Ministry of Agriculture and Fisheries—The Secretary, Minister of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (August 12).

A professor of physics (August 31) and an assistant in bacteriology (August 20) in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, London, W.C.2.

Structural engineering assistants for the Designs Branch of the Directorate of Fortifications and Works—The Under-Secretary of State (C. 5), The War Office, London, S.W.1.

A physicist or applied mathematician to the British Cotton Industry Research Association—The Director, Shirley Institute, Didsbury, Manchester.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 207.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Preliminary Note on a New Fossil Human Skull from Swanscombe, Kent

IN June 1935, a fossilized human occipital bone was found *in situ* at a depth of 24 ft. below the surface, in the middle gravels of the Thames 100-ft. terrace at Swanscombe, Kent, in association with implements of the Acheulean culture phase. A note on the discovery appeared in NATURE of October 19, 1935, p. 637.

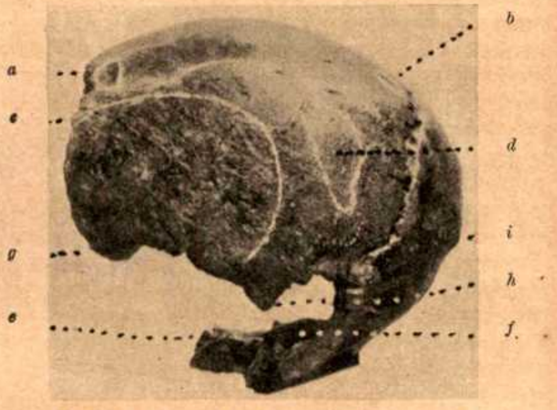

FIG. 1. Left lateral view of the Swanscombe skull.

a, Anterior oval depression.
b, Posterior round depression.
c, Temporal line.
d, Muscle attachment above and behind temporal line, perhaps for origin of functional ear muscle.
e, Basilar process.
f, Foramen magnum, filled with plasticene to support skull.
g, Inverted antero-inferior angle of parietal bone.
h, Everted postero-inferior angle.
i, External occipital protuberance.

In March 1936, at the same depth, and in the same seam of gravel, the left parietal bone of the same skull was discovered, and this was witnessed and photographed while still embedded in the gravels, by an independent observer.

Both of the bones are in a remarkable state of preservation. The occipital bone is unique among the earlier specimens of fossil man in preserving the basilar process, the foramen magnum and the condyles, and both bones are complete in all their margins. They thus furnish the important positions for cranial measurements of the bregma, lambda, asterion, opisthion, inion, pterion and basion, and the completeness of the two bones permits of the most precise measurements being taken without resort to speculation.

In its relation to other fossil types, the Swanscombe skull is to be regarded definitely as a precursor of the Piltdown type. The comparison of the Swanscombe and the Piltdown skulls may be summarized as follows.

(1) The anatomical features of the two skulls points to a definitely more primitive status for the Swanscombe skull than for Piltdown. The features of the Swanscombe are those of a specialized type less advanced than Piltdown but of the same general type, rather than a variant due to either the difference in sex or in age between two individuals of the same contemporaneous type. Both skulls are almost brachycephalic.

The main features in which the Swanscombe shows greater primitiveness are :

(*a*) Lower vault measured by the bregma-opisthion chord. Swanscombe is smaller than the lowest of the three British reconstructions of Piltdown (after Sir Grafton Elliot Smith).

(*b*) Flat ruggedness and non-filled out contours.

(*c*) Lower height and greater outward and downward slope of the parietal vault.

(*d*) The parietal eminence is not developed to the upward and backward position of Piltdown, but occupies the centre of the parietal bone.

(*e*) Lower frontal development at the coronal suture, with greater incurvature of the antero-inferior parietal angle.

(*f*) The parietal bone covers more of the frontal and the temporal regions of the brain than in Piltdown.

(*g*) An extensive obelion depression marks the sagittal border, and two peculiar depressions or pits, an anterior pit above the temporal line near the anterior border, and a posterior pit near the postero-superior angle are present.

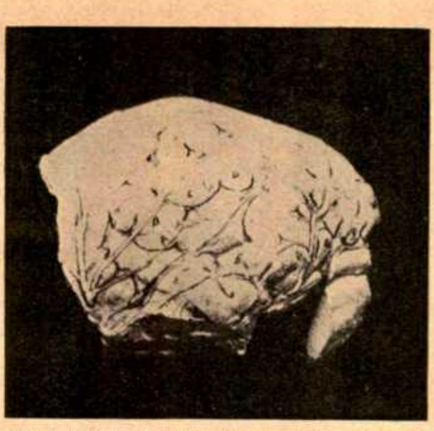

FIG. 2. Left lateral view of Swanscombe endocranial cast.

(2) The comparison of the endocranial casts of the two skulls shows a definitely more primitive stage for Swanscombe than for Piltdown.

(*a*) The visual territories on the occipital region extend over the greater part of the cerebral hemispheres covered by the occipital bone. On the left side, the sulcus lunatus crosses the line of the lambdoid suture.

(*b*) In the parietal region, the orbital, fronto-parietal and temporal opercula have not approximated at the anterior end of the horizontal limb of the fissure of Sylvius, and a large fossa lateralis measuring about 2·5 cm. from above downwards, and 1·0–2·0 cm. from before backwards is present.

(*c*) The parietal lobule, and the temporal lobe stand out in high relief as exuberant masses of neopallial growth, and the central and the intraparietal sulci occur in primitive form.

(*d*) The Sylvian fissure runs obliquely upwards and backwards.

(*e*) Low development of the parietal association area.

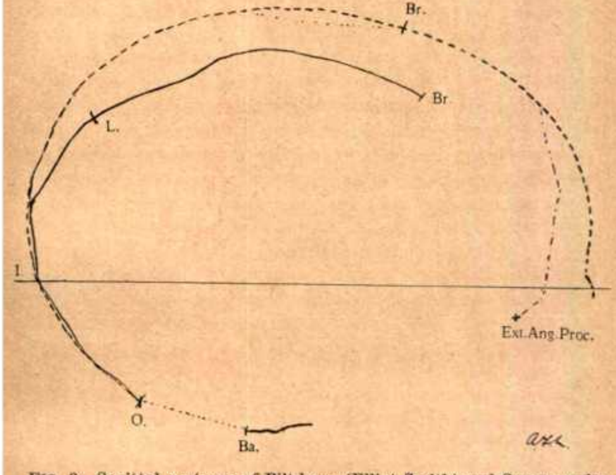

FIG. 3. Sagittal contours of Piltdown (Elliot Smith) and Swanscombe superimposed so that the inion and opisthion coincide. The Piltdown basion does not exist, but the opisthion is represented on the occipital fragment. The difference between the bregma-opisthion chord of the two specimens is not the result of the faulty reconstruction of the Piltdown skull, for if the bones of the two skulls be examined and angulated separately apart from the skull restorations as a whole, the Piltdown bones show an advanced developmental stage over the Swanscombe bones. (Swanscombe : full line. Piltdown: interrupted line.)

(*f*) The distribution of the middle meningeal arteries on the endocranial cast is more primitive in form than Piltdown.

(*g*) The shallow depth from above downwards of the cerebellar fossae is more primitive in form in Swanscombe.

Consideration of the above is sufficient to invite an inquiry into the status of the Piltdown skull. While the geological horizon of Swanscombe as the fossil of the middle gravels of the 100-ft. terrace is authenticated and recognized by the Geological Survey, the Piltdown horizon has been referred to the 80-ft. terrace, the 50-ft. terrace, and the 100-ft. terrace. The presence of the 'eoliths' or of the 'bone implement' is not reliable evidence of a Pliocene or Early Pleistocene status for Piltdown. The acquisition of a brain is a process of slow growth, and the differences between the actual anatomical features of the two skulls overwhelmingly favours the view that the geological horizon of Piltdown should be considered as later than that of the Swanscombe horizon in the middle gravels of the 100-ft. terrace.

The Swanscombe associated implements and flakes have been examined by the Abbé Breuil, who classes them as belonging to the St. Acheul 1 and 3 divisions of his nomenclature. The Swanscombe skull may therefore be referred to the St. Acheul 3 culture phase of Breuil.

The Swanscombe associated fauna is being examined separately by Mr. M. A. C. Hinton.

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Mass Equivalent of the Energy in Radioactive Transformations

WITH a spark between a lead electrode and an electrode of palladium or one made of a platinum rhodium alloy, it was found that doubly-charged lead ions were formed, which in the mass-spectrograph gave close doublets with the singly-charged rhodium and palladium ions at 102, 103 and 104. The mass differences were $0{\cdot}0860 \pm 0{\cdot}003$ at 104 (Pd), and $0{\cdot}0861 \pm 0{\cdot}003$ at 103 (Rh). Although the packing fractions of palladium and rhodium have not been determined directly, they occupy a position on Dr. Aston's curve[1] where the divergence of the atomic mass from an even integer reaches its maximum value of approximately $0{\cdot}085 \pm 0{\cdot}005$. Assuming this value as applying to palladium and rhodium, we find a value for the atomic masses of the lead isotopes of $206{\cdot}00 \pm 0{\cdot}01$ and $208{\cdot}00 \pm 0{\cdot}01$.

It is of interest to deduce the atomic masses to be expected for the lead isotopes from the atomic masses of uranium (238·088) and thorium (232·070) given in a recent letter[1]. In the uranium series of radioactive transformations, eight α-rays and six β-rays are ejected with a total energy of 52 million electron-volts (43 in the α-rays, and 9 in the β-rays). In the thorium series, six α-rays, four β-rays and an energy of $43{\cdot}3 \times 10^6$ e.v. are emitted. The α-rays and total number of electrons lost by the radioactive elements are in the proper number to form neutral helium atoms[2] of a mass 4·0039. If we should neglect the mass equivalent of the energy, we would be led to expect mass values for the lead isotopes of $238{\cdot}088 - (8 \times 4{\cdot}0039) = 206{\cdot}057$ and $232{\cdot}070 - (6 \times 4{\cdot}0039) = 208{\cdot}047$. These are higher than the values deduced above by several times the possible experimental errors, and it is impossible to ascribe the discrepancy to uncertainty in the masses of palladium and rhodium, as it would be necessary to suppose that the masses of those elements diverge from integers by less than half the amount required by Dr. Aston's curve.

We have thus an example of the necessity of allowing for the mass equivalent of the energy emitted. As one million electron volts is closely equivalent to 0·001 mass units, the 52×10^6 e.v. and $43{\cdot}3 \times 10^6$ e.v. would reduce the expected mass of uranium lead to 206·005 and that of thorium lead to 208·004, which agree within the experimental error with the values deduced from the observations in the first paragraph. Unfortunately, the precision of the measurements is not yet sufficient to decide whether the maximum energy of the β-rays (9×10^6 e.v. and $6{\cdot}3 \times 10^6$ e.v.) or the mean energy must be considered, or even whether their energy has a definite mass equivalent.

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June 13.

[1] NATURE, [**137**, 120 (1936)].
[2] F. W. Aston, NATURE, **137**, 358 (1936).

Ranges of Particles Emitted in the Disintegration of Boron and Lithium by Slow Neutrons

I HAVE determined the ranges of particles emitted during disintegration of ^{10}B and ^{6}Li by slow neutrons, using a boron or lithium-coated ionization chamber connected with a Hoffmann electrometer. The ranges were deduced from the position of angles on the curves representing the ionization as a function of the pressure. The chamber filled with air was a brass cylinder of 8 cm. inner diameter and 10 cm. height. In the case of boron, pure finely powdered boron mixed with some water was distributed over the inner walls of the chamber; the density of the layer after evaporation of water was 2×10^{-3} gm./cm.^{2}. In the case of lithium, lithium hydroxide made insoluble by heating at a high temperature was spread over the surface in an analogous manner with the same density as before. About 10 millicuries of polonium mixed with beryllium were used as source of neutrons, and the chamber was surrounded with a large cylindrical block of paraffin wax for slowing down the neutrons.

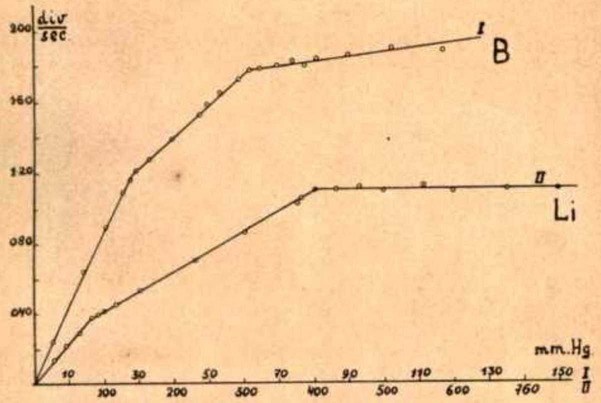

FIG. 1.

In order to evaluate the effect due to slow neutrons, measurements were made at each pressure (a) with neutrons filtered through a sheet of cadmium 0·5 mm. thick, (b) without cadmium. The difference $b - a$ is due to slow neutrons only.

These differences are plotted against the pressure of air on Fig. 1. The angles corresponding in the case of boron (Curve I) to α-particles and ^{7}Li nuclei, and in the case of lithium (Curve II) to α-particles and ^{3}H nuclei are well apparent. They occur respectively at the following pressures:

Disintegration of boron: α, 62 mm.; ^{7}Li, 27·6 mm.
Disintegration of lithium: α, 82 mm.; ^{3}H, 408 mm.

Owing to the shape of the chamber, the paths of particles *in vacuo* were of unequal length, and it was therefore necessary to define a 'mean effective length of path'. To do this, the apparatus was calibrated in the following way. To the boron powder a few drops of an extremely weak solution of polonium were added, and the substance spread over the walls in exactly the same manner and quantity as before. The ionization pressure curve gave 293 mm. for the position of the angle, which gives 10 cm. as the 'effective mean length of the path' of the particles. Using this value, I obtained the following values for the ranges:

Disintegration of boron: α, 8·18 mm.; ^{7}Li, 3·64 mm.
Disintegration of lithium: α, 10·8 mm.; ^{3}H, 53·6 mm.

The ranges for α-particles correspond to the energy $E_{a\mathrm{B}} = 1 \cdot 43 \times 10^6$ e.v. and $E_{a\mathrm{Li}} = 1 \cdot 93 \times 10^6$ e.v. respectively[1].

Owing to the conservation of quantity of movement, the total kinetic energy of the emitted particles is equal to $\frac{m' + m_a}{m'} \times E_a$, E_a being the energy of the α-particles, m' the mass of the nucleus emitted simultaneously with the α-particles (namely, ^{7}Li in the case of boron and ^{3}H in the case of lithium). If the disintegration is not followed by any γ-ray emission, this kinetic energy represents the total energy, E_B and E_Li, released in the nuclear processes under examination. Assuming this to be true, I find $E_\mathrm{B} = \frac{11}{7} E_{a\mathrm{B}} = 2 \cdot 24 \times 10^6$ e.v., and $E_\mathrm{Li} = \frac{7}{3} E_{a\mathrm{Li}} = 4 \cdot 5 \times 10^6$ e.v.

Using the following atomic masses[2], $n = 1 \cdot 0091$, $^{3}\mathrm{H} = 3 \cdot 0171$, $^{4}\mathrm{He} = 4 \cdot 0039$, $^{6}\mathrm{Li} = 6 \cdot 0167$, $^{7}\mathrm{Li} = 7 \cdot 0180$, $^{10}\mathrm{B} = 10 \cdot 0161$, I find $E_\mathrm{B} = 0 \cdot 0033$ mass units, or $3 \cdot 07 \times 10^6$ e.v., and $E_\mathrm{Li} = 0 \cdot 0048$ mass units, or $4 \cdot 48 \times 10^6$ e.v. The agreement is excellent in the case of lithium, while in the case of boron the discrepancy is greater than could be attributed to errors in the determinations of ranges. If instead of the experimental velocity-range relation given by Blackett and Lees, we use the numbers calculated from the theories of Bethe and of Bloch[3], then the agreement is in both cases within probable experimental errors. It may also be noticed that Curve I for boron shows a slight increase even at pressures at which the ionization should be constant. This increase may correspond to an unknown mode of release of energy, perhaps related to the existence of γ-rays of boron, reported by Kikuchi, Aoki and Husimi[4].

The cross-section of the boron nucleus for capture of a slow neutron was found to be eight times greater than the cross-section of the lithium nucleus.

My thanks are due to Prof. L. Wertenstein for his interest in this work.

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June 27.

[1] Blackett and Lees, **134**, 658 (1931).
[2] Oliphant, NATURE, **137**, 396 (1936).
[3] M. Curie, "Radioactivité", tables (1935).
[4] NATURE, **137**, 745 (1936).

Kikuchi Lines from Etched Copper Crystal

IT is well known that a cross-grating pattern of spots is produced when a fast electron beam is incident, at a small angle, on the etched surface of a single crystal. Two explanations have been given of this phenomenon. Thomson[1] showed that the effect would arise if the electrons passed through small projections on the surface, while Germer[2] attributed it to distortion of the crystal lattice. When etched single crystals of zincblende and galena were studied by Tillman[3], he found Kikuchi lines to be present in addition to the cross-grating and, as has been pointed out previously[4], the presence and sharpness of Kikuchi lines may be taken as a criterion of the degree of perfection of the crystal lattice.

It has been found that an etched single crystal of copper gives Kikuchi lines along with a cross-grating of spots (Fig. 1). The crystal was cut from a freshly prepared single-crystal rod which had been carefully protected from any distortion. Subsequent specimens, cut from the same rod and etched in the same way, did not give Kikuchi lines, due to the inevitable slight bending of the rod during the first sawing operation. The Kikuchi lines observed were not so sharp as those from zincblende and galena but, nevertheless, they do not indicate a degree of distortion sufficient to allow the formation of a cross-grating pattern in the way suggested by Germer.

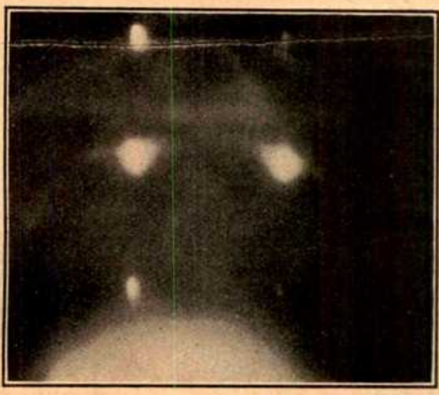

FIG. 1.

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June 18.

[1] G. P. Thomson, *Proc. Roy. Soc.*, A, **133**, 1 (1931).

[2] L. H. Germer, *Phys. Rev.*, **44**, 1012 (1933).

[3] J. R. Tillman, *Phil. Mag.* (7), **18**, 656 (1934).

[4] G. P. Thomson, *Phil. Mag.* (7), **18**, 640 (1934); J. R. Tillman, *loc. cit.*

Chemistry of Growth Substance *B*

SOME years ago, we found[1] that a growth substance acting upon *Aspergillus niger* and other moulds was produced when sugars (both pentoses and hexoses) were heated in a solution which also contained some organic acids or salts of these acids. This growth substance only acts when small amounts of ten different metals are added[2]. Also the growth substance produced by moulds or the growth substance extracted from plants, urine, etc., needs these metals to be able to influence the growth of moulds. We called these metals 'co-growth substances'.

TABLE I.

Added per 50 c.c.	Dry weight in mgm.
1·0 mgm. pyruvic acid	219
0·3 mgm. glycolic acid	167
1·0 mgm. pyruvic acid + 0·3 mgm. glycolic acid	343
No addition	132

A continued investigation has shown that this growth substance is produced when sucrose is inverted by means of organic or inorganic acids. For example, a solution of 25 per cent sucrose may be inverted by hydrochloric acid at room temperature. If some of this sugar solution is added to a culture of *Aspergillus niger* after the hydrogen ion concentration has been adjusted, the growth of *Aspergillus* will increase very much. An attempt to purify the active substance is not yet finished; but it has been shown that glycolic acid and pyruvic acid act as growth substances upon *Aspergillus niger*. Glycolic acid or pyruvic acid alone have little or no effect on the growth; but when added together they have a considerable effect.

It is seen from Table 1 that the growth of *Aspergillus niger* is more than doubled by the addition of glycolic acid and pyruvic acid. Some other organic acids also seem to have some influence on the growth. Thus ascorbic acid has a rather large effect when added together with glycolic acid and pyruvic acid, but not alone. Glyoxylic acid seems to have a very strong growth-accelerating influence when added alone or together with the glycolic acid and the pyruvic acid (Table II).

TABLE II.

Added per 50 c.c.	Dry weight in mgm.
1·0 mgm. pyruvic acid + 0·3 mgm. glycolic acid	451
1·0 mgm. pyruvic acid + 0·3 mgm. glycolic acid + 10·0 mgm. glyoxylic acid	551
10·0 mgm. glyoxylic acid	503
No addition	252

The growth substances which act upon *Aspergillus niger* and other moulds are very resistant to oxidation. If a mixture of different plant growth substances is oxidized by means of potassium permanganate or hydrogen peroxide the growth substances which act upon yeast are destroyed, whereas the growth substances acting upon moulds are not destroyed. In this way the two groups of growth substances may be separated.

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[1] *Biochem. Z.*, **256**, 2 (1932).

[2] *Biochem. Z.*, **259**, 340 (1933).

Relative Velocities of the Absorption of Different Sugars from the Intestine of Rat and Pigeon

THE different velocities, with which various simple sugars are absorbed from the intestine, are among the outstanding facts which demonstrate the active part played by the intestinal mucosa during absorption. Cori[1], for example, finds for the ratio of the absorption velocities of *d*-galactose, *d*-glucose, *d*-fructose, *d*-mannose, *l*-xylose and *l*-arabinose in the rat: 110 : 100 : 43 : 19 : 15 : 9; while Verzár's pupils Wilbrandt and Laszt[2] find 115 : 100 : 44 : 33 : 30 : 29; and McCance and Madders[3] for the ratio of the last two sugars 44 : 25. According to Verzár and his collaborators, the absorption of the hexoses is inhibited by monoiodoacetic acid in contrast with that of the pentoses *l*-xylose and *l*-arabinose, which should not be affected by it. This, combined with the fact that they found equal absorption velocities for these two sugars, leads them to conclude that the absorption process in the case of the pentoses is a simple diffusion from the gut to the blood.

Now, I have shown[4] that the absorption velocities of glucose, galactose and fructose are largely affected by the composition of the diet to which the rats are accustomed, at least when there is only a short fasting period before the beginning of the absorption experiment. There is a real adaptation of the absorption to the presence of these sugars in the diet: the absorption of glucose is increased by the presence of glucose, fructose or galactose in the diet, compared to a carbohydrate free diet; the absorption of fructose, however, is more specifically stimulated by fructose, the absorption of galactose by galactose in the diet.

From these data several further questions arise. First, has the sequence of absorption velocities, as cited above, a general meaning, or is it more or less a casual product of dietary conditions? Secondly, what are the relative velocities of xylose, and arabinose absorption, those of Verzár and his associates, or those of Cori and those of McCance and Madders? If the latter authors be right, is there really a contrast between the hexoses and xylose as regards monoiodoacetic acid intoxication? Does the ratio of the velocities hold only for the rat, or is it general? Lastly, if it is shown to hold for other animals, at what stage of evolution does it appear first?

I have been carrying out experiments on rats and pigeons which for five days had been on a diet consisting only of fat, casein and salts (no vitamins, as I feared to introduce carbohydrate with the yeast). The rats showed the following series of absorption velocities : *d*-galactose : *d*-glucose : *d*-fructose : *d*-mannose : *l*-xylose : *l*-arabinose = 108 : 100 : 42 : 15 : 13 : 2; the pigeons gave 115 : 100 : 55 : 33 : 33 : 16. Thus there is no essential difference between my results with the rat and Cori's, and also there is no fundamental difference between the rat and the pigeon. Thus the same relationship holds for two species belonging to different, though not quite remote, classes. The smaller differences may easily be explained by differences of technique.

The pigeon showed itself much more sensitive to monoiodoacetic acid than the rat. Doses which did not kill it in two hours did not affect glucose absorption. In the case of the rat, however, not only inhibition of glucose absorption was observed, but also of xylose absorption. I believe that it is quite possible that the inhibitory effect of monoiodoacetic acid is not a direct influence on the metabolism of the intestinal mucosa, as Prof. Verzár thinks, but is a consequence of its disturbing effect on the circulation system.

A full account of my experiments will be given in *Arch. néerl. Physiol.* Experiments with lower animals have been started.

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July 1.

[1] C. F. Cori, *J. biol. Chem.*, **66**, 691 (1925).
[2] W. Wilbrandt and L. Laszt, *Biochem. Z.*, **259**, 398 (1933).
[3] R. A. McCance and K. Madders, *Biochem. J.*, **24**, 795 (1930).
[4] H. G. K. Westenbrink, *Arch. néerl. Physiol.*, **19**, 563 (1934).

Several Spontaneous Chromosome Aberrations in *Drosophila*

THE solution of the problem of the phylogeny of the *Drosophila* species requires, in addition to a comparison of the structure of the chromosome in the salivary gland nuclei of related species, also a study of the spontaneous chromosome aberrations. Dubinin, Sokolov, Tiniakov[1] have found a large number of highly concentrated inversions in autosomes in populations of *D. melanogaster* and *D. funebris* taken from different places, but they have found no inversions in the *X*-chromosome, nor no translocations and no deficiencies.

Mass cultures may be compared to a certain extent with populations distributed on a small area, especially when the hatched flies are transferred on to fresh food without being selected. During six months, I studied the salivary gland chromosomes of four *Drosophila* species (*hydei*, *repleta*, *sulcata* and *lugubrina*) taken from such mass cultures. I found six spontaneous aberrations, of which only three were inversions in the autosomes (one in *D. repleta* and two in autosome II of *D. sulcata*). The other three spontaneous aberrations were chromosome rearrangements which have not been discovered in Nature by Dubinin, Sokolov and Tiniakov, namely, a deficiency in an automosome of *D. lugubrina* and two inversions in the *X*-chromosome of *D. sulcata*.

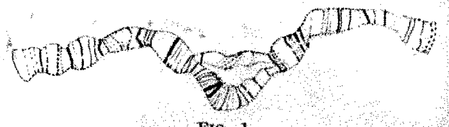

FIG. 1.

A heterozygous deficiency in one automosome limb of *D. lugubrina* (Fig. 1) was detected in about two-thirds of the number of larvæ in one culture; this heterozygous deficiency is retained in mass cultures throughout eight months.

The heterozygous inversions in the two limbs of the *X*-chromosome of *D. sulcata* (Fig. 2) belong, strictly speaking, to two different haploid chromosomes. They occurred independently of each other in two different mass cultures and were retained for several months.

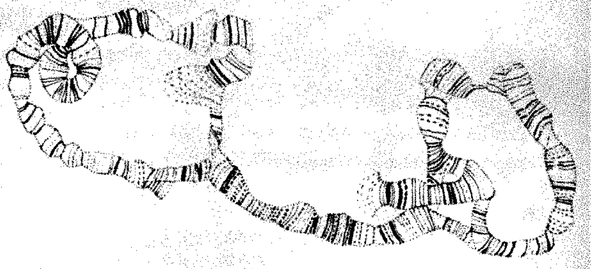

FIG. 2.

In these cultures the females heterozygous for inversions in the right or left limb of the *X*-chromosome were much more numerous than normal ones, and in addition to normal males there were males with an inversion in one of the limbs of the *X*-chromosome. Only owing to the viability of the males with an inversion in the *X*-chromosome could both inversions join in one individual in the case when a chance intermixture of flies from two different mass cultures occurs.

Of course, females with two inversions simultaneously may be only heterozygous. Females homozygous for inversions in one of the limbs are theoretically possible, but in fact they have not been detected either in mass nor in individual cultures. These females are apparently non-viable, this being proved by the numerical predominance of the males in individual cultures, where one of the inversions in the *X*-chromosome has been detected in the larvæ.

Two inversions in both limbs of the second autosome of *D. sulcata* belong to one chromosome because they are always detected simultaneously. No individuals, homozygous for these inversions, have been found. Chromosome II, heterozygous for both inversions, was found in one of the cultures where both inversions of the X-chromosome had been detected. Consequently, in this culture a small number of larvæ with a normal chromosome set and individuals with combinations varying between normal chromosomes and inversions both in the X-chromosome and autosome II were observed; which phenomena may also take place in populations in Nature.

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June 21.

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[1] NATURE, **137**, 1035 (1936).

The Teaching of Science in Schools

WITH much of what Mr. H. S. Shelton says on the subject of science teaching in schools, in his letter in NATURE of July 18, every teacher will agree. For example, closer association of prominent men of science with secondary education would be welcomed and would be most desirable. It is probable, too, that if another Committee were appointed, similar in constitution to that which sat in 1916–18 under the chairmanship of Sir J. J. Thomson, it would perform valuable service.

Unfortunately, however, Mr. Shelton includes in his letter a number of statements which may mislead those not closely in touch with what is happening. In the first place, it is inaccurate to say that the recent conference on general science represented a belated attempt to implement the (Thomson Committee) recommendation "That the science work . . . should include . . . some study of plant and animal life". The title given to the conference meant what it said and, as a matter of fact, far more schools include biology in their curriculum than Mr. Shelton probably recognizes. Before long, there will be few which do not.

Nor does the sub-committee appointed by the Science Masters' Association to consider the teaching of general science propose (as Mr. Shelton hints) to recommend a time-allowance of three hours per week. On the contrary, its members heartily endorse the original Thomson Committee recommendation that "the time given to science should be *not less* . . . than 6 periods". They would, indeed, prefer a more generous allowance than this.

Facts must, however, be faced: in many schools the recommendation has not been implemented. So that the report might prove useful to teachers in such schools, and so that it might not be merely an academic curiosity, the sub-committee has decided to work out two distinct syllabuses, of which the one to which Mr. Shelton refers is the less important.

When Mr. Shelton writes "If this proposal comes into being, we shall be back again in pre-scientific times", he seems to me guilty of pessimistic exaggeration. By "proposal", I suppose he means the publication of a syllabus, since no one proposes to recommend diminishing the time allowance given to science. It is very unlikely, after all, that the publication of a syllabus—explicitly stated as intended for schools giving a meagre time allowance to science—will encourage the more enlightened headmasters to curtail the time given to the subject in their own schools.

Lastly, I cannot subscribe to Mr. Shelton's statement that "The whole problem of the school time-table is now in hopeless confusion. No attempt is being made, for example, to correlate the mathematics and the science . . ." Confusion is, on the whole, less than it was and in many of the best schools a genuine attempt is being made to achieve some degree of correlation and to act on the recommendations of the various committees which have already considered the matter.

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Dissociation Energy of Diatomic Sulphur, Selenium and Tellurium Vapours

ON the basis of the spectroscopic data of Naudé and Christy[1], Montgomery and Kassel[2] have recently calculated F^0 values for S_2 and the dissociation constant for the equilibrium $S_2 = 2S$. Their log K values are smaller by nearly 3 units than the experimental data of Nernst and v. Wartenberg[3] at 2290° and 2350° K. Although these latter values may be somewhat erroneous, it seems highly probable that they give the right order of magnitude. The necessary corrections to Montgomery and Kassel's calculations according to the data on vibrational and rotational levels[4] cannot explain this difference.

However, if we assume that the products of predissociation of S_2 at $4{\cdot}41 + 0{\cdot}02$ v.[5] (Montgomery and Kassel have used the value 4·45 v.) are $S(^3P) + S(^1D)$ instead of two normal ^3P atoms, we get $D_{S_2} = 3{\cdot}28$ v. and the dissociation constant falls within the limit of error of Nernst and v. Wartenberg's measurements.

The dissociation measurements of Nernst and v. Wartenberg allow also of the calculation of the dissociation energy of Se_2 and Te_2, although the necessary spectroscopic data are not yet sufficient for a high degree of accuracy. The accompanying table summarizes the thermochemical and spectroscopic values of the dissociation energies. In the case of sulphur, the normal state of the molecule is a $^3\Sigma$ state[4], whereas in the case of Se_2 and Te_2 it is not certain whether it is a $^3\Sigma$ or a $^1\Sigma$ state. In the table, the first value corresponds to the former, the second value to the latter case.

Dissociation energy in electron-volt

	from spectroscopic data	from equilibrium data at 2350° K.
S_2	4·41±0·02 or 3·28±0·02	3·2
Se_2	3·1±0·2[6]	2·7 or 3·1
Te_2	2·3±0·2[7]	2·0 or 2·4

With the value $D_{S_2} = 3{\cdot}28$ v., the equilibrium measurements for the three equilibria would be in good agreement; they would also be consistent with the spectroscopic data. If $D_{S_2} = 4{\cdot}41$ v. is correct, however, we would have to assume a very considerable error in Nernst and v. Wartenberg's measurements in the case of S_2, although the agreement is satisfactory for Se_2 and Te_2.

On the other hand, the value $D_{S_2} = 3{\cdot}28$ v. would mean that the dissociation products in the upper level of the main S_2-band system are not $^3P + {}^1D$ as in the analogous levels of O_2, Se_2 and Te_2, but probably $^3P + {}^1S$. Although there is spectroscopic evidence in favour of this solution[6], it is not quite satisfactory.

The two possibilities could be tested by measuring the energy of combustion of the SO molecule, which has been recently isolated by Schenk[8]. For this molecule as well as for S_2, two values are possible, $D_{SO} = 5{\cdot}05$ v. and $D_{SO} = 3{\cdot}92$ v., corresponding to the two possible interpretations of the predissociation at 5·05 v. A thermochemical cycle gives for the heat of combustion of SO, for the possible values of D_{S_2} and D_{SO}, the values 63, 77, 90 or 104 kcal., so that a measurement of that heat of combustion would give D_{SO} as well as D_{S_2}.

Note added in proof: In a recent paper[9], Olsson suggests the value 3·6 v. for D_{S_2} on the basis of his experiment on the induced predissociation. His interpretation of the process of induced predissociation is, however, not necessarily correct[6] and the value 3·6 v. does not agree with the attractive character of the S_2-level producing predissociation at 4·41 v.

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[1] *Phys. Rev.*, **37**, 490 (1931).
[2] *J. Chem. Phys.*, **2**, 417 (1934).
[3] *Z. Elektrochem.*, **9**, 626 (1903); *Z. anorg. Chemie*, **56**, 320 (1908).
[4] Olsson, NATURE, **137**, 745 (1936); *Z. Phys.*, **99**, 114 (1936).
[5] Rosen, Désirant et Duchesne, *Phys. Rev.*, **48**, 916 (1935).
[6] Rosen, *C.R. du Congrès de photoluminescence*, Varsovie 1936. In the press.
[7] Désirant et Minne, *Bull. acad. Roy. Belg.*, **22**, 646 (1936).
[8] Schenk, *Z. anorg. Chem.*, **211**, 150 (1935).
[9] *Z. Phys.*, **100**, 656 (1936).

Scattering of Light by Light

IN a recent paper[1] Euler and Kockel have calculated the effective cross-section for the scattering of light by light. The calculation was carried out for the case of small frequencies ($\hbar\omega << mc^2$), the frequencies being taken in a frame of reference, where the total momentum of the colliding quanta vanishes.

We have calculated the cross-section for the opposite case of large frequencies ($\hbar\omega >> mc^2$). For the integral cross-section we get an expression of the form:

$$\sigma = a\,\alpha^4\left(\frac{c}{\omega}\right)^2,$$

where $\alpha = \frac{e^2}{\hbar c}$ with a constant a, which is difficult to compute. According to Euler and Kockel, for small frequencies σ is proportional to ω^6. Consequently σ has a maximum value in a region $\hbar\omega \sim mc^2$.

It is also difficult to compute the dependence of the differential cross-section on the angle of scattering. We find that for the small angles the polarization of the light quanta is not altered. The differential cross-section for small angles is

$$d\sigma = 8\pi\,\alpha^4\left(\frac{c}{\omega}\right)^2 \log^4 \Theta\, d\theta,$$

Θ being the angle of scattering and $d\theta$ the solid angle. This formula is valid for small angles, but not essentially small compared with $mc^2/\hbar\omega$. In the latter case it is necessary to insert into the logarithm $mc^2/\hbar\omega$ in place of Θ.

The formula has a relative accurateness of $1/\log\Theta$. The cross-section increases with decreasing angles, but not very rapidly, and it is impossible to affirm that this region plays the main role in the integral cross-section.

The detailed calculations will appear elsewhere.

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[1] *Naturwiss.*, **23**, 246 (1935).

Mechanism of the Photo-Decomposition of Acetone

IN continuation of an investigation which has been reported elsewhere[1], an attempt was made to produce free methyl radicals by the photo-decomposition of acetone. According to Norrish, Crone and Saltmarsh[2], the radicals are produced by the following mechanism:

$$(CH_3)_2CO + h\nu \rightarrow 2CH_3 + CO$$

which is based on the latter authors' observation that at 60° the main products are equal volumes of carbon monoxide and ethane.

At room temperature, however, we were unable to obtain this equivalence, the volume of ethane being always 1·5 times that of the carbon monoxide. Furthermore, we were able to isolate diacetyl from the liquid products in considerable quantity, determine its boiling point and prepare several derivatives. Diacetyl has previously been detected in the products of photo-decomposition of aldehydes and ketones by Barak and Style[3].

Further experiments with filtered light of different intensities and with different concentrations of acetone suggest that the primary photo-chemical process is:

$$(CH_3)_2CO + h\nu \rightarrow CH_3 + CH_3CO.$$

However, when the photolysis is carried out at 60°, approximately equal amounts of carbon monoxide and ethane are formed together with some methane, the acetyl radical evidently being extremely short-lived at this temperature.

A detailed account of the experiments will be given in a forthcoming publication.

R. SPENCE.
W. WILD.
University,
Leeds.
June 16.

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[1] *Proc. Leeds Phil. Soc.*, **3**, 141 (1936).
[2] *J. Chem. Soc.*, 1456 (1934).
[3] NATURE, **135**, 307 (1935).

Proposed Suspension of Rules of Nomenclature in the Case of Bohadsch 1761

THE undersigned invites the attention of the zoological profession to the fact that application has been made to the International Commission on Nomenclature to suspend the Rules in Bohadsch 1761, "De Quibusdam Animalibus Marinis" and its translation 1776, on the ground that the application of the rules in these cases will produce greater confusion than uniformity.

Zoologists interested in this case, for or against suspension, are invited to present their views to the Commission.

C. W. STILES.
(Acting Secretary.)
U.S. National Museum,
Washington, D.C.

Measurement of River Bores

WITH reference to the note in NATURE of April 25, p. 711, concerning the observations of the bore in the River Trent, may I direct attention to the observations made by the surveyors of Whangpoo Conservancy Board in February 1920 on the famous bore of the Ch'ien Tang River? Apart from general tide readings, special water-levels were observed every ten minutes during the day and every minute for one hour before and after the passing of the bore, at six stations covering a reach of 18½ miles, for two weeks. The maximum height of the vertical face of the bore was 4½ feet, the total rise in that tide being about 16 feet.

Representative figures, diagrams and photographs are given in the publication entitled "Report on the Hydrology of the Hangchow Bay and the Ch'ien Tang Estuary". This is now out of print, but a copy was deposited in the Science Library at South Kensington.

HERBERT CHATLEY.
(Engineer-in-Chief.)

Whangpoo Conservancy Board,
Shanghai.
May 29.

The Beams Ultracentrifuge

AN ultracentrifuge designed by Beams has been in operation in this laboratory for the past year. From information published[1,2,3,4], we assumed the forces to be of the order of 5×10^5 times gravity when driven by air at about 80 lb. pressure. On subsequent measurement we find that the maximum force developed is 4×10^6 times gravity. This is obtained at a speed of 10,000 r.p.s., which is considerably in excess of that obtained by Beams[4] with a similar rotor under the same conditions.

The figures given in cytological papers from this Department therefore require correction.

A paper on the apparatus and methods of measurement is in course of preparation.

W. CUSACK FAHIE.

University College,
Dublin.

RALPH H. J. BROWN.

Trinity College,
Dublin.

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[1] Beams, *Rev. Sci. Inst.*, 1, 667 (1930).

[2] Beams and Weed, *Science*, 74, 44 (1931).

[3] Beams, Weed, and Pickels, *Science*, 78, 338 (1933).

[4] Beams and Pickels, *Rev. Sci. Inst.*, 6, 229 (1935).

Points from Foregoing Letters

A DESCRIPTION of a new fossil human skull from the middle gravels of the Thames 100 ft. terrace at Swanscombe, Kent, is given by A. T. Marston. Its features are those of a specialized type less advanced than the well-known Piltdown skull. The author considers that the Piltdown skull must be assumed to come from a later geological horizon than the Swanscombe skull.

Values of 206·00 and 208·00 for the mass of lead isotopes are calculated by Prof. A. J. Dempster, by comparison with palladium and rhodium, by means of the mass spectrograph. This is in agreement with the atomic masses to be expected for lead isotopes derived from the radioactive transformation of uranium (238·088) and thorium (232·070), allowing for the loss of mass due to the emission of alpha-rays (helium) and beta-rays (electrons), and also for the mass equivalent of the energy of the emitted particles.

Graphs showing the ranges of particles emitted by boron and lithium (due to the capture of slow neutrons only) at different air pressures are submitted by J. Rotblat. Taking into account the most probable values of the masses of the particles involved in the transformation, the author finds in the case of lithium good agreement with the total energy calculated ($4 \cdot 5 \times 10^6$ e.v.). In the case of boron good agreement is obtained if the velocity-range calculated from the theories of Bethe and of Bloch is substituted for the experimental velocity-range relation given by Blackett and Lees. The boron curve indicates that there is an additional release of energy from boron, probably in the form of gamma-rays.

When a fast electron beam is diffracted by an etched surface of a single crystal of copper, Dr. W. Cochrane finds, in addition to the cross-grating pattern, also the 'Kikuchi' light and dark line pattern, which indicates a high degree of perfection in the crystal.

Data indicating the growth-promoting action of glycolic, pyruvic and glyoxylic acids upon the mould, *Aspergillus niger*, are given by N. Nielsen and V. Hartelius, in continuation of their investigation on the nature of the growth substance produced when cane sugar is inverted by means of acids.

Dr. H. G. K. Westenbrink shows that fundamentally the same ratio holds for the velocities of intestinal absorption of certain sugars (*d*-galactose, *d*-glucose, *d*-fructose, *d*-mannose, *l*-xylose and *l*-arabinose) with the rat and the pigeon. With both rat and pigeon there is a distinct difference between the velocities of absorption of *l*-xylose and *l*-arabinose.

Dr. S. L. Frolova describes and illustrates spontaneous aberrations of the chromosomes in mass cultures of several species of the fruit-fly, *Drosophila*. Of six changes observed, three were inversions in the autosomes of *Drosophila repleta* and *D. sulcata* and the other three consisted of a deficiency in an autosome of *D. lugubrina* and two inversions in the X-chromosome of *D. sulcata*.

A table summarizing the values of the dissociation energies of the sulphur, selenium and tellurium molecules, as deduced from both spectroscopic and thermochemical observations, is given by P. Goldfinger, W. Jeunehomme and B. Rosen. The authors state that a determination of the heat of combustion of the recently isolated sulphur monoxide would enable a choice to be made between the alternate values deduced from spectroscopic data.

A. Akhieser, L. Landau and I. Pomeranchook have calculated the cross-section for the scattering of light quanta by light quanta for the case of large frequencies.

Research Items

Early Man in New Mexico

In view of the discovery by Mr. E. B. Howard of stone artefacts attributed to Folsom man in association with the fossil remains of extinct mammals in what he termed "blow-outs" near Clovis, New Mexico, it is essential for chronological purposes that the geological character of these formations and the conditions in which the remains and artefacts were deposited should be clearly understood. This question was investigated by Messrs. Chester D. Stock and Frances D. Bode of the California Institute of Technology (*Proc. Acad. Nat. Sciences, Philadelphia*, **88**, 1936). The "basins"—a term preferable to either "blow-out" or "lake", which are misleading—are depressions, usually several hundred feet in diameter and two to ten feet in depth, in a long shallow trough, the Black Water Draw, from five to ten miles wide, which originates some thirty miles south-west of Clovis. The basins have been formed by wind-action, which has scoured the soil and underlying sediments of the centre, piling it up as sand dunes on the periphery, down to the Blue Sand (a blue-grey sandstone), which forms a smooth flat unbroken floor. As the Blue Sand is cut away—in the centre to a depth of four or five feet—flat benches with steep vertical banks develop. Residual areas capped by Blue Sand are left standing on the floor like islands. Erosion does not proceed beyond the Blue Sand. Probably the Blue Sand underlies the entire floor of Black Water Draw near Clovis. Masses of broken bones are found weathering out of the Blue Sand. These include bison, horse, elephant and camel. Flint chips are abundant on the floor of every basin, and several types of artefacts are associated with them. Artefacts of the Folsom or Yuma type occur only where the Blue Sand has been dissected. Convincing association with fossil mammal material was demonstrated in at least two basins, the Gravel Pit and Anderson Lake. Charcoal suggests a fire, but not necessarily of human origin, as it may be due to spontaneous combustion. The stratigraphic and physiographic relations of the Blue Sand to the present landscape suggest that it is possible to assign a very recent age to the deposit. It dates back to a pluvial period when the rainfall was greater than it is to-day; but this period does not necessarily fall into Pleistocene times.

Apparent Transformation of one Virus into Another

There are two inoculable tumour-diseases of rabbits, somewhat similar in appearance, and both caused by ultra-microscopic filterable viruses. One, rabbit myxoma, is malignant and always fatal; the other, rabbit fibroma, is never fatal and ultimately ends in recovery. A curious fact recently observed is that animals that have recovered from an attack of fibroma are unsusceptible to myxoma, and cannot be inoculated with it. According to Science Service, Dr. George Berry has reported at the meeting of the American Association for the Advancement of Science at Rochester, N.Y., that when active fibroma virus is mixed with myxoma virus killed by heating and the mixture injected into rabbits, the animals develop the deadly myxoma and die. That is to say, the benign fibroma virus by admixture with dead myxoma virus is apparently transformed into the myxoma virus. Controls with the dead myxoma virus alone had no effect. Further details respecting this important observation, which has been repeated many times, will be awaited with interest.

Microbiology of Australian Soils

The results of a study, at different ranges of temperature, of the rate of decomposition of organic matter in soil in relation to the numbers of micro-organisms present are detailed in a recent paper by Mr. H. L. Jensen (*Proc. Linn. Soc. N.S.W.*, **61**, 27–55; 1936). The decomposition rate was measured by the carbon dioxide production. In soils to which there had been no addition of organic matter, the carbon dioxide production was generally 100 per cent stronger at 28° than at 15° C., and some 50 per cent stronger at 37° C. than at 28° C. At each temperature, there was a significant correlation between daily yields of carbon dioxide and direct counts of bacteria. Growth of fungi was more extensive in sand soils than in loam soils, but no correlation was found between density of mycelium and yield of carbon dioxide. Decomposition of the soil's own 'humus' seems to be carried out almost entirely by bacteria, the accelerating influence of increasing temperature being due to stimulation of the metabolic activity of the bacteria. In soils to which various undecomposed plant materials (straw, hay, fungal mycelium) had been added, the rate of carbon dioxide production increased steeply with rise of temperature from 5° C. to 37° C. Significant correlations appeared between daily yields of carbon dioxide and densities of mycelium, and also between yields of carbon dioxide and direct counts of bacteria, but not between carbon dioxide yields and plant counts. The efficiency of the organisms decreased rapidly with advancing time. The fungi appeared to be important agents of decomposition during the earlier stages when the most intensive destruction of organic matter takes place. It is suggested that, especially at 28° C., their carbon dioxide production may considerably exceed that of the bacteria; with advancing degree of decomposition they cease to be of importance. The decreasing rate of decomposition of added organic materials, together with the increasing accumulation of microbial substance, seems to offer an explanation for the increasing accumulation of 'humus' with decreasing soil temperature.

Californian Shrimps of Commerce

Mr. Hugh R. Israel's researches on the commercial shrimps of California are interesting and instructive ("A Contribution Towards the Life Histories of Two Californian Shrimps, *Crago franciscorum* (Stimpson) and *Crago nigricauda* (Stimpson)". Division of Fish and Game of California. Bureau of Commercial Fisheries. Fish Bull., No. 46, 1936). Both species move towards the ocean as the spawning season approaches, and the eggs hatch in water of high salinity, the young shrimps migrating farther inshore into less saline water, and as they grow larger gradually moving into deeper water. Both species breed at the end of their first year, and soon afterwards disappear from the commercial catch, the main breeding season being December–May or June for *Crago franciscorum* and April–September for *C. nigricauda*. A very large catch of *C. franciscorum* in 1932 was made after the breeding season had ended, and one of *C. nigricauda* corresponded exactly with the breeding season. It is suggested that as in May and June 1933 the expected increase of this species did not occur, the heavy inroads made during the spawning season of the year before may be responsible. Very little is known about the planktonic larval stages of their shrimps, although it is presumed that they are similar to those of *C. vulgaris*. The latter species, however, may breed close inshore, and it would be useful to make a careful survey of the larvæ of these two Californian shrimps. The post-larval stages are taken at a considerable distance from the ocean in the shallow water of tidal flats and shoals.

Cercospora Leaf-Spot of Tobacco

A DISEASE of tobacco caused by the fungus *Cercospora nicotianæ* has attained severe proportions in the tropical areas of Queensland, Australia, the Dutch East Indies, Rhodesia and Nyasaland. The organism may produce spots upon leaves of the host at any stage of growth, and if it occurs in epidemic form shortly before the harvest, it results in a very destructive 'barn spot' during the process of curing. Mr. A. V. Hill has made a thorough study of the disease (*Bull.* **98**, Coun. Sci. and Ind. Res., Australia, Melbourne, 1936), and shows that it can attack twelve species of *Nicotiana*, in addition to the thorn apple and *Nicandra physaloides*. The optimum temperature for growth of the fungus is 26° C., and outdoor temperatures of this order, combined with rainy periods, greatly aggravate the effects of the malady. Seed from infected capsules is capable of transmitting the disease to a subsequent crop grown from it, and the main control measure lies in the use of healthy seed. Many other aspects of the problem are discussed in the paper, which has also seven excellent plates illustrating symptoms and the causal organism.

The Angiospermic Carpel

DR. I. V. NEWMAN has published (*Proc. Linn. Soc. N.S.W.*, **61**, 56–88; 1936) details of his studies of the floral apex of *Acacia longifolia* and *A. suaveolens*, which have induced him to champion the old theory of the origin of the carpel, and to criticize theories advanced in recent years by a number of investigators. After discussion of the evidence he concludes that (i) the legume is a lateral structure, (ii) the legume is a single, folded structure, (iii) the legume is not a foliar structure; and considers that in the two species dealt with there is no reason for doubting that the legume is of foliar nature and that it is reasonable to interpret the flowers of these species as modified leafy shoots. The subject has recently been under notice in the columns of NATURE (**137**, Jan. 11; March 14, 1936).

Lunar Periodicity of Earthquakes

OF the three laws that Perrey stated as governing the lunar frequency of earthquakes, the third, according to which earthquakes are more frequent when the moon is near the meridian than when it is at a distance of 90° from it, has suffered most from recent criticism. Mr. M. W. Allen (*Bull. Amer. Seis. Soc.*, **26**, 147–157; 1936) urges, however, that this criticism depends on statistics obtained from large areas, and takes no account of the strike or hade of the faults concerned. He has, therefore, considered the earthquakes during about forty-five years that originated within five or ten miles from three great faults in California. The earthquakes were grouped in different intervals of time, and harmonic analysis was applied to the numbers of shocks within lunar hour angles of 30°. Mr. Allen shows that, for the second harmonic alone, that associated with the semi-diurnal lunar effect, does the epoch incline towards constancy. Moreover, the amplitudes of this harmonic are more prominent than the others, ranging about 0·25 and being in some intervals nearly four times as great as that required by Schuster's test. It is thus difficult to escape the conclusion that "the semidiurnal lunar tidal forces have in some manner acted to determine the moment of occurrence of a significant number of the shocks of the region of the San Jacinto, Agua Caliente, and Elsinore faults".

Cosmic Rays

THE July issue of the *Journal of the Franklin Institute* devotes 81 pages to the report of the work of the Bartol Research Foundation 1934–35, made to the members of the Institute by Dr. W. F. G. Swann, the director of the Foundation. Almost the whole of the work during that period has centred around cosmic rays which have been investigated at ground-level, and at various altitudes up to 4,300 metres in Peru, Panama, Mexico and at stations in the United States up to 45° N. latitude. The 45 figures given enable the general reader to follow with ease the descriptions of the apparatus used and the results obtained. So far as they relate to the variation of the radiation with the latitude of the place of observation and angular distance from the zenith of the point from which they emanate they confirm the results of other observers, and they supply new facts as to the efficiencies of radiations from different directions in producing the secondary effects known as cosmic ray bursts. Dr. Swann concludes that the primary cause of the rays as measured is in the main an electrically charged particle of which the energy and the energy of the radiation measured is absorbed more rapidly when it is small than when it is large by its passage through the atmosphere.

The Compton Effect

IN the June issue of the *Review of Scientific Instruments*, Prof. E. L. Hill, of the University of Minnesota, reviews the recent work on this effect, and shows that the simple quantum theory of it, hitherto thought adequate, requires revision. That theory gives when a photon impinges on an electron: (1) the angle of deviation of the photon and its change of frequency, (2) the angle of recoil of the electron and its recoil energy, (3) that the three momenta concerned are coplanar and that the angles of deviation and recoil are related in a certain way. While conclusions (1) and (2) have been verified experimentally, the recent work of Dr. R. S. Shankland in Prof. Compton's laboratory has cast doubts on the simultaneous production of a photon deviation and an electron recoil which (3) assumes, and a revision of our corpuscular theories of radiation will be necessary. Dirac (NATURE, **137**, 298; 1936) has expressed the opinion that most of the present quantum mechanics may be retained, but that the quantum theory of the electro-magnetic field will probably have to be sacrificed.

Flagella Movement

By A. G. Lowndes, Marlborough College

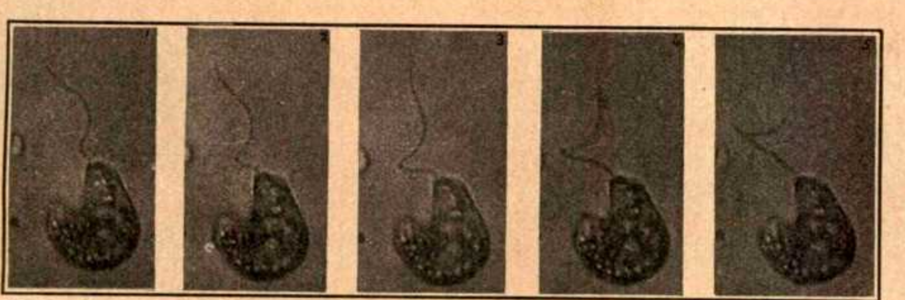

FIG. 1. *Peranema trichophorum.* Five consecutive exposures. Time of exposure, 1/8,000 sec. Interval, 1/30 sec. approx. The wave is clearly passing up the flagellum. The dark spot in the flagellum shows where a slight twisting occurs. This results in the extremity of the flagellum rotating. Measurement shows that the wave passes up the flagellum with an increase in velocity.

ALTHOUGH flagella movement or propulsion by means of a single flagellum is probably one of the first types of movement which came into existence, the fact remains that comparatively little is known for certainty about its actual mechanics. For example, it has always been a debatable point whether the flagellum is a passive unit mechanically operated by the cell, or an active structure developing partly or wholly its own energy. It is true that Gray[1] has given much evidence in favour of the latter view, but quantitative data are lacking. It has also been maintained in practically all standard text-books, that in all tractella or cases in which the flagellum is attached to the anterior end of the cell or organism, the waves of distortion pass from the tip of the flagellum to its base.

By the application of ultra-rapid cinema photomicrography[2] it has been possible to settle the one point and disprove the other. The flagellum is an active unit and generates its own mechanical energy. In the tractella of five species investigated, the waves of distortion start at the base of the flagellum and travel towards the tip.

Fig. 1 shows five consecutive exposures of the flagellum of *Peranema*, which is a very common monoflagellate with a so-called tractellum. The exact interval between the exposures is known, and so is the magnification. The distance from the base of the flagellum to the crest of the wave is easily measured, and on plotting this against the interval, it is established that the wave is passing along the flagellum with a definite increase in velocity.

Fig. 2 shows four consecutive exposures of the flagellum of the same species, but the flagellum is behaving rather differently. Both figures show, however, that a wave passes along the flagellum with an increase in velocity and also an increase in amplitude.

Reference to Fig. 1 also shows that as the wave of distortion passes along a flagellum, a certain amount of rotation of the distal end is caused, and if the energy output of such a flagellum is increased, the amplitude of the waves decreases while the frequency increases and thus a series of small waves is produced. This is illustrated to perfection in *Peranema*, in which the waves pass along the flagellum sufficiently rapidly to cause the tip to rotate rapidly while the proximal part appears to be rather stiffly extended.

The actual tip of the flagellum is bent round so that the impulses passing from base to tip actually produce a forward component, and it is only when the flagellum is extended in this manner that the organism swims forward with its maximum velocity (Fig. 3). The organism itself does not rotate as it progresses, nor does the base of the flagellum.

In *Euglena viridis* the waves of distortion pass along the flagellum as in *Peranema*, but the flagellum is bent right back from the actual base. The waves passing along the flagellum produce both a lateral and a forward component, thus causing the organism to rotate as it moves forward (Fig. 4). The net result is that, as the organism swims forward, its anterior end traverses a circular path at right angles to the long axis of the animal, while the whole of the animal rotates.

Now *Euglena* is highly metabolic, or in other words, it changes its shape rapidly. If the organism approaches or meets anything which normally would compel a reversal or change of direction, the organism immediately swells out at its posterior end and thus causes the anterior end to retract. This causes the flagellum to be swung forward, and the waves passing along it now constitute a powerful backward component, with the result that the organism either swings round with its hinder end acting as a pivot or it may actually swim backwards. When *Euglena* is swimming normally and is rotating, the flagellum appears first on one side and then on the other, and it is, of course, obscured in the intermediate positions.

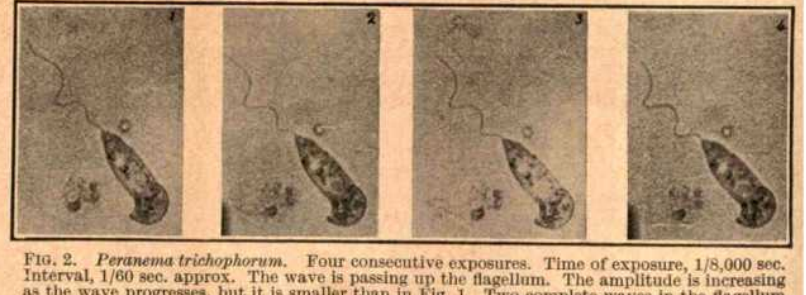

FIG. 2. *Peranema trichophorum.* Four consecutive exposures. Time of exposure, 1/8,000 sec. Interval, 1/60 sec. approx. The wave is passing up the flagellum. The amplitude is increasing as the wave progresses, but it is smaller than in Fig. 1. Two complete waves in the flagellum indicate an increase in frequency.

The rotation may be in a clockwise or anti-clockwise direction.

Altogether five species of monoflagellates have been investigated, and three of them filmed at considerable length. The action of the flagellum in all five species appears to be identical in outline, though quite different in detail.

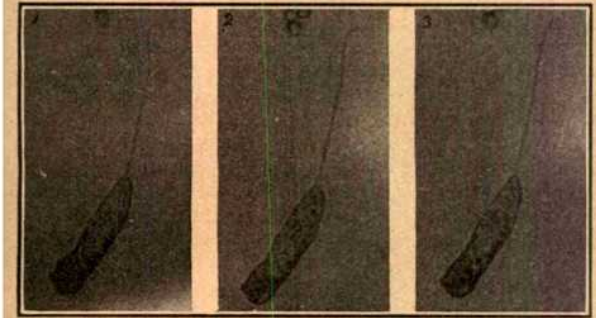

FIG. 3. *Peranema trichophorum*. Three consecutive exposures. Time of exposure, 1/8,000 sec. Interval, 1/30 sec. approx. The waves are confined to the tip of the flagellum. In this case, the organism is swimming forwards with its maximum speed. The extreme tip of the flagellum is not seen since it lies beyond the penetration of the objective.

To sum up: (1) The flagellum generates its own energy, at any rate in part, if not completely. (2) The waves of distortion pass from base to tip of the flagellum and not in the reverse direction. (3) The actual position taken up by the flagellum at any instant will determine whether these waves of distortion constitute a forward or backward component. (4) They may also cause the organism to rotate in a clockwise or anti-clockwise direction. (5) They constitute an important escape movement by causing the organism to reverse its direction rapidly without necessitating a reversal in either the direction of propagation of the waves themselves or the direction of rotation of the organism.

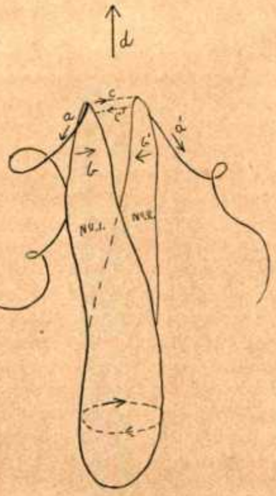

FIG. 4. Diagrammatic representation of *Euglena viridis*.

No. 1. A wave is passing along the flagellum in a direction *a*. This causes the organism to rotate in a clockwise direction *b*. It also causes lateral displacement of the front end of the animal *c*.

No. 2. The flagellum is now on the right of the organism. Either the same wave or another passes along the flagellum. Lateral displacement is in the direction *c'*. The organism is propelled in the direction *d*, and rotates in a clockwise direction. The anterior end moves in a circular path at right angles to the mean direction.

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[1] J. Gray, "A Text-Book of Experimental Cytology". Cambridge University Press. 1931.

[2] A. G. Lowndes, "The Twin Polygraph and Strobograph", NATURE, **135**, 1006 (June 15, 1935).

Specific Heats of Metals and Alloys at High Temperatures*

AFTER some ten years of experience in the investigation of various physical properties of metals at high temperatures, Prof. F. M. Jaeger and his collaborators at Groningen commenced, about fifteen years ago, the much more difficult investigation of the changes which the specific heats of metallic substances undergo at temperatures up to 1,600° C. At that time there were considerable differences in the data published by various experimenters regarding the specific heats of metals and their temperature coefficients at those high temperatures—differences which could not be accounted for entirely by variations in experimental technique, but which seemed to be due, in part at least, to unknown peculiarities of the metals themselves. As a result of the work of Prof. Jaeger, many of these discrepancies have been removed and much valuable information has been obtained concerning the nature of thermal and molecular transformations in the metallic state.

The direct specific heat measurements were carried out by means of a high-precision metal-block calorimeter in which temperature differences of a few millionths of 1° C. could be measured with certainty. The results obtained by the calorimetric technique were checked and confirmed by independent methods, for example, by measurements of the variation with temperature of the electrical resistance and of the thermo-electric behaviour of the metals. In studying the variation of any such property as a function of temperature, use was also made of two optically coupled galvanometers combined with a photographic recording device in order to obtain continuous curves, which immediately reveal any sudden discontinuity of the variable property at a particular temperature.

As regards the discrepancies in the results of previous workers, Prof. Jaeger's investigations show that these can be largely attributed to the measurements having been made with samples of metal which had undergone different preliminary thermal or mechanical treatment and which, therefore, were physically non-homogeneous due to the presence of inner stresses. Metals which have been suitably tempered by prolonged heating *in vacuo* at a constant high temperature as near to the melting point as possible, followed by slow cooling *in vacuo*, give values of the specific heat which, even at lower temperatures, are quite reproducible. This is especially striking in the case of silver, for which Prof. Jaeger has obtained a C_p-temperature curve which is concave to the temperature axis and not convex, as indicated by the best previously recorded data.

In many cases, the behaviour of metals at high temperatures is complicated by the occurrence of allotropy, and the calorimetric method is particularly suited to the detection of such changes. The transformation to a new allotropic form usually commences at a much lower temperature than the thermodynamically defined transition point, and in this 'transition interval' the specific heat of the metal increases very rapidly with the temperature, often reaching extremely high values.

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* Substance of a lecture by Prof. F. M. Jaeger, University of Groningen, delivered at University College, London, on May 11.

In passing through the transition point, either by heating or by cooling, the allotropic changes are frequently accompanied by certain retardation phenomena. For example, beryllium, which has been given a preliminary heating at temperatures of 450° C. or more and is then allowed to cool from 400° C., gives off the same amount of heat, but over a longer period, than a sample of the metal which has not been heated above 400° C. The change in the internal state of the metal brought about by the preliminary heating may persist for several months, but there is a continuous return to the original state. Similar changes have been observed with rhodium, zirconium, chromium, titanium, and other metals, and the phenomenon appears to be a very general one. It is interesting to note that in the case of beryllium, the retardation of heat evolution completely disappears if the sample of metal is previously finely powdered.

Another factor of importance is the remarkable influence which may be exerted by almost imperceptible traces of gases—chiefly of oxygen, but occasionally also of nitrogen and of hydrogen—on the phase changes which occur in metals. In the α-titanium $\rightleftarrows\beta$-titanium transition, for example, there is at the transition temperature of 882° an additional hysteresis effect, which disappears with a sample of metal prepared *in vacuo*, but returns on the addition of traces of oxygen and nitrogen.

Prof. Jaeger's experimental study of the specific heats of metals at different temperatures has provided more accurate data which can be applied to testing the validity at high temperatures of two important theoretical deductions. According to the quantum-theoretical treatment by Einstein and by Debye of the variation of the specific heat of solid substances with temperature, the atomic heat at constant volume of solid mono-atomic elements should, even at the highest temperatures, never exceed a value of $3R=5\cdot955$ cal. The experimental results make it improbable, however, that any such upper limit exists, since this value is already exceeded in most cases at relatively low temperatures. The second application concerns the validity of the Neumann-Kopp law, which states that the molecular heat of a compound is an additive property of the atomic heats. Prof. Jaeger's measurements show that, in the case of alloys, the law is obeyed only when true solid solutions are formed between the component metals. With intermetallic compounds, the deviations from additivity, which are sometimes very considerable, may be either positive or negative, and in all cases rapidly increase with the temperature of observation.

O. J. WALKER.

Insect Pests of Crops in England*

THE Ministry of Agriculture and Fisheries' report for 1932–34 on insects affecting crops has been drawn up by Mr. J. C. F. Fryer, in collaboration with his colleagues at the Plant Pathological Laboratory, Harpenden. In dealing with advances in the application of insecticidal measures, the subject of pyrethrum is again considered in this report. Methods for the evaluation of the toxic principles of pyrethrum, elaborated by Dr. F. Tattersfield at the Rothamsted Station, have proved valuable, and it has been further shown that the incorporation of certain antioxidants greatly retards the deterioration of pyrethrum dust when exposed to the air. The plant has been shown to grow, and to yield satisfactorily, under English conditions; but the available methods of harvesting entail too heavy labour costs to warrant cultivation as a paying proposition. This aspect, therefore, remains in abeyance, at any rate for the time being, but in view of the valuable properties of pyrethrum, and the safety attending its application as a spray fluid, we may hope that cultural difficulties will eventually be overcome.

The hot-water treatment of daffodil bulbs as a measure against the Merodon fly and nematode pests is now an established procedure, and the same method has now become applicable in respect to the *Tarsonemus* mite of the strawberry. The treatment has been further developed with reference to strawberries, chrysanthemums and violets.

Among introduced pests, the Colorado potato beetle is of great importance: the recent eradication of a slight infestation in the Tilbury–Gravesend area is a matter for congratulation to all concerned. But for the prompt measures put in force by the Ministry, this insect might have gained a foothold, and led to a veritable campaign for its eradication. The extent of its adopted area in France, and its continued spread in that country, will serve as a justification for the close scrutiny that is being maintained at likely English ports of ingress.

Among other foreign pests that have found entry into Great Britain, reports on the eradication of the chrysanthemum midge and fluted scale are satisfactory, and measures to preclude the introduction of the apple maggot and cherry fruit fly have given the effective results anticipated. During the period under review, many indigenous crop pests are mentioned. There were no very outstanding attacks on cereals but with regard to potatoes, the *Heterodera* eelworm was a serious menace and appeared to be spreading. Larvæ of chafer beetles were specially in evidence as pests of grassland, while in connexion with sugar beet cultivation, the discovery of the *Heterodera* potato eelworm in that crop has complicated the situation. Proper rotation and clean cultivation may avert the severe losses which this creature has brought about on the continent of Europe. *Brassica* crops came in for heavy infestation by the aphis *Brevicoryne*, flea beetles and the cabbage white fly—dry weather conditions seemingly having favoured such attacks.

Fruit pests are always numerous: the apple sawfly attracted most attention, but the application of proper measures, when carefully timed, reduced the menace to manageable proportions. The deterioration of strawberries has greatly concerned growers, and the discovery that the disease known as 'yellow edge' is carried by a prevalent species of aphis has added to the importance of the latter as a pest. Among glass-house troubles, the record of damage to tomato seedlings by a species of the order Symphyla during the three successive years under review is of interest. Much damage has been claimed as being due to such creatures in America in recent years, but the status of this species as a pest is not as yet universally accepted.

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* Ministry of Agriculture and Fisheries. Bulletin No. 99: Report on Insect Pests of Crops in England and Wales, 1932–1934. Pp. vi+50. (London: H.M. Stationery Office, 1936.) 1*s*. net.

The report concludes with a useful bibliography of publications bearing upon the subjects dealt with.

A. D. I.

The Marine Steam Boiler

In a recent note on "The Future of Steam Propulsion", reference was made to a paper on the relative merits of steam and oil engines for ships (NATURE, 137, 267; 1936). The subject is one of considerable importance at the present time, when a period of increased ship construction is imminent, and a new and different 'battle of the boilers' such as occurred at the time of the introduction of the water-tube boiler into H.M. Navy may be anticipated. Two papers dealing with the matter were read before the spring meeting of the Institution of Naval Architects in April last. In one of these, a "Review of the Present Position of Marine Steam Boilers", Eng.-Rear-Admiral W. M. Whayman dealt with large high-speed ocean-going mail steamers and passenger liners; he holds that these services constitute practically an exclusive field for steam machinery. Asserting that oil is, at present, the only suitable fuel for such installations, he points to the fact that, where speed and passenger comfort are the main consideration, oil-fired water-tube boilers have been adopted for ocean liners in all countries, and he gives details of the boiler equipment of many well-known ships. Whereas pressures on shore approach 1,500 lb. per sq. inch at 900° F. the tabulated figures show that 400–450 lb. per sq. in. and 650°–740° F. constitute the generally accepted limits for high-class sea installations at present. It is suggested that by reason of the more severe conditions of sea service, these pressures and temperatures may be expected to remain fairly steady. It should, however, be recognized that since these special sea conditions must always exist, marine practice, while necessarily following land practice at a safe distance, will steadily advance as quickly as new methods, machinery and means of operation have been proved to be sufficiently reliable for service at sea.

The water-tube boiler, by reason of the much smaller diameters used as compared with the Scotch type, has enabled pressures to be nearly doubled, and the present tendency towards the elimination of the drum makes possible further advances in working pressures. Towards this end also the use of higher tensile alloy steels, the adoption of welding processes, the provision of air heaters, and the introduction of forced circulation, of pure feed supply and of methods of treating the steam between the turbines either by re-heating or by extraction of moisture, indicate the lines on which improvements may be anticipated.

In "Naval Water-tube Boilers", Eng.-Capt. S. R. Dight gave particulars of tests and experiments which have been carried out at the Admiralty Fuel Experimental Station, Haslar, with the object of obtaining more intimate information regarding the internal working conditions, and so enabling further improvements in efficiency and reliability to be made. Circulation was tested by means of Pitot tubes, and marked variations were noted between differently placed tubes, with occasional reversals occurring in fire-row tubes when sudden changes took place in the feed supply.

A device described as a circulation augmenter was introduced to enable the feed supply to assist circulation, and proved advantageous. The overheating of fire-row tubes, the use of air pre-heaters and of automatic feed regulators were among the subjects of test, and the general conclusion was that increase of output for the same space and weight was possible. The application of forced circulation is stated to be under consideration.

Breeding of Arctic Marine Prosobranchs*

DR. GUNNAR THORSON accompanied the Danish Three-Year Expedition to East Greenland in 1931–34 under the leadership of Dr. Lange Koch, and made extensive and regular collections of plankton from the southern main station of Ella Island during the period from January until September 1932. Later, these samples were supplemented by others collected by a Greenlander, Benjamin Samuelsen; thus giving a whole annual cycle of East Greenland plankton. In none of these samples and in none previously examined from these regions were there any prosobranchiate gastropods. This remarkable fact was partially explained by the large number of different prosobranchiate egg capsules with big embryos in the bottom samples and dredged material.

In order to investigate further, Dr. Thorson continued the collecting of gastropod egg-masses in 1932 and during the cruise of the *Godthaab* in the summer of 1933, and in addition examined material from other expeditions. By carefully studying the species in their various habitats and their distribution, and by comparing the embryos with the adults a good knowledge of the prosobranchiate fauna was obtained, with their breeding, resulting in the discovery that not one species has a pelagic larva, but all pass directly into the free bottom stage after they have reached a considerable size in their capsules. Alone of the twenty-eight Greenland molluscs noted (in twenty of which the breeding is described for the first time) *Acmaea rubella* was found to be viviparous and hermaphrodite.

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* "Studies of the Egg-Capsules and Development of Arctic Marine Prosobranchs" by Gunnar Thorson. Treaarsexpeditionen til Christian den X's Land 1931–1934 under Ledelse af Lange Koch. *Medd. om Grønland*, 100, No. 5 (1935).

The present paper deals with the egg capsules and enclosed embryos, their breeding seasons and habitats (very characteristic in most cases). The young in the capsules were identified by comparing the shell with the apex of the adult, which is very different from the rest of the shell and gives a perfectly good clue to the embryonic period. Whenever possible the size and shape of the capsules, description of embryos, duration of embryonic state and number of embryos in each capsule are given. In many cases, especially in the large species, there are nurse eggs. In *Siphocurtus* about eight hundred eggs are laid in each capsule, of which usually only two develop into shelled embryos which devour the others. It is found that the number of embryonic whorls in a species is not always constant, but depends upon the conditions of nourishment in the capsules, and the time of escape of the embryos depends on the amount of nourishment.

The fact that these arctic species have no pelagic larvæ is very important, especially when we compare closely related species from Britain and elsewhere, and find that many of these have distinct veliger larvæ which often stay in the plankton until several whorls are attained. With the larger forms such as *Buccinum* and *Neptunea*, the young emerge in the crawling stage in both Arctic and British waters, but the British turrids and the species of *Natica* and *Velutina* whose larvæ are known all have well-developed veligers which remain in the plankton for a considerable time.

The author does not in this paper make any suggestions as to the special conditions in these Arctic waters which apparently prevent any pelagic prosobranch larvæ from living. One anticipates with interest a discussion on these general problems.

Radio Research in Australia

IT is with considerable satisfaction that those responsible for the organization of radio research in Great Britain will note the continued activity of the Australian Radio Research Board as shown by the seventh Annual Report for the year ended June 30, 1935, recently issued by the Commonwealth Council for Scientific and Industrial Research[1]. Some of the papers published during the year under review have already been noticed (NATURE, 136, 650; 1935) and further papers have just been issued in Report No. 9.

Investigations connected with the fading of radio signals and the transmission of waves through the ionosphere have been continued with the aid of fresh modes of attack and advances in technique. A new method of carrying out frequency-change emissions for the recording of interference fringes at the receiving station has been developed, involving the production and separation of modulation sidebands at the transmitter. It is pointed out that one of the methods of controlling the wireless signal variations, commonly known as fading, is to emit signals simultaneously on a number of adjacent carrier frequencies; and some preliminary experiments have been carried out to ascertain the possibilities of this technique as applied to radiotelephony circuits. In the field of atmospherics, observations of direction, wave form and intensity are being continued as a long-term investigation. Most of the evidence supports the now generally accepted view that every atmospheric originates in a storm centre and probably in an actual lightning flash. From the study of intensities of atmospherics from lightning at known distances, it has been estimated that the equivalent power of a lightning flash is about 2 kw. for a receiver tuned to 1,000 kc./sec. and with a band-width of 20 kc./sec.; the total peak radiated power is probably of the order of 100,000 kw. The application of the knowledge obtained in this work to interference with broadcast reception, to meteorology and particularly in reference to aircraft navigation at night, receives continuous consideration in Australia.

The Annual Report acknowledges the co-operation which the Radio Research Board has received from such institutions as the Postmaster General's Department, the Universities of Melbourne and Sydney, the Department of Defence, and the Commonwealth Solar Observatory and Meteorological Bureau. The Board also welcomes the indication of the way its staff is regarded by industry, given by the fact that two of its members have recently resigned to take up industrial appointments.

The other publication recently issued, No. 9 in the series of Reports of the Australian Radio Research Board[2], contains seven papers. The first two papers deal with the study of the magneto-ionic theory of wave-propagation. A graphical method to facilitate this study, worked out by Prof. V. A. Bailey, has been applied by Dr. D. F. Martyn to the calculation of dispersion, absorption and polarisation curves for five typical wave-lengths between 100 m. and 20,000 m.

In the third paper, Mr. J. H. Piddington describes an investigation of the causes of frequency variation of a dynatron valve oscillator, and indicates the manner in which such variations may be reduced. Two of the papers by Dr. G. Builder deal with certain aspects of circuit technique as applied to radio reception, while a third describes a useful and robust thermionic voltmeter having four ranges between 0–5 and 0–500 volts. The last paper in the Report is by Mr. Piddington, and this describes the principles and design of a novel form of harmonic analyser which operates by suppressing the fundamental frequency and measuring the harmonics with a cathode ray tube outfit or a thermionic voltmeter.

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[1] Reprinted from the *Journal* of the Council for Scientific and Industrial Research, Vol. 8, No. 4, November, 1935. (Melbourne Government Printer.)

[2] Commonwealth of Australia: Council for Scientific and Industria Research. Bulletin No. 95: Radio Research Board, Report No. 9 Pp. 71. (Melbourne: Government Printer, 1936.)

Educational Topics and Events

BIRMINGHAM.—Mr. C. G. Parsons has been awarded a Walter Myers travelling studentship to be used in research in the United States on anæmia.

The following appointments have been announced: Dr. M. Stacey to be lecturer and Mr. F. Smith assistant lecturer in chemistry; Dr. A. Lamont to be assistant lecturer in geology; Mr. J. W. Drinkwater to be lecturer in mechanical engineering.

CAMBRIDGE.—Mr. A. L. Hodgkin, of Trinity College, has been elected to the Michael Foster studentship in physiology, which is offered annually for the encouragement of research. The value of the studentship is £105.

At King's College, O. L. Zangwill and J. W. S. Pringle have been elected to Martin Thackeray studentships.

LEEDS.—The Lord Mayor of Leeds has given a capital sum to provide an annual prize in clinical dental surgery, to be known as the Percy Leigh Prize.

The following appointments have recently been made: J. C. Gregory, to be honorary lecturer in the history of science; Dr. Frank C. Happold, at present lecturer in pathology and bacteriology, to be lecturer in biochemistry; H. R. Noltie, to be lecturer in physiology; W. Hobson, to be part-time lecturer in physiology and hygiene; G. D. A. MacDougall, to be assistant lecturer in economics.

WALES.—At the University Congregation held on July 22 at Bangor the honorary degree of D.Sc. was conferred on Prof. A. A. Read, emeritus professor of metallurgy in University College, Cardiff.

ADULT education in the United States has in the past been academic in scope and method, depending in the main for its inspiration and agencies on the universities through their 'university extension' departments. With the inauguration in a number of States of large-scale projects on the lines of the Des Moines "Public Affairs Forums", it has entered upon a new phase in which it finds inspiration and objectives that are frankly political. In his bulletin "Education for Democracy: Public Affairs Forums" (Superintendent of Documents, Washington, price 10 cents), the United States Commissioner of Education attempts a partial answer to the question "How can we make democracy work?" The success of American democracy depends very largely, he holds, upon how much understanding of our common problems can be diffused among the people, and he suggests that such understanding can be most rapidly and effectively promoted through the instrumentality of public forums to be established throughout the country and conducted on the lines of those which have been for the past four years in successful operation in Des Moines. In this city of 140,000 inhabitants some twenty-five 'small-neighbourhood' forums, five large-district forums and one city-wide forum were attended in 1934 by 70,000 adults. Distinctive features of the system are: it is administered as a fundamental part of the public school system under the control of the local education authority; the forum meetings are conducted by expert leaders; corresponding with the varying size and composition of the membership various techniques are used.

Science News a Century Ago

Suspended Animation

THE *Indian Journal of Medical and Physical Science* of August 1, 1836, gives the following account of a man who submitted to be buried alive for a month and was dug out alive at the end of that period: "He is a youngish man, about 30 years of age . . . he generally travels about the country, and allows himself to be buried for weeks or months by any person who will pay him handsomely for the same. The man is said by long practice to have acquired the art of holding his breath by shutting the mouth and stopping the interior opening of the nostrils with his tongue; he also abstains from solid food for some days previous to his internment, so that he may not be inconvenienced by the contents of his stomach, while put up in his narrow grave; and, moreover, he is sewn up in a bag of cloth, and the cell is lined with masonry, and floored with cloth so that the white ants and other insects may not easily be able to molest him. The place in which he was buried at Jaisulmer is a small building about 12 ft. by 6 ft., built of stone, and in the floor was a hole about 3 ft. long, 2½ ft. wide, and the same depth, in which he was placed in a sitting posture, sewed up in his shroud, with his feet turned inwards towards the stomach, and his hands also pointed inwards towards the chest. Two heavy slabs of stone, 5 or 6 ft. long, several in. thick and broad enough to cover the mouth of the grave, so that he could not escape, were then placed over him. The door of the house was also built up, and people placed outside that no trick might be played. At the expiration of a full month the walling up of the door was broken and the buried man dug out of his grave. . . . He was taken out in a perfectly senseless state, his eyes closed, his hands cramped and powerless, his stomach shrunk very much, and his teeth jammed so fast together that they were forced to open his mouth with an iron instrument to force a little water down his throat. He gradually recovered his senses and the use of his limbs".

Disease in Elm Trees

AT a meeting of the Entomological Society held on August 4, 1836, a letter was read from Mr. Spence giving an account of the destruction of elm trees in the promenades of Dunkirk, Boulogne and Calais, by *Scolytus destructor*. The decay of the trees had there, as in many other cases, been attributed to wind, soil and various other causes; but the writer was convinced it was owing to the one he had assigned, regarding which he had gained much information. Mr. Westwood added some observations on the extensive injury sustained by the elm trees in Kensington Gardens, London, the majority of those on the south side being dead. He considered that the Society, having accumulated a large mass of information on the subject, should hold an official communication with the commissioner of Woods and Forests for the purpose of suggesting some means by which the ravages might be restrained, as they had already extended to the trees in Lord Holland's park and along the Western Road past Hammersmith. Some attempts at remedying the evil had recently been made with the young elms, by plastering them over with cow dung, which was, however, quite ineffectual, as the beetles might be seen in thousands running over the covered surface. The neglect of the authorities was a matter of regret, as there could be no doubt that entomological science would cure the evil.

Giraffes at the Zoological Gardens, London

A correspondent writing to *The Times* said that the Zoological Society, "which is now extended to about 3000 members held their monthly meeting for the first time on Thursday last [Aug. 4, 1836] in the room which has been fitted up for that purpose, as also for the scientific meetings which are held every fortnight, at the new museum in Leicester-square, the collection of preserved specimens having been removed from Bruton-street". In the report of the council read at the meeting it was stated that M. Thibaut, who had secured the giraffes for the Society, had now left England. The total cost and expenses connected with the four giraffes had been about £2,340. A building for their accommodation would be ready by October, and it was proposed to heat this by air which had passed through pipes surrounded by hot water, a plan suggested by Mr. Sylvester.

Terrestrial Magnetism in Chile

In its columns of Miscellanea, the *Athenæum* of August 6, 1836, said: "M. Gay, residing in Chile, has communicated to the French Academy of Sciences that at the time of the great earthquake in that country in February 1835, he observed great variations in the diurnal movements of the needle; but in the lesser shocks the variations were feeble. His observations amount to more than two thousand, all of which have proved to him, that magnetic phenomena are much more complete in that part of the world than in Europe; for instead of two daily movements he obtained three: one in the morning in the East, another in the middle of the day in the West, and a third in the evening to the East again. This triple movement he considers as permanent, and suggests the great chain of the Cordilleras as one of the influential causes."

Education of French Pharmacists

In the *Records of General Science* of August 1836 is a note on the French School of Pharmacy. The object of this School, it said, is to teach all the sciences connected with pharmacy, and to receive such apothecaries as in four trials prove they possess the requisite knowledge for exercising this profession. Every candidate must produce certificates of his having studied for eight years—of his having attained his twenty-fifth year, and must place in the hands of the treasurer the sum of 1,300 francs. The School consists of a director, a joint-director, ten professors, of which four are joint-professors, and a treasurer. The necessary examinations are two upon theory, one of which is upon the principles of the art, the other upon the botany and natural history of simple drugs, and a third and fourth on the practice of the art which last for four days and consist of at least ten chemical or pharmaceutical operations, which the candidate must perform himself, describing the process, materials and results. The existence of this establishment thus enables every apothecary in France to be a chemist; while in England, whoever heard of an apothecary being a chemist or of doing anything for the improvement of pharmacy?

Societies and Academies

Paris

Academy of Sciences, June 22 (*C.R.*, 202, 2021–2108).

Ernest Esclangon: Observations of the eclipse of the sun of June 19, 1936. Observations of Nova Cephei and Peltier's comet. The partial eclipse in France was observed under excellent conditions at Paris, Meudon, Besançon and Bourges.

Vito Volterra: The canonical equations of biological fluctuations.

W. Doeblin and Paul Lévy: The sums of contingent independent variables with lower restricted dispersions.

B. Hostinsky: Movements depending on chance.

Octav Onicescu and G. Mihoc: Statistical chains.

Charles Ehresmann: The notion of complete space in differential geometry.

David Wolkowitsch: A family of surfaces of the fourth order.

Victor Lalan: Two groups of transformations defined by geodesy.

Armand Rauch: Integral algebroids.

Henri Poncin: The search for the conditions of stability of a limiting surface of cavitation.

Léopold Escande and Georges Sabathe: Experiments on the piers of bridges or of mobile dams with aerodynamic profile.

Charles Bertaud: The star stream of Scorpio-Centaurus.

Roger Mérigoux: The movement of contaminated liquid surfaces.

Pierre Jolivet: A cause of the small power of electrostatic machines and a means of remedying this. The yield is increased by enclosing the electrostatic machine in a vessel containing air under pressure.

Alexandre Marcel Monnier and Joseph Bazin: A continuous voltage amplifier.

Pierre Girard and Paul Abadie: Molecular interactions and chemical affinity.

Ladislas Goldstein: Collisions of the second kind and electronic affinity.

Robert Forrer: Electrons, carriers in supraconduction.

Léon Capdecomme: The substitution of surfaces in comparisons of reflective powers by means of the microscope. Discussions of the magnitude of the errors and precautions to be taken for reducing them.

Lewi Herman and Mme. Renée Herman-Montagne: The absorption coefficients of the bands 4774, 5770 and 6290 A. of oxygen. As found by Janssen, the absorption varies proportionally to the square of the pressure. A table is given for calculating the optical densities of atmospheric oxygen for different zenithal distances, neglecting the influence of temperature.

Maurice Roulleau: The spectral transmission of developed photographic emulsions.

Mlle. Yvette Cauchois: Observation and measurement of the $L\alpha$ satellites for the elements 72, 73, 75, 83, 90 and 92. The presence of satellites has been definitely proved and this suggests the necessity of modifying or completing certain recent theoretical conceptions.

Aurelio Marques da Silva: The materialization of the energy of the β-rays of radium C.

Albert Portevin and Paul Bastien: The mechanical study of the malleability of various types of light and ultra-light alloys. A study of the best conditions for hot working of aluminium and its alloys with copper and magnesium.

Ernest Toporescu: The transformation of urea into ammonium carbonate. Some ammonia is produced by dialysing a solution of urea containing sodium chloride.

René Paris and P. Mondain Monval: The crystallization of zinc borate. A contribution to the study of the conditions of the devitrification of glass.

Mlle. Suzanne Veil: The Liesegang periodicity and the concentration of the reagent drop.

Raymond Zouckermann and René Freymann: The high-frequency absorption of various alcohols. For a given wave-length, going up a homologous series, the conductivity rapidly increases, tending to become constant starting with the term C_5. This fact does not follow from Debye's theory, nor from the experiments of Malsch.

Guy Gire and Fernand Rivenq: The hydrolysis of solutions of pentavalent vanadium.

Etienne Canals, Max Mousseron, Louis Souche and Pierre Peyrot: The Raman spectra of some substituted epoxycyclohexanes.

André Dupire: Contribution to the study of the borates of the polyalcohols. Pure boric esters can be obtained by azeotropic distillation with toluene.

Marcel Patry: Esters of polymetatelluric acid.

Pierre Legoux: The relations between the granitogneiss and the schists and quartzites in western Africa.

Marcel Gautier: The tectonic of the Nemours region.

Marcel Mascré: The action of acrolein on the structure of the plant cell.

Robert Quetel: The variations in the proportion of nitrogen in the lily-of-the-valley during forcing.

Emile Miège: Experimental cultures of the potato in Morocco in 1935 in the mountains and on the plain. Whatever the origin and mode of preservation of the tubers sown, the yields are always greater in the mountains.

Roger Heim: The relationship between *Lactarius* and certain Gasteromycetes.

Pierre Drach: The cycle traversed between two moults and the principal stages in *Cancer pagurus*.

Gabriel Guignon: The study of the blood circulation of the wings in Coleoptera and Orthoptera by means of nicotine.

Raoul Michel May and Mlle. Alice Frank: The replacement of an anterior foot by a grafted bulb, in the embryo of *Discoglossus*, and its relations with the law of bilateral symmetry of the neurones.

Amsterdam

Royal Academy (*Proc.*, 39, No. 5, 1936).

L. S. Ornstein, C. Janssen, D. T. J. ter Horst, C. Krijgsman and G. H. Frederik: Investigation of transformer oil. Physical studies of ageing.

W. H. Keesom and P. H. van Laer: Measurements of the latent heat of tin in passing from the supraconductive to the non-supraconductive state.

W. H. Keesom and A. Bijl: Comparison of platinum resistance thermometers with the helium thermometer from −190° C. to −258° C.

R. Weitzenböck: The theory of semi-invariants.

J. G. van der Corput: (1) Distribution functions (8). (2) On some Vinogradoff methods (3).

E. Cohen and A. K. W. A. van Lieshout: An electrical pressure dilatometer. Apparatus for the study of polymorphic transformations at pressures up to 200 atm.

A. H. Blaauw, Ida Luyten and Annie M. Hartsema: Accelerated flowering of Dutch irises (1).

J. J. van Laar: Variation of some thermal and calorimetric quantities along the two melting curves of helium.

A. G. Boer, E. H. Reerink, A. van Wijk and J. van Niekerk: A naturally occurring chicken provitamin D. The isolation and chemical nature of a provitamin D from cholesterol.

K. Mahler: An analogue to a theorem of Schneider.

H. Freudenthal: Partially ordered moduli.

J. Beintema: Crystal structure of barium antimonate. X-ray and crystallographic examination of $Ba\{Sb(OH)_6\}_2.2H_2O$.

D. Tappenbeck: Tertiary Foraminiferan rocks of Sipoera (Mentawei Islands).

W. van Tongeren: Mineralogical and chemical composition of the syenite-granite from Boekit Batoe near Palembang, Sumatra, Dutch East Indies.

H. A. Barker: Fermentation of some dibasic C_4 acids by *Aerobacter aerogenes*. The process involves an initial oxidation-reduction between two molecules of the substrate and a subsequent decomposition of the oxidized molecule.

B. van der Eyken: Dentition and teeth development in the irisforelle (*Salmo irideus*) (5). Palate and pharynx.

D. Wiersma: Imagination and attention during childhood.

A. Geesink, H. de Jong and F. J. Nieuwenhuyzen: Experimental catatonia produced by auto-intoxication. (2) Experimental catatonia after ligation of the arteria hepatica propria.

H. A. Meyling: The glomus caroticum and the sinus caroticus of the horse.

Cape Town

Royal Society, May 20.

Mrs. M. R. Levyns: Notes on the genus *Stoebe*. *Stoebe* falls into two well-marked sections based on distinct types of floral structure. One type is widespread in Africa and extends to Madagascar and Reunion. Distribution of species of this type is predominantly discontinuous. The other type (comprising most of the species) is almost confined to the south-west Cape and the species have, with few exceptions, a restricted and continuous distributional range. The distribution supports the view that the south-western flora at one time occupied a much larger area than it does to-day.

J. L. B. Smith: Fishes new to South Africa.

Vienna

Academy of Sciences, May 7.

Leopold Schmid, Siegmund Margulies and Sidonie Lenzer: Chemical investigation of amber.

Leopold Schmid and Hugo Körperth: (1) The colouring matter of the poppy (*Papaver rhoeas*, L.). (2) Examination of extracts of petals. The chemical nature of the colouring matter of ten flowers is given.

Georg Koller and Hermann Hamburg : Rhodocladonic acid.

Philipp Gross and Hans Suess : Thermal decomposition of dioxane.

H. Dostal and R. Raff : The mechanism of thermal polycondensation reactions.

B. Ormont and B. A. Petrow : Thermal decomposition of simple and complex cyanides with formation of alkali metals, with special reference to potassium.

W. J. Müller, H. Freissler and E. Plettinger : Anodic behaviour of gold-copper alloys in 5*N* hydrochloric acid and *N* sulphuric acid. The relative quantities of gold and copper dissolved out of alloys of various compositions are measured when these are made the anode in acid solutions.

W. J. Müller and E. Low : (1) The influence of the purity of aluminium upon corrosion in hydrochloric acid of varying concentration. (2) Theory of corrosion phenomena. Part 4. Application of the theory of local elements to the problem of corrosion.

Alfred Lichtenfeld and Karl Schwarz : The theory of Kikuchi lines studied by means of models. Light is transmitted through a 3-dimensional grating having a spacing of about 1000 λ and bright lines are formed on a screen behind the grating.

F. Seidl : (1) Electrical conductivity of solidified melts of Rochelle salt. Conduction in Rochelle salt is found to be ionic in nature. (2) Electrical behaviour of single crystals of Rochelle salt crystallized from saturated solutions in an electric field.

Herbert Haberlandt : Radioactive haloes in fluorite from Striegau.

Max Toperczer : Contribution of the data of the magnetic survey of Austria in 1930.0 to the study of the earth's magnetic field. (2) Improvement of some values of the vertical intensity.

Wilhelm Schmidt : Vertical motion in clouds studied by cinematograph pictures. Vertical motion of any part of a cloud is detected by placing two successive photographs of the cloud in a stereocomparator.

Norbert Lichtenecker : Glacier research in the Sonnblick in 1930–34.

F. Steinhauser : Probability of precipitation in the eastern Alps.

H. Tollner : Glacier winds on the Pasterze glacier.

Erhard Braumuller : The north boundary of the Tauern between the Fusch and Rauris valleys.

Siegmund Prey : The possibility of the emergence of the Dent Blanche nappe in the Sonnblick.

Gabriele Rogenhofer : Action of growth-promoting substances on bark formation in woody shoots.

Helmuth Zapfe : The possibility of aragonite surviving the fossilization process investigated by means of the Feigl-Leitmeier reagent.

Emil Abel and A. Bildermann : Kinetics of the oxidation of formic acid by iodic acid.

Walter Kosmath, Volkmar Hartmair and Otto Gerke : Contribution of plant physiology towards the assessment of the biological or balneological importance of the radioactivity of the treatment at Bad-Gastein.

May 14.

Franz Rinagl : The importance of the upper elastic limit. By making use of the bending of bars of various cross-sections, trustworthy values of the upper elastic limit are obtainable.

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Purposes of University Education

IN the plea for devising an education which would secure for us representatives capable of co-operating intelligently with technical experts in constructive social enterprise and would also teach us how to choose them, which formed one theme of his Conway Memorial Lecture (see NATURE of July 25, p. 139), Prof. L. Hogben uttered a warning against the teaching of science for vocational purposes which deserves close attention. He raises essentially the same question regarding all education that was raised of university education by the recent report of the University Grants Committee (see NATURE of June 27, p. 1057), and the wider question should in fact be faced before we really formulate our answer to the question, what is the purpose of university education.

The valuable study of education for citizenship in secondary schools, issued early this year under the auspices of the Association for Education in Citizenship (London: Oxford University Press. 5*s*. to non-members; 3*s*. 6*d*. to members), directed attention to the inadequacy of indirect education for citizenship to-day. Experience has shown that a man with a good general education based on languages or science may be an excellent father, an excellent business or professional man and at the same time a bad citizen. The political world has become so complex and difficult that it is essential to train men just as consciously and deliberately for their duties as citizens as for their vocation or profession.

The monograph to which we have just referred proceeds to discuss how the direct teaching of citizenship may be achieved, particularly by linking it to the subjects at present taught in secondary schools. Prof. Doris L. Mackinnon, for example, suggests that it is a prime duty of the teacher of science to let the pupil understand from the beginning what are the responsibilities in common life which the scientific discipline lays on all those who have once submitted to it. Moreover, the suggestions in regard to the teaching of clear and of accurate thinking made by Prof. G. C. Field and Dr. R. H. Thouless are scarcely needed more in any section of the community than in regard to the training of the scientific worker.

The present unsatisfactory position arises in fact from the growing tendency towards vocational education, and perhaps more particularly the teaching of science for vocational purposes. Already this has invaded the public and other secondary schools and spread far beyond the universities and technical colleges. In a highly organized society political administration must be the vocation of certain people. It is also true that intelligent citizenship is no longer possible without some understanding of the place of science in the everyday life of the whole nation; and the teaching of science needs to be adapted to such requirements rather than to those of assisting the few to gain a livelihood in a particular way.

If, therefore, we could re-orientate the teaching of science in both post-primary and secondary schools so that it would be taught as part of the equipment of everyone for living in a scientific age, and not as the first stage in preparation for a career in science, we should have taken one step to facilitate co-operation between the technical expert and the political administrator. If, further, by means of training for citizenship on the lines advocated by the Association for Education in Citizenship, we could ensure that those entering a university had received at any rate some equipment in this respect before embarking on their specialized studies, we should be in a much sounder position to discuss the question of the quality and quantity of university education.

As the report of the University Grants Committee points out, the engineer, chemist, medical man or schoolmaster trained at a university is rightly expected to have received a sound technical training in the particular calling or subject he has studied. Whether he has also received that stimulation and enrichment of the whole mind which enable him to lead a fuller and more interesting human life, and to play more adequately his part as member or leader of the community, must depend at least partly on the way in which he has been prepared for the training he receives at the university.

If the tendency to specialize at a too early age, and particularly in the later years of school life, has had insidious consequences and needs to be resisted strenuously, at least it should teach us that there can be no hard and fast separation between secondary education and university education. One must be planned in relation to the other, and we cannot throw on the university stage the whole responsibility of training a man not only as a skilled worker but also as a member of society and a human being.

The special responsibilities of the universities in this field must of course be recognized. Industrial and commercial appointments are being thrown open to university graduates over an increasingly wide field. The growing extent to which leadership in commerce and industry, like that in national and local administration, is passing under the influence of professional men, means that the great majority of those who become leaders in the national life will continue to be drawn from those who have received a university training. No university can fail to recognize the opportunities of service in ensuring conditions of training which enable its students to go into the world with minds richly informed, unsleeping in the exercise of a critical intelligence and imaginatively alive to the human issues underlying the decisions they may be called upon to take.

The importance of giving due attention to these fundamental issues at the present time can scarcely be over-emphasized. Mechanization of thought is a peril in Great Britain as in other countries, and the suppression in the universities of several European and other countries of all independent thought and critical discussion of the principles of government, or of the meaning of life, throws a special responsibility upon British universities if the Greek tradition of candid and intrepid thinking about the fundamental issues of life is to be preserved for mankind.

Training for citizenship is a part of this wider question of training for life, but the two can scarcely be separated in any discussion of education to-day. Both the school and the university, each within its own limits, must endeavour to give its students a training for life, and this is even more important than training for a particular vocation or career. It is at last becoming more widely recognized that it is scarcely possible for a university to equip its students with the technical knowledge which might be expected to be of immediate use to them in any branch of industry they may enter on leaving the university. The detail of technical work can in fact be mastered only by practical experience after the student has left the university. The function of the universities in training scientific workers and technical men for industry is rather to give them such a knowledge of the principles of science and technology that they are able to bring trained minds to bear upon the understanding of practical problems which they encounter in their industrial or professional life.

The stimulation of thought, the widening of its horizons, the development of the faculty of judgment, and the evoking in its students of the energy of the soul in which Aristotle found the essence of true well-being, are the essential contributions to education which characterize the university rather than the schools. The dissatisfaction with many graduates of universities to-day is largely due to the fact that their primarily specialized training has robbed them of the essence of a university education and left them unequal to the demands which the major problems of life and industry make upon them when questions of value and judgment are involved. Moreover, specialization in itself is not so much criticized as premature specialization and the inadequate foundation upon which it is built, with the result that many of those completing long courses of study at a university in medicine or science, for example, are in danger of being uneducated persons.

Prof. Hogben showed convincingly in his lecture how ability to sort out the real issues, and to think clearly on the values as well as on the scientific and technical factors involved, are demanded to-day in our political leaders and in some degree in those who elect them. The professional aspects of after-life are to-day scarcely the major preoccupation of the universities, at least so far as they are not linked up with the wider question of training in thought which they give to their students and of the linking of thought to action.

It is no part of the duty of a university to inculcate any particular philosophy of life. Never, however, was it more important than it is to-day that it should stimulate and train its graduates to think strenuously about the great issues of right and wrong, of liberty and government on which for the individual and for the community a balanced judgment is essential to a rational life. Without overlooking the place of research in the functions of a university or the desirability of upholding the value of learning for the sake of learning, the linking of knowledge to action is of such supreme importance at the present time that even the research activity of the universities needs to be re-orientated so as to secure that the advance of knowledge proceeds on a more even front. Only when our research effort is directed in some relation to the fundamental needs of society can we hope to redress some of the evils which the rapid advance in the physical sciences as compared with the biological or social has brought in its train.

An undoubted consequence of the redistribution of our comparative research effort between the physical and the biological and social sciences in the way urged by Dr. Julian Huxley or Prof. W. McDougall, for example, would be not merely the fertilization of thought in the social sciences and the breakdown of barriers between them but also the stimulation of thought generally in these fields. As in the physical sciences, we might witness significant advances through the overlapping of traditional disciplines in several branches of knowledge.

Given this redirection of research effort and the stimulation of thought in social and biological problems, the training of men and women who will bring unprejudiced minds, critical powers and moral courage to bear upon the new and difficult problems which they must meet in this era of physical science should become much simpler. To some extent, the absorption of the graduate into industrial or other employment may become a simpler problem because he will be better fitted to take any place as an intelligent member of the community, though the warning of the University Grants Committee in regard to the limitation of the members of those entering a university needs to be kept in mind. Nor can we overlook the importance of that early training for citizenship which those entering a university should share with those whose school education finishes at the post-primary or secondary school education stage. There at least must be laid a foundation from which a university can fittingly start to impart, not a mere training for livelihood, but a training for life and for leadership, so that its graduates are distinguished by a sense of values, a wide vision and a capacity for the creative thought and judgment which require only the ripening of experience to enable them to bring a trained mind to bear on any of the problems with which they may afterwards be confronted in their professional, industrial or civic life.

Morphology of Muscles

The Cranial Muscles of Vertebrates
By Prof. F. H. Edgeworth. Pp. ix+493. (Cambridge: At the University Press, 1935.) £5 5*s.* 0*d.* net.

IN this large, copiously illustrated and splendidly produced volume, Prof. Edgeworth has brought together the knowledge which has been gained in the last hundred and fifty years of the comparative anatomy and embryology of the cranial muscles (and their motor nerves) in vertebrates The author is well equipped for this task. Though not a professional zoologist—he was for many years, until recently, professor of medicine in the University of Bristol—he has long been a worker on this subject "so far as medical practice and teaching permitted", and has become widely known from his many published observations which have added to our knowledge of the subject.

This memoir is a notable and important contribution to vertebrate morphology, and contains the most complete account which has been published of the homologies of the cranial muscles. Its scope may be indicated by mention of the principal subjects discussed in its chapters. They begin with a discussion of the embryonic head mesoderm and its segmentation, of the relation of the muscle plates of the head to the myotomes of the body, and of the number of the branchial segments. The author finds that in the cephalic mesoderm, premandibular, mandibular and hyoid segments are followed by a "branchial region" in which the number of segments varies in different phyla, and, as he has found, among the genera of any one phylum. He puts forward the view that this variability occurs not by the intercalation or dropping out of segments but by "the separation of the branchial region as a whole into a greater or a lesser number of segments than is usual in their respective phyla".

The chapters which follow show the extensive range of the author's observations on the development and anatomy of the cranial muscles in the vertebrates from the Dipnoi to mammals. The subjects dealt with include the external ocular muscles, the palato-quadrate bar in Ichthyopsida and Amphibia, the mandibular muscles and the palato-quadrate bar in Sauropsida, and the palato-quadrate and mandibular muscles in mammals.

Separate chapters deal with the hypobranchial skeleton and the hyoid muscles, the superficial facial and cervical muscles of mammals, and the branchial muscles. Considerable space is devoted to the description of the Cucullaris muscle, and the author presents a condensed but valuable account of this muscle throughout the vertebrates. The first stage in its phylogenetic history is represented in the Dipnoi, in which a muscle, the "constrictor branchialis V", extends back as a broad sheet, "whose ventral edge is attached to the pectoral girdle and coraco-branchialis V. Probably generally in Holocephali and Selachians it is developed from the dorsal ends of all five branchial muscle plates. These extend forwards and backwards and fuse together to form a longitudinal muscle, the anterior end of which becomes attached to the cranium and its posterior end to the shoulder girdle. It is innervated by a branch of the 'R. intestinalis X', the fibres of which can be traced from the caudal, exclusively motor, fibres of the vagus or vago-accessorius.

"A cucullaris is present in most of the Amphibia and in the Reptilia. In birds there is no cucullaris—its function is taken over by the cranio-cervicalis, which also extends from the head to the shoulder girdle, but is innervated by a different nerve, the N, hypoglosso-accessorius. In mammals a cucullaris is present, developed from the most caudal branchial plate, and extends back to the limb as a single band."

The number and complexity of the cranial muscles is illustrated by the fact that thirty-eight pages are required merely for a list of the synonyms used by different writers for individual muscles, a list which the author states is "far from complete". This section is notable, not only from the wide range of vertebrate forms, but also from the number of embryos at different stages of development which he has examined. Its value is enhanced by the number of illustrations given in corroboration of the facts stated in the text.

The author discusses at length some of the difficulties which arise in determining muscle homologies. The segment of origin of homologous muscles is in general constant from genus to genus and from phylum to phylum, but exceptions occur. Anatomists have long been accustomed to consider that the nerve supply to a muscle affords sound and reliable evidence of its homology, and this is generally the case, but again exceptions occur; the muscle plate of the mandibular segment is as a rule innervated by the fifth nerve, but in certain instances the seventh nerve may be the source of nerve supply, and this arises, according to the author, from the shortness of the first gill cleft.

The author has dealt more fully than is usual with the relation of nerve to muscle and not only with the peripheral pathway through which muscles are innervated, but also with the significance and the homologies of the groups of motor cells, spinal and medullary, from which the nerves are derived. Experimental evidence is made use of whenever possible to determine afferent from efferent fibres in different nerves, and a chapter is devoted to analysis of the groups of efferent cells in the "occipito-spinal motor cell column".

The aim of the author has been to ascertain what evidence the study of these muscles gives on the problem of the genetic relation of the vertebrate phyla "and so of the phylogenetic history of Man in the remote past". It may perhaps be doubted whether the material which he uses is capable of affording such information. The successive changes undergone by the developing embryo and its parts give only a general indication of phylogenetic history. The skeleton, the central nervous system and many of the viscera have been studied from this point of view, but have yielded no information of great significance on this problem. Where these systems have failed, it is scarcely to be expected that the study of muscles would be more fruitful, but the author's studies have led him to certain conclusions as to what were the characters of the ancestral forms from which the existing vertebrate phyla have originated, and these are given in detail in the final chapter.

No one who works, as the author has done, on broad problems of morphology can fail to have his interest excited in the significance of the whole embryological process and the variations in its details which occur in different forms. The author's attitude towards this problem is best expressed by some sentences which may be quoted :

> "The development of the cranial muscles gives much evidence of its purposeful character."
>
> "In some unknown way the growing organism appears to foresee future needs, and sets to work with such material as it has to develop the necessary structures along the lines followed by its ancestors".
>
> "Experimental embryology shows that the growing organism from the zygote upwards is a whole and not merely an aggregate of parts. Similarly, animals are psychological units, characterised by memory and purpose, by striving after ends in view. The variations in the development of homologous structures and in the structures by which the same functions are carried out show that this psychological factor is of great importance from the first."
>
> "This immaterial, non-spatial, teleological factor, the mind, can initiate and inhibit physico-chemical processes. Life, development of individual organisms and evolution are primarily due to this power."

In view of the size and form of this volume and the wealth of illustrations—there are 841 figures, clearly drawn and reproduced on special paper, pp. 301–493—the price cannot be considered unduly high, though it may restrict its circulation. It is indispensable to workers in vertebrate morphology, and the author deserves the highest commendation for the care, the skill and the wide range of his inquiries, and is to be congratulated on the completion of a work which is a credit to British zoology.

DAVID WATERSTON.

A Study of the Ephemeroptera

The Biology of Mayflies:

with a Systematic Account of North American Species. By Prof. James G. Needham, Dr. Jay R. Traver, Prof. Yin-Chi Hsu, assisted by Specialists in certain Subjects. Pp. xvi+759. (Ithaca, N.Y.: Comstock Publishing Co., Inc., 1935.) 7.50 dollars.

PROF. JAMES G. NEEDHAM, of Cornell University, the senior author of this book, has made a very valuable contribution to the knowledge of a little-known order, the Ephemeroptera. This biology has one outstanding feature of merit, it is original work. Prof. Needham has gathered around him a band of enthusiastic workers who have come forward and in their own words and under their own names, have told us of the results of their researches. Two of these workers appear with Prof. Needham as joint authors. The second author, Dr. J. R. Traver, has been responsible for nearly the whole of Part 2, the systematic description of the North American species, about five hundred pages, as well as a portion of Part I dealing with life-history and collecting. The third author, Prof. Yin-Chi Hsu, is responsible mainly for the chapters dealing with structure and anatomy. There are further chapters on anatomy under the pen of Dr. V. Knox.

This book is perhaps the most comprehensive that has ever been undertaken on the biology of the order. Pictet, in 1843, dealt with both anatomy and systematics in his "Histoire des Névroptères" ; Eaton's classic monograph on "Recent Ephemeridæ" was mainly systematic ; there have been sundry papers written by various authors since 1888, the date of Eaton's great work, scattered through entomological literature.

Prof. Needham's book will appeal, of course, mainly to the specialist, having regard to the fact that so large a proportion of its space is devoted to American systematic work ; but the biology proper, consisting as it does of no less than 236 pages, has an interest not only for entomological workers but is also of economic value to all who are concerned with the study of the food of fishes, in Great Britain, more particularly the trout.

Chapter i deals with the life and habits of the Ephemeroptera or, as they are perhaps unfortunately called in America, the mayflies. It is unfortunate because the title is misleading. Not only do these insects appear on the wing during every month of the year—at least they do so in Great Britain—but also the name mayfly in the fly-fisher's world is restricted in its application to species of *Ephemera*, and the fly-fisher's popular nomenclature may be traced back for nearly five hundred years.

While, generally speaking, the life of an ephemeropteron is not quite so ephemeral as the name would suggest, Prof. Needham tells us of a species, *Callibœtis fluctuans*, the entire life of which in the winged condition is restricted to some forty-eight hours, during which it emerges from the water, changes from the subimago to the imago stage, pairs, oviposits and finally dies. The mayfly proper, the British species, *Ephemera vulgata*, on the other hand, has been observed by the writer, at least two months after emergence, having been so long on the wing as to have darkened to nearly black.

America is a country of extremes, and this trite saying applies even to the Ephemeroptera, for we read here that instances have been recorded of these little insects swarming in such incredible numbers that camp fires have been extinguished beneath their corpses.

Several pages are devoted to the nymphal stages and then we come to Prof. Hsu's chapters on structure; not only are the external parts explained but the internal anatomy as well, with a final word which carries us through the insect's development moult by moult.

Dr. O. R. Smith contributes a chapter on the eggs and methods of oviposition. We learn that the females habitually fly against the breeze in order to maintain their position over a selected portion of the water: that some get rid of their eggs a few at a time, dipping over the surface; others drop them in a mass; and that others again crawl down under water and lay their eggs on stones and rocks.

Passing to Chapter xvi, we find some useful information on the economic value of the Ephemeroptera; then there is a chapter on collecting, preserving and rearing them in captivity, and finally we come to Part 2, which deals with systematics. It suffices to state with regard to this branch of the subject, that the known North American species number 507 grouped in 3 families, 17 subfamilies and 47 genera. Useful keys and tables are included, and the whole plan of this part has been extremely well constructed.

We have no hesitation in stating that this book is a very fine contribution indeed to entomological literature. MARTIN E. MOSELY.

Developments in Organic Chemistry

(1) Physical Aspects of Organic Chemistry
By Dr. W. A. Waters. Pp. xv+501. (London: George Routledge and Sons, Ltd., 1935.) 25*s*. net.

(2) The Chemistry of Natural Products related to Phenanthrene
By Prof. L. F. Fieser. Pp. xii+368. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1936.) 32*s*. 6*d*. net.

(3) Reactions of Organic Compounds
By Dr. W. J. Hickinbottom. Pp. x+449. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 16*s*. net.

(1) A TREATISE on the implications to organic chemistry of new conceptions of the atom is particularly valuable at this stage when the arbitrary ideas of the chemist have been largely justified. Electro- and co-valencies, and the semi-polar bond are now universally recognized, and the complex hypotheses of induced polarity and conjugation are receiving physical interpretation.

Just as the existence of polar and non-polar bonds has been admitted, it is now certain that both ionic and non-ionic reactions occur in organic chemistry. The latter resemble photochemical reactions, and include those like the pyrolysis of diazoamines, in which transient formation of free uncharged radicals must occur. Greater space is devoted to ionic reactions, which are induced by polar reagents, and generally involve carbonium anions and cations. Thus the properties of free radicals, which behave variously as non-polar radicals, or as cations, or as anions, receive an explanation. Molecular rearrangements result from the reconstruction of a carbonium cation, caused by an ionic reagent.

In dynamic isomerism, which involves an equilibrium between two forms, an ion wanders from one part of a molecule to another (prototropy or anionotropy) with consequent redistribution of valency bonds. The classical idea of tautomerism, that a single substance can react as if it had two structures, is revived in terms of wave-mechanical resonance, to which brief reference is made. The two structures differ only in electronic arrangement, neither representing the molecule, "but a hybrid intermediate between them, which cannot be represented by ordinary symbols, and has to some extent the properties of both" (Sidgwick). Conjugation and aromatic properties are discussed chiefly in terms of the theories of Ingold and Robinson, according to which an electromeric change may be induced in an aromatic derivative giving an activated molecule, the polarization of which determines further substitution.

The value of the book to students is enhanced by the use of the historical method of approach. In the more physical chapters, such as that on dipole moments, mathematical treatment is curtailed, but conclusions important to chemists are concisely stated.

(2) Structures containing polynuclear ring-systems based on the hydrogenated phenanthrene nucleus have been allotted to the morphine alkaloids, the sterols, sex-hormones and cardiac poisons. The dramatic manner of progress lends added interest to this monograph, which is a comprehensive interim report (the copious references include January 1936, and 70 per cent date from 1930) on a subject important alike to chemists and physiologists.

An account of the chemistry of phenanthrene itself is followed by a lucid treatment of the morphine alkaloids and resin acids, which deals with their genetic relationships, their phytosyntheses, and the problem of drug addiction. Throughout, relevant features of general or biological interest are described, so that the complex chemical side is put in its correct perspective. This is exemplified in the account of the cancer-producing hydrocarbons, which though not yet known as natural products are related to the latter, and generally contain a phenanthrene ring-system. That methylcholanthrene, the most powerful carcinogenic agent known, is a bile-acid degradation product has obvious significance, and points to metabolic derangement as a natural prelude to cancer.

Although Windaus and Wieland had seemingly settled the structure of the sterols, in 1932 Rosenheim and King, guided by the results of X-ray crystallography and by an observation of Diels, suggested an improved formulation. Since then organic chemists have not looked back, and the story of the elucidation of the structures of the sterols, bile-acids and sex-hormones forms the most fascinating part of the book. The cardiac poisons and the saponins are yielding their secrets too, and are already known to possess the same polynuclear system as the sterols, which has the most diverse distribution in Nature, and may fulfil the most manifold functions. Structures chemically similar have such different physiological properties as those of vitamin D, the sex-hormones, and the cardiac poisons!

The book may be recommended to all chemists interested in the subject; the author, who has himself made worthy contributions, deals impartially with the work of many investigators in many lands, and frequently interpolates his own valuable suggestions where finality is still lacking.

(3) This text-book presents organic chemistry in a way making for closer liaison between theory and laboratory practice, but is recommended also as a reference book, not least for the large number of well-chosen references. Compounds are treated according to functional groups in eleven chapters, each of which has a summary and descriptive tables; reactions are dealt with fully, and a number of representative preparations is included.

Within the limits imposed by the author (for example, heterocyclic compounds and condensed nuclei are only referred to incidentally) the work is reasonably complete. The section on diazonium compounds might have included Nesmejanov's work on mercurials, and that on halogen compounds recent patent literature on sodium alkyls and aryls. On the other hand, the influence of structural factors, polar or steric, on the course of well-known reactions is usefully treated.

With journals so drastically abridged that reactions are referred to only by the names of their discoverers, the author might have named them so; and the absence of an author index makes it difficult to look up less-known reactions. Textual errors are rare, and generally of a minor nature. For the amount of information it contains, the book is low priced, and should prove invaluable to the student as a manual of organic reactions, and an aid in the identification of carbon compounds.

Mysore Tribes and Castes

The Mysore Tribes and Castes
By Diwan Bahadur L. K. Ananthakrishna Iyer. (Published under the auspices of the Mysore University.) Vol. 1. Pp. lxxii + 502 + 68 plates. (Mysore: Government Oriental Library, 1935.) 15 rupees; 24*s*.

A PERIOD of more than thirty years has elapsed since the late Mr. Nanjundayya commenced a systematic survey of the tribes and castes of Mysore on the lines laid down by a former Census Commissioner for India, the late Sir Herbert Risley. In 1925, Mr. Ananthakrishna Iyer succeeded the original superintendent of the Mysore Survey. Three volumes have already appeared containing the Survey results, caste by caste, in alphabetical order; and we now welcome the appearance of vol. 1, which deals with the results as a whole.

It is not unusual for the authors of such works to invite a distinguished scholar to add a short introduction to his general volume; but Mr. Ananthakrishna has thought fit to enlist for this purpose the assistance of several well-known anthropologists, so that his book becomes more a compendium of essays than the mature conclusions of one writer. Thus, Dr. R. R. Marett commences with a short appreciation of the book, and some interesting reflections on the parts which East and West may profitably play in such inquiries. The late distinguished scholar, M. Sylvain Lévi, follows with some general remarks on the nature of caste. These are followed by a translation for use in India.

We then come to a lengthy and most important essay by Baron von Eickstedt, of Breslau. This is perhaps the most important feature of the book. Von Eickstedt, dealing in some detail with the racial invasions of India in the past, and after allotting due influence to occupation and environment, presents the reader with an entirely novel classification of the population, for which he supplies some anthropometrical data. It will be remembered that most former writers on Indian racial elements have been disposed to assume an original Kolarian population of a very early type, displaced later, largely in the south, by a Dravidian immigration, upon which followed the arrival from the north-west passes of an Aryan-speaking people. Later bands of immigrants, such as the Scythians, Yuechi, and Huns, penetrated northern and western India between 100 B.C. and A.D. 600. Von Eickstedt, rejecting the existing terminology as savouring too much of linguistic instead of racial significance, evolves a threefold base for the Mysore population, namely, the Veddids, the Melanids, and the Indids. To each of these he allots sub-groups. A table giving anthropometric data for these will be found on p. 76.

The reader must be left to study for himself the exact significance of these new divisions. It is possible to convey a rough idea of them by explaining that the Veddids have much in common with the old Kolarian, the Melanids seem to be similar to Dravidian, and there is little to distinguish the Indid from the Aryan. In the special Ethnographic Appendix to the last Census of India, some doubt is thrown on the value of von Eickstedt's classification owing to the inadequacy of the anthropometric data on which it rests. It is, however, one that will repay careful examination; and it certainly possesses the merit of simplicity when compared with the almost incomprehensible formulæ of 'co-efficients of relative likeness' on which Dr. Guha proceeds in the Census of India volume.

Not content with the assistance of the three scholars referred to above, the compiler of this volume next offers the reader a chapter on the cultural geography of Mysore by a distinguished member of the Indian Civil Service, Mr. F. J. Richards. Writing with personal knowledge of the country, Mr. Richards gives us a thoughtful study of the history and cultural features of the population of Mysore which by itself would make Mr. Ananthakrishna's book a valuable possession. Interesting charts are added, showing the extent and distribution of various elements in the population, such as Marāthas Lingāyats and Jains. From these it can be learned by a rapid glance how the main castes and tribes are distributed throughout the State territories.

Following these more or less introductory essays, the reader will find chapters on caste, religion, taste in dress and ornaments, totemism, magic, animism, etc.; and here we meet for the first time with an attempted summary of the various contents of the articles in the preceding volumes. The writer's survey takes him far afield; and we are even given specimens of the particular tattoo marks favoured by Hindu ladies, such as a picture of the temple of the god Shiva, accompanied by his attendant *Nandibail* (p. 438). Space does not, unfortunately, admit of a study of the significance of this material. A few words must, however, be devoted to the important Chapter vii, which deals with the practice of totemism.

Some recent investigations in the neighbouring Presidency of Bombay concerned with the same subject have tended to show that more prospect exists of arriving at the origin of the population by having regard to the practices of the people in this connexion rather than by measuring their heads and their noses. In the pages of the *Indian Antiquary* (61, 106–111; 1932) a list of some two hundred and twenty totem divisions identified in the centre and south of the Bombay Presidency will be found, and will repay most careful study. On p. 255, Mr. Ananthakrishna gives a list of a hundred and twenty-five such totems, which are classified as animals, trees and plants, and inanimate objects. Needless to say, the resemblance to the Bombay list is striking, the entries in many cases being identical. As was to be expected, the author of this work finds the system in many cases to be in a state of decadence; but it is none the less widespread among tribes and castes of non-Aryan origin. He shows that customs such as matriarchy, adult marriage, burial and totemism are a surer guide to the racial origin of a caste or tribe than most of the traditional accounts which are so readily forthcoming to mislead the investigator.

The chapters on animism and magic contain little that has not already been recorded in other works on the subject. On p. 237 *et seq.* reference is made to the curious custom known as the *couvade*. Mr. Rice, in the *Mysore Gazetteer*, has already supplied evidence of confinement restrictions on the husband among the Kuravas. Little fresh material can be gathered from the present volume.

In conclusion, it remains to congratulate Mr. Ananthakrishna Iyer on the completion of his great task. The separate and final volume promised by him, which is to contain a bibliography and index, will be awaited in the hope that it may also find place for the missing synonyms of caste and tribal names which the previous three volumes should have included. The present work is signally free from misprints, though it may be observed that 'ironette' (p. 473) as a kind of dancing seems a somewhat novel form of movement. Are we really dealing with a 'pirouette'? There are numerous excellent illustrations.

R. E. ENTHOVEN.

The Land of Britain:

the Report of the Land Utilisation Survey of Britain. Edited by Dr. L. Dudley Stamp. Part 78: Berkshire. By J. Stephenson, with an Historical Section by W. G. East. Pp. 113. (London: London Utilisation Survey of Britain, 1936.) 2*s.* 6*d.*

THE publication of the first of the contemplated eighty-seven county reports on the utilization of the land of Great Britain gives an idea of the scope and value of the work. The report begins with a summary of the geographical background, geology, relief, soils and climate. Then follow accounts of the distribution of woodland, arable land and grassland, which are closely correlated with physical conditions and illustrated with distributional maps. Next comes the distribution of orchards and poultry farming and lastly the distribution of settlements and population in general.

The report brings out not merely the present use of the land but also indicates the changes that have taken place chiefly through the operation of economic factors. Thus to-day the arable land of Berkshire covers 26·5 per cent of the county, while in 1808, and for many years subsequent, it appears to have covered more than fifty per cent. The process of putting arable land down to grass is still continuing. On the other hand, arable farming would appear to be concentrating in the areas best suited to that use. This tendency is accentuated by better transport, which helps to nullify advantage of position, and uniform wages which reduce the ability of poor areas with low wages to compete with better land. Mr. Stephenson concludes by dividing the county into agricultural regions each with its own characteristics and potentialities, and he notes that Berkshire is in a transitional stage common to all counties near London. Price conditions are changing the aspects of farming, and growth of population and transport are making the east and south more and more into residential areas.

The report concludes with a valuable article by Mr. W. G. East on the utilization of the land about 1800.

Wild Flowers of the Wayside and Woodland

Compiled by T. H. Scott and W. J. Stokoe, based upon the Standard Work "Wayside and Woodland Blossoms" by Edward Step. Pp. 352+81 plates. (London and New York: Frederick Warne and Co., Ltd., 1936.) 7*s.* 6*d.* net.

THIS attractive book will prove very useful to the field naturalist rather than to the academic student of systematics. It is well produced, and is of a size convenient for the pocket. Such a book, well printed and beautifully illustrated, is just that type which helps the intelligent man to a truer appreciation of the country, while at the same time giving a valuable insight into the beauties of Nature. It should, therefore, give full satisfaction to the country rambler interested, if only mildly, in the surrounding flora. Apart from this, however, it will provide an excellent introduction to a later more serious study of systematic botany.

The book opens with a short description of the more common forms of leaves, and this is illustrated by two pages of line diagrams. Next follows a short dissertation on the forms of flowers, illustrated by a typical flower and line diagrams of the more common types of inflorescences. A short glossary of botanical terms helps the reader to follow more easily the descriptions in the greater part of the book.

An unusual and helpful feature then follows: forty pages are devoted to line diagrams of common flowers, grouped according to the colours, white or whitish, and shades of pink, red, yellow, blue, purple, lilac, green and brown.

The bulk of the book is occupied by a description of the most common plants in the British flora. This occupies about 250 pages, interspersed with eighty coloured plates each portraying about four types of flowers. There is an index.

This book is to be unreservedly recommended, and, in view of the amount of subject matter and coloured illustrations which it contains, it is excellent value for the price demanded.

The Heavens and Faith

By the Rev. M. Davidson. Pp. xv+162. (London: Watts and Co., 1936.) 5*s.* net.

THE impact of the science of astronomy upon the Christian faith is a topic which has been dealt with by a number of writers, but Dr. Davidson is better equipped than many, because he is at once a clergyman and an astronomer, Sir Frank Dyson testifying in a foreword to his competence in this science. But, what is not less important, Dr. Davidson has not only the requisite knowledge, but also the necessary candour, apart from which all discussion ends with foregone conclusions.

The problems set for religious faith by modern astronomy are threefold: (1) the apparent indifference of an incredibly vast universe to man and his destiny; (2) how to reconcile the three-storey universe of Creeds and Scripture with present scientific knowledge; and finally (3) what we are to make of the eschatological beliefs entertained not only by Paul and the primitive Church, but also, as is now recognized by scholars, by the Founder of Christianity himself. Most works of orthodox apologetic tackle (1) and (2) with varying degrees of success, but there is a widespread tendency to ignore (3) altogether, in spite of its vital importance. Dr. Davidson, however, does not evade this issue, nor seek to obscure the point that the ethic of the Sermon on the Mount had a very definite basis of apocalyptic belief which is no longer held. How far its validity may be thereby affected is a matter for serious inquiry and not for dogmatic assertions. As a matter of fact, if we believe that the world is soon to end and be replaced by a better, the ethic of the Sermon is mere common-sense, and not fantastic idealism, as it appears to most 'world-accepting' citizens to-day.

This book was very well worth writing, and will repay study. J. C. H.

Out of the Night:

a Biologist's View of the Future. By Prof. H. J. Muller. Pp. 127. (New York: The Vanguard Press, 1935.) 1.50 dollars. Pp. 160. (London: Victor Gollancz, Ltd., 1936.) 4*s*. 6*d*. net.

EUGENICS is based very largely on genetics, and any technical or theoretical advance in the latter science has its effect on eugenical thought. Consequently, the considered views of Prof. Muller, well known as one of the leading geneticists of the day, on eugenical topics are very welcome.

Prof. Muller commences with a consideration of the evolution of man, illustrating his argument with novel and effective analogy. He then discusses the future of man and contrasts man's probable fate if conscious control of the occurrence of various genetical types is not exercised, with his possible achievements if such a control is successfully attempted.

The author next considers the measures which seem desirable for the purpose of such a control of genetical change in man. He favours the extensive use of a few chosen sires, by a technique involving the storage of gametes and artificial insemination. It is important to note that technically many of the proposals made are either possible at present or likely to be rendered possible by a relatively small amount of further research.

It is certain that Prof. Muller's views on the technique of human improvement will not be universally accepted. Some geneticists do not agree that the use of a few chosen sires is the best way of achieving rapid selection. It can be stated, however, that, in spite of possible disagreement on some points, the book will be of great interest to anyone concerned with the problems of eugenics, as it is both genetically and technically accurate.

K. MATHER.

L'Année psychologique

Fondateurs: Henry Beaunis et Alfred Binet. Publiée par Prof. Henri Piéron. (Bibliothèque de Philosophie contemporaine.) Année 35 (1934). Vol. 1. Pp. xix+480. Vol. 2. Pp. 481–912. (Paris: Félix Alcan, 1935.) 120 francs.

THIS excellent annual publication becomes more and more an indispensable aid to the study of the ever-increasing production of works and memoirs on psychology. The research value of the "Année Psychologique" is shown not only in its original memoirs, but also and mainly in the useful classification and summary reviews of the current literature concerning psychology published during the year. Among the original memoirs published in the present issue, we should mention H. Piéron's "L'Evanouissement de la sensation lumineuse" and the two essays on psychological factors by N. Margineanu. The classification of the works reviewed occupies fourteen pages of the table of contents; which shows the reviewer's difficulty in making a satisfactory selection, and also the wealth of material which has been sifted and analysed by the editors of this important publication.

T. G.

The Monks of Athos

By Prof. R. M. Dawkins. Pp. 408+6 plates. (London: George Allen and Unwin, Ltd., 1936.) 15*s*. net.

PROF. DAWKINS, whose knowledge of the eastern Mediterranean now extends over more than thirty years, has long been known to students not only as an archæologist, but also as a diligent collector of the folk-lore and legends current, or recently current, among the modern Greeks of the mainland and the islands. In the course of four visits to Athos, he has made a gathering of the legends current among the members of the remarkable monastic communities of the peninsula, to which he has added a gleaning from the literature relating to it. His purpose, however, has been inspired by a deeper motive than that of collection merely: his aim has been to test the value of folk-memory as preserved in these legends—a purpose for which Athos is better fitted than most localities. It is somewhat remarkable to find that, in communities which are notoriously anti-feminine, the Virgin Mary holds a place no less prominent than in other parts of the Mediterranean. It is also to be noted, the author points out, that theological controversy, which has raged here on more than one occasion, appears to have been forgotten almost immediately after settlement, and has left little or no mark on tradition.

Prof. Dawkins found that his main purpose would have been very inadequately served without some account of the geographical and cultural setting. In consequence, he has written a full description of the peninsula, which conveys its charm in a literary style no less felicitous than the subject matter demands.

Geologie von Asien

Von Prof. Dr. Kurt Leuchs. Band 1, Teil 1: Überblick über Asien, Nordasien. (Geologie der Erde, herausgegeben von Prof. Dr. Erich Krenkel.) Pp. viii+236. (Berlin: Gebrüder Borntraeger, 1935.) 18.40 gold marks.

THIS addition to the "Geologie der Erde" series, published under the general editorship of Prof. E. Krenkel, is planned to comprise two volumes each of two parts, and, in its completed form, will fill a long-felt want in geological literature.

The first part of vol. 1 contains a general introduction including a summary of the physiography and geological structure of Asia as a whole. This is followed by the section dealing with north Asia, which includes a relatively detailed discussion of the stratigraphy and igneous rocks, the tectonic structure and the chief ore deposits of the region.

To some extent it covers the same ground as Obrutschew's "Geologie von Sibirien", published in 1926; but in the intervening years much new material has become available and is incorporated by Prof. Leuchs.

The chief value of this book lies undoubtedly in the fact that it summarizes and makes available a great body of obscure, and for all practical purposes, inaccessible Russian publications, and as such is a notable addition to geological literature.

Seventh International Congress of Refrigeration

By Dr. Ezer Griffiths, F.R.S.

THE Seventh International Congress of Refrigeration, organized by L'Institut International du Froid and the Netherlands Association of Refrigeration, opened at The Hague on June 16 and closed at Amsterdam on June 20. For the opening ceremony, about four hundred members of the Congress, including delegates of fifty nations and members of the Dutch Government, assembled at the historic Ridderzaal—the Hall of the Knights at The Hague. At this meeting, speeches of welcome were made by representatives of the Dutch Government and such preliminaries settled as the appointment of presidents and secretaries of sections, together with the procedure to be followed in the conduct of the meetings.

The work of the Congress was subdivided between four sections, and altogether about two hundred papers and reports came under consideration. Abstracts of the papers were printed in the language supplied, followed by translations in French and (or) English. The topics of these papers covered the whole field of low temperature work, and were of a varied character, ranging from paramagnetism to a new method of making ice rinks. The mass of material to be dealt with proved embarrassing, since in the limited time available full discussion was impossible.

There was a feeling that a more rigid process of selection would need to be followed in preparing the programme of the next Congress. In a congress of this character, adequate time for discussion is all-important, for sometimes ancillary information of considerable interest is brought out in the course of a discussion. For example, a paper was read describing the development of refrigeration in Japan ; and, in answer to a question, an outline was given of the method employed in certain parts of that country for the cultivation of strawberries—a subject of general interest. A sunny slope is selected exposed to sea-breezes. The rocks are arranged with pockets of earth between, and in these the roots of the strawberry plant are planted. At night the rocks cool and condense water vapour which trickles down the rocks and is absorbed by the earth. By day the rocks warm up rapidly and afford a source of heat to the strawberry plant.

The majority of the papers dealt with that aspect of low temperature work which is concerned with methods for the preservation of perishable foodstuffs. The papers read at this Congress would perhaps suggest that the engineer is greatly in advance of the biologist in the science of refrigeration, but this impression is probably due to the fact that biological workers as a whole failed to support the Congress to the same degree as their engineering colleagues. Much of the biological work recorded was more of a descriptive character than an attempt to get down to fundamentals as regards the chemical and structural changes taking place consequent on storage temperature and environments. There is great scope for investigation on the biological side, particularly in respect of tropical fruits, and it may be of interest to record that a resolution was passed at this Congress recommending that the question of tropical fruits should occupy a prominent place in the programme of the next Congress ; such fruits afford interesting material for research, for it is possible to carry out, in the course of weeks, experiments which may be protracted over many months in the case of hard fruits.

Reverting to the engineering side, it was noteworthy from the papers submitted to the Congress that advances are being made in the production of temperatures considerably lower than those customary in cold-stores work, although of course much higher than liquid air temperatures. Here the question is not one of the mere attainment of low temperatures, but the economical production of temperatures of the order of − 50° C. in large spaces. For example, ice-cream manufacturers prefer quick hardening of their product in wind tunnels at − 40° to − 50° C. to slow hardening at a higher temperature.

These developments in refrigeration have resulted in the evolution of special types of refrigerating machinery. For intermediate temperatures of, say, − 25° to − 40° C. the booster compressor of the rotary blower or piston type finds application in raising the pressure of low density vapour to densities at which it can be efficiently handled by compressors of standard design. Lower temperatures are obtainable by refrigerating equipment of the modern absorption type, in which temperatures so low as − 76° C. can be economically obtained in commercial practice, using ammonia, in spite of that temperature being within one degree of the triple point of ammonia and the specific volume being twenty-five to thirty times as great as at ice-making temperatures.

The question may reasonably be asked what useful purpose does such a Congress serve. In the first place, it affords unique opportunity for workers in various countries to establish contact and exchange views, and on this occasion the various nationalities came together with a common objective. Representatives from the Dominions Overseas appreciated to the full the value of the Congress as an opportunity to meet their colleagues. The Congress also demonstrated to those countries which are lagging behind in the encouragement of scientific work the benefits accruing from organized research.

During the period of the Congress, meetings of some of the commissions functioning under the auspices of the Institut International du Froid were convened. Commission No. 1 considered the question of temperature measurements down to liquid hydrogen temperatures. The temperature scale is defined by international agreement down to the boiling point of oxygen; beyond this there is no generally accepted standard scale. Even in the range covered by the International Scale, further work appears to be necessary, since some investigators have found that platinum thermometers constructed and calibrated according to specification differ by so much as 0·03° at about – 140° C. To study this question, it was decided to set up a committee composed of representatives of the various national laboratories and of those centres where low temperature investigations are in progress.

Commission No. 12 on land transport and Commission No. 13 on water transport held a joint session. As problems for further study, they decided that data should be collected as to the heat production of various types of fruit, this being a matter of interest to the marine engineer when dealing with fruit delivered to the ship without pre-cooling. It was also decided to consider methods for the control of the atmospheric conditions in the holds of ships carrying perishable produce requiring atmospheres of high carbon dioxide and low oxygen content.

These are subjects which will be studied by expert committees under the auspices of the Institut International du Froid and reported upon at the next Congress.

Thanks to the thorough planning of the executive committee, the arrangements worked smoothly and efficiently, and those participating will retain the most pleasant memories of a very useful meeting.

The Royal Research Ship *Research*

By Dr. H. Spencer Jones, F.R.S., Astronomer Royal

THE destruction of the non-magnetic ship *Carnegie* by an explosion, at Apia, Western Samoa, on November 29, 1929, brought to a sudden end the magnetic survey of the oceanic areas, which had been carried on for twenty-five years by the Carnegie Institution of Washington. The *Carnegie* had been specially designed and constructed for obtaining magnetic observations at sea. She was a hermaphrodite brig, built of white oak and pine, with copper or bronze fastenings, and with a displacement of 568 tons. She was equipped with an auxiliary engine, capable of giving a speed of about 6 knots in calm weather; the engine was of internal combustion type and, at first, used gas generated from solid fuel, but, as this proved not altogether satisfactory, petrol was substituted. Sufficient fuel was carried to give a cruising range of 2,000 miles at 6 knots. With the exception of cast-iron pistons for the cylinders of the engine and the steel cams necessary for operating the valves, amounting in all to less than 600 lb., no magnetic material was used in the construction of the ship.

In six cruises between 1909 and 1921, the *Carnegie* traversed 252,702 miles in 3,267 days actually at sea. Her last cruise was planned to extend from May 1928 to September 1931 and to cover 110,000 miles. It was designed to determine the secular change of the earth's magnetism in all oceans, by making numerous intersections with the tracks of previous cruises. Nearly one half of this cruise had been completed at the time of her loss.

The results obtained by the *Carnegie* were placed freely and promptly by the Carnegie Institution at the disposal of the British and other Governments, for use in the construction of world magnetic charts. Successive issues of these charts were based to an increasing extent upon the data provided by the *Carnegie*.

The secular changes of the magnetic elements at any given place are not constant quantities. Extrapolation over long periods may therefore lead to considerable errors. The continual accumulation of observations is necessary in order to determine both the secular change and the rate of change of the secular change of each element. At the present time, the magnetic data are most uncertain in the Indian Ocean. The last cruise of the *Carnegie* in the Indian Ocean was in the year 1919. The cruise on which she was engaged at the time of her destruction was to have taken her into the Indian Ocean in 1930 and 1931. In South Africa there has been a considerable decrease within recent years in the secular change of the magnetic declination, and in Western Australia there has been a considerable increase. There are no data available as to how the secular change is altering in the southern Indian Ocean between South Africa and Australia. The magnetic charts for this area are therefore based at present upon very uncertain extrapolations. In other areas, where the magnetic elements are known at present with reasonable accuracy, the extrapolated values would become less and less reliable in the course of time, in the absence of further observations, such as were provided by the *Carnegie*, to serve as a control on the changes in the secular variations.

In view of the fact that Great Britain is the principal maritime nation, the British Government has accepted the responsibility of providing accurate magnetic data at sea, and a non-magnetic ship is to be built, equipped and operated for this purpose by the Admiralty. The ship is to be known as the Royal Research Ship *Research* (R.R.S. *Research*), and she will fly the Blue Ensign and Jack with the yellow Admiralty anchor in the fly.

The plans for the new ship have been prepared at the Admiralty and it is hoped that the construction will be commenced shortly. The Department of Terrestrial Magnetism of the Carnegie Institution of Washington not only placed at the disposal of the Admiralty all information with regard to the construction and the instrumental and other equipment of the *Carnegie*, but also generously gave the services of Mr. W. J. Peters as consultant, without charge. The experience and advice of Mr. Peters, who commanded the *Carnegie* on her first two cruises, have been of the greatest value in the design of the ship and of her equipment.

The R.R.S. *Research* will be somewhat larger than the *Carnegie*. She will have a displacement of 650 tons and will be brigantine rigged. She will be provided with a single screw Diesel engine and will carry sufficient oil fuel to give a radius of action of about 2,000 miles at 6 knots. Her cables will be of bronze, instead of the hemp rope used in the *Carnegie*, and to some extent brass or bronze will take the place of wood. She will carry a total complement of 31, including the commanding officer, three deck officers, three scientific workers, a surgeon (who will also be a scientist) and an engineer.

The work of the R.R.S. *Research* will not be restricted solely to magnetic observations. She will undertake observations of atmospheric electricity. Such observations are particularly valuable at sea, where the air is less contaminated by suspended impurity than it is on land. It may be recalled that it was by means of observations on the *Carnegie* that it was established that the maximum potential gradients are related to Universal Time and not to the local time of the place of observation. The *Research* will be provided with an oceanographic winch and motor for oceanographic work, will carry an echo depth sounding gear, and will also make meteorological observations, including upper air observations by means of pilot balloons.

The principal magnetic instruments for observations at sea will be a marine collimating compass for observations of declination ; a sea-deflector, for observations of the horizontal intensity ; and a marine dip inductor for observation of the dip. The collimating compass is a modification of the standard marine liquid compass. The magnet system carries four concave speculum mirrors, adjusted so that their optical axes are in the direction of the four cardinal compass points. A scale is mounted in the focus of each mirror. The four scales are carried on arms attached to the magnet system. The angle between the sun, when at low altitude, and one or other of the four compass points, as defined by the scale images, is measured with a sextant, the scales being viewed through windows in the compass bowl. This observation provides the means of calculating the magnetic declination. The compass will be mounted in such a position that it will have as clear a view of the horizon as possible.

The sea deflector consists of a marine compass, provided with permanent attachments, whereby a deflecting magnet can be mounted in a horizontal position and vertically above or below the compass magnet system. The bowl is rotated until the deflecting magnet is perpendicular to the compass magnet, as shown by the reading of the card. The angle of deflection is read on a graduated scale on the edge of the bowl. The deflector is mounted in an observatory adjacent to, and forward from, the chart room, in which is the standard compass. As the observer at the deflector reads off the angle of deflection, a second observer at the standard compass reads off the direction of the ship's head. The horizontal intensity is proportional to the cosecant of the deflection. The constant of proportionality is determined periodically by simultaneous observations ashore, with the sea deflector and land magnetometer.

The marine earth-inductor follows the general design of earth-inductors, but is provided with a special gimbal stand that is not affected by the rotation of the coils. It is important, for observations at sea, that it should be driven at a constant speed, and a special tuning-fork controlled rotary converter, situated in the after part of the vessel and driving through an articulated phosphor-bronze shaft, will be provided to ensure this. Two galvanometers, one of the moving coil type, with short period, and the other of the string type will be provided and experience will be gained at sea of the relative suitabilities of the two types. The earth-inductor will be mounted in an after observatory.

Portable instruments for land observations, at fixed magnetic observatories and elsewhere, will also be carried. The designs of the instruments have been based on the Carnegie Institution designs, with such modifications as were suggested by experience on the *Carnegie* or as seemed desirable for various reasons.

The magnetic observations on the R.R.S. *Research* will be made primarily in the interests of navigation. But they will provide at the same time valuable information about the earth's magnetism, which is needed for the investigation of such matters as the non-potential portion of the earth's field and the line integrals around closed contours on the earth's surface.

Body Orientation of the Lower Crustacea (Branchiopoda)

By John H. Lochhead, University Museum of Zoology, Cambridge

AMONG the Branchiopoda it is now well known that the Anostraca swim normally lying on the back, while the Notostraca swim with the back directed upwards. Orientation is also constant among the Cladocera, but there are here considerable differences between genera.

Four possible controlling factors have been suggested. These are the aeration of the water, gravity, the surface resistance of the animal, and light.

Lowndes[1] and Wertheim[2] hold that the limbs of Anostraca, which are doubtless respiratory, are normally directed upwards because the upper layers of water are best aerated. This view, however, cannot apply to the Notostraca. Nor could orientation be controlled in this way except perhaps very near the water surface, since the differences in aeration above and below a swimming animal must normally be too small to be detected. It is true, however, that both Anostraca and Notostraca often come up and beat their limbs just below the surface film, the Notostraca specially turning over on to their backs for this purpose. It has been widely stated that this occurs especially when the oxygen content of the water is low. It may thus well be a respiratory phenomenon, though Mathias[3] has shown that the oxygen requirements of *Artemia* are surprisingly small. In any event, however, the habit is quite distinct from the more usual swimming of the animals farther below the surface.

Control of orientation by gravity may occur in two ways. There may be automatic control, the centre of gravity of the animal being so placed that a constant attitude tends to be maintained independent of muscular effort. The factor of the resistance offered by the surface shape of the animal to the water may also play a part here. Or there may be nervous control due to the effect of gravity on special sense receptors, the position maintained by the animal being then not necessarily the stable one with respect to the automatic forces just mentioned.

Surface resistance is a factor of special importance in the Cladocera, because of the regular rest pauses which characterize their swimming. But in the Anostraca and Notostraca, considered for the sake of simplicity only when swimming or floating more or less horizontally, the effect of surface resistance on dorso-ventral orientation must be small. R. T. Müller[4], however, has shown that for Anostraca the effect due to the centre of gravity may be important. It has long been known that in water the anostracan body sinks back downwards. This might be due to the position of the centre of gravity, or to surface resistance. Müller showed that it is due to both these factors. He placed both fixed and narcotized *Tanymastix* in sugar solution of the same specific gravity as that of the animals, and found that they then lay floating in the solution back downwards. This could be due only to the position of the centre of gravity. He then raised the specific gravity of the solution until the animals rose up fairly rapidly towards the surface; they did so back upwards, surface resistance overcoming the force exerted by the centre of gravity. Thus when an anostracan sinks in water, both forces tend to keep the back downwards. For the Notostraca, such careful experiments have not been done; but Seifert[5] has shown that a dead *Apus* also sinks in water back downwards. Probably this is due to the same forces acting together as in the Anostraca. If this is so, then *Apus* normally swims in an unstable position with respect to its centre of gravity, and if gravity plays any role in controlling orientation it must be by acting on sense receptors. But although *Apus* has been histologically well investigated, nothing in the nature of a statocyst has been found.

The effect of light on the dorso-ventral orientation of Anostraca and Notostraca may be very marked. But Müller[4] gives much experimental evidence to show that in the anostracan, *Tanymastix*, the responses occur only when phototropism has been awakened by other stimuli ; the possibility that this may also be the case for the Notostraca has not been investigated. Both orders, however, respond to sudden changes in the direction of light, the Anostraca seeming always to try to keep the ventral surface facing the source of light, while Notostraca show the opposite response. This corresponds with the normal swimming positions of these animals when light is coming from above. When illuminated from below the animals turn over, though the fresh-water Anostraca seem to find difficulty in swimming in the unaccustomed and unstable position. Individuals of *Streptocephalus* observed by me repeatedly 'looped the loop' when illuminated from below, swimming slowly ventral side down when at the bottom of the loop and going rapidly, ventral side up, over the top of the loop. *Apus* when illuminated from below swims easily on the back, this being for it, as it is for the Anostraca, the presumably stable position with respect to the centre of gravity. In both Anostraca and Notostraca, control of orientation in respect to light has been shown by Seifert to be effected in the first place solely through the eyes. In the Anostraca he has shown[6] that probably only the lateral eyes are concerned. In the Notostraca he has found[6] the lateral eyes to play the chief part, assisted, however, to a small extent by the median eye.

It may be concluded that, while in fresh-water Anostraca control of orientation by light is probably secondary to that exerted by the centre of gravity, this is apparently not so for the Notostraca. Here the normal swimming position is perhaps in direct response to the direction of light, although the possibility that gravity plays a role is not excluded. Seifert[5] found that *Apus*, in response to a change in the lighting, appeared to turn over more rapidly to the normal position with the back upwards than it did for the reverse change. He also found that when the normal habitat conditions are reversed, by lighting from below and placing a false bottom above, *Apus* does not behave towards this false bottom in the same way that it does towards a true one when the light comes from above. But the tendency for the animal to sink rather spoils the significance of this experiment. Much more interesting should be the behaviour of the animals at night. I have found, in agreement with Müller, that fresh-water Anostraca continue to swim ventral side up at night, this being the stable position with respect to the centre of gravity. But for the Notostraca I have no observations on this point, and I can find only two brief notes by Seifert[5]. He states (p. 403) that animals swimming in the dark show some uncertainty in their orientation, and (p. 414) when allowing themselves to sink down after a period of swimming, do so back downwards. These observations, if they are correct, would seem to show that it is indeed light which controls the normal daytime swimming position of the Notostraca. In fresh-water Anostraca this control is probably more latent, being awakened, according to Müller, only by certain disturbing stimuli.

An interesting confirmation of the probable truth of these general conclusions is contained in the later paper by Seifert[6]. In this paper, Seifert compares a fresh-water anostracan, *Chirocephalus*, with the 'brine-shrimp', *Artemia*. For *Chirocephalus* his results are in close agreement with those of Müller on *Tanymastix*. But he finds that in *Artemia* conditions have been reversed by the nature of the environment. *Artemia* swims on the back like other Anostraca, but Seifert finds that in the strong brine in which it lives, this is actually the unstable position, because its body is tending to rise rather than to sink. Correlated with this presumed instability of the normal swimming position, there is a much more constant orientation of the body with respect to light than has been found in other Anostraca. Probably Seifert would thus divide the Euphyllopoda into those forms which normally swim in a 'stable' position and respond to light only after suitable stimulation, and those forms which swim in an 'unstable' position, maintaining their orientation by a constant response to the direction of light.

Clearly other factors than light and gravity, such for example as the currents set up by the animal, may also play a part. But for the sake of simplicity I have not considered these here ; nor have I more than briefly mentioned the Cladocera, because the large amount of work done on this group has already been well reviewed (*cf.* Wagler[7]).

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[1] A. G. Lowndes, *Proc. Zool. Soc. Lond.*, p. 1093 (1933).

[2] P. Wertheim, *Zool Anz.*, 108 (1934).

[3] P. Mathias, *Ann. Sci. nat. Zool.*, (x), 17 (1934).

[4] R. T. Muller, *Z. Biol.*, 69 (1919).

[5] R. Seifert, *Z. vergl. Physiol.*, 11 (1930).

[6] R Seifert, *Z. vergl. Physiol.*, 16 (1932).

[7] E. Wagler, Branchiopoda, in Kukenthal and Krumbach, "Handbuch der Zoologie" Bd. 8, H.I. (1926–27).

Obituary

Mr. A. H. S. Lucas

AUSTRALIAN science loses a notable and versatile votary by the death of Arthur Henry Shakespeare Lucas, on June 9. The son of the Rev. S. Lucas, he was born in 1853 at Stratford-on-Avon and educated at Kingswood School, Bath, and the University of Oxford, where he was an exhibitioner of Balliol College.

Going to Australia as mathematics and science master of Wesley College, Melbourne, in 1883, Lucas later became tutor and natural science lecturer at Trinity, Ormond and Queen's Colleges of the University of Melbourne. From 1893 until 1898 he was headmaster of Newington College, Sydney, after which he joined the Sydney Grammar School as mathematics and science master, and headmaster in 1920. He was also for some time lecturer in physiography at the University of Sydney. Retiring from school work at the end of 1923, he acted for two years as professor of mathematics at the University of Tasmania.

One of the founders of both the Victorian and the New South Wales Naturalists' Societies, Lucas was president of both at different times. In 1907–9 he was president of the Linnean Society of New South Wales, and he was a councillor until his death. For many years he was curator of the Algæ of the Sydney Botanic Gardens, and the last twelve years of his life was devoted to active research and wide collecting of Algæ, from Western Australia to the Barrier Reef, usually spending the summer months—including the last—with his co-adjutors, Mr. and Mrs. Perrin, near Georgetown, Tasmania, in this work. His last paper, "The Marine Algæ of Lord Howe Island", was read at the Linnean Society of New South Wales in June 1935. His "Introduction to Botany", written in conjunction with Prof. Dendy, is a well-known text-book to Australian students. But botany, although his chief love, was but one of many studies. In his teaching life, one learned that his personal pupils in the Senior Public Examinations had won University medals in eleven different subjects—these including all branches of science and mathematics. Besides papers on Australian lizards, in collaboration with the late Dudley Le Souef, he published two books on the animals and on the birds of Australia respectively.

Lucas's passion for acquiring learning led him also into the study of languages. A sound classic and English scholar, he extended his range of modern languages beyond the usual French and German to Italian, Spanish and Russian, by way of holiday pastime. The present writer, spending a summer vacation with him at Twofold Bay, found him reading "Don Quixote" in the original, while during the Great War he was requisitioned to interpret Russian in a law court, in the cause of some Russian refugees. Italian was a necessary concomitant to the study of De Toni's work on Algæ. Far beyond Dr. Johnson's conception of learning, Lucas earned the famous epitaph on Goldsmith "Nihil quod non tetigit; nihil tetigit quod non ornavit".

A great teacher, a humorous and lovable friend, Lucas's wide influence was attested by the large and representative gathering which—at the shortest notice—attended Roseville Church to pay the last honours to a rare personality. He leaves three daughters and three grandchildren. H. J. C.

Dr. J. D. Unwin

WE regret to record the death of Dr. J. D. Unwin, anthropologist and head of Cambridge House, the University social settlement in south London, which took place after an operation at the age of forty years.

Joseph Daniel Unwin was born on December 6, 1895, the son of Mr. F. D. Unwin of Chauntry House, Haverhill, Suffolk. He was educated at Shrewsbury School, and would have gone to Oriel College, Oxford, with a classical exhibition in 1914, had it not been for the outbreak of war. He served in the Northamptonshire Regiment and the Tank Corps, was twice wounded, and was awarded the Military Cross. After the War, he spent some years in Abyssinia. In 1928 he was elected a Fellow Commoner Research Student of Peterhouse, Cambridge. He then compiled a thesis in anthropology for the Ph.D., which was published in abbreviated form in 1933 under the title "Sexual Regulations and Cultural Behaviour". A fuller account of his research, with much additional material, was published as "Sex and Culture" in 1935. His theories of the relation of degrees or stages of culture and the intensity of sexual prohibitions, which was based upon evidence from no less than eighty tribes and peoples, attracted considerable attention and discussion. This book showed that Dr. Unwin had remarkable powers of analysing and marshalling cultural evidence. He had also engaged in research work for the Home Office on the subject of the imprisonment of debtors. The results of this research appeared in "Imprisonment for Debt" (1935). He also wrote "Notes on the Unwin Family" (1934).

Dr. Unwin's knowledge of social conditions and problems made his appointment as head of Cambridge House peculiarly suitable; and it was fully justified by his work for the settlement.

Miss Alice Balfour

MISS ALICE BLANCHE BALFOUR, of Whittingehame, who died on June 12, at the age of eighty-six years, was a naturalist born and bred, and her scientific interest in Nature persisted in spite of the social distractions of her association with her brother, Arthur James Balfour, politician and philosopher. In her earlier days, her bent was shared and encouraged by a younger brother, Prof. F. M. Balfour, already a leader in zoology when he died at the age of thirty-one years. Later she paid particular attention to gardening, so that the garden at Whittingehame became famous for its beauty, and to the collecting of a full series of the butterflies and moths of East Lothian. Her knowledge of the specific characters and local distribution of these and of other living things was thorough, and her inquiries brought her often to the Royal Scottish Museum in Edinburgh, to which she left her natural history collections.

It would be misinterpreting Miss Balfour's life to regard science as dominating her outlook, for her intellectual interests were wide, and her chief activities were social, in the broadest sense, and personal; but it may be said that the sustained pleasure of her life depended upon her love of Nature. J. R.

WE regret to announce the following deaths:

Prof. Franklin D. Barker, professor of zoology in Northwestern University, an authority on Trematodes, on July 10, aged fifty-eight years.

M. Louis Bleriot, who made the first flight across the English Channel from Baraques, near Calais, to Dover, on July 25, 1909, in a monoplane having a three-cylinder engine of 22–25 horse-power, on August 1, aged sixty-four years.

Lieut.-General Sir Alfred Keogh, G.C.V.O., G.C.B., director-general of the Army Medical Service 1904–10 and 1914–18, and Rector of the Imperial College of Science and Technology, 1910–22, aged seventy-nine years.

Prof. E. J. Nanson, emeritus professor of mathematics in the University of Melbourne, on July 1, aged eighty-five years.

Dr. F. J. F. Shaw, director of the Imperial Institute of Agricultural Research, Government of India, aged fifty years.

News and Views

Dr. E. J. Allen, C.B.E., F.R.S.

ON July 30, a special meeting of the Council of the Marine Biological Association of the United Kingdom was held in the rooms of the Royal Society in order to appoint Dr. Stanley Kemp, former director of the "Discovery" expeditions to the antarctic, secretary of the Association and director of the Marine Biological Association at Plymouth, the appointment to take effect on October 1. The present director of the Station, Dr. E. J. Allen, retires at his own request on September 30 after forty-two years of arduous service to the Association. During this period, Dr. Allen has seen the Station grow from being a small and poorly equipped second-rate institution to becoming the premier marine biological station of the world. We propose to refer in a later issue to Dr. Allen's great services to zoological science.

Dr. Stanley Kemp, F.R.S.

DR. STANLEY KEMP is probably the leading authority on oceanography at present living. During the years which he spent cruising in the Antarctic, he finally elucidated the circulation of the water in that ocean and proved its bearing on the habits and life-histories of the various species of whale which go south during the brief Antarctic summer in order to feed and grow fat and during this period fall a prey to whalers. He discovered the amazing fact that the largest of them all, the Southern Fin-Whale, feeds practically exclusively on one small species of 'shrimp' about 2 inches long. The baby whale when born is 20 feet long; it grows to a length of 50 feet during its first year, and attains its full size (100 feet long) in less than five years. He showed further that each antarctic summer is characterized by an enormous growth of diatoms on which these 'shrimps' feed and consequently a rich oxygenation of the sea-water due to photosynthesis. As this water flows north to the antarctic circle it sinks from the surface to an ultimate depth of about 600 fathoms and it takes approximately five years to reach the equator. The sequence of antarctic summers can be traced in the patches of oxygenated water which it contains, and the intensity of the oxygenation of each patch marks the degree of warmth of the corresponding summer. Dr. Kemp's appointment is therefore a happy augury for the future of Plymouth and for fishery science in general. It is becoming increasingly clear that the variations in British fisheries are connected with variations in intensity of a southward flow of arctic water carrying with it stupendous harvests of diatoms and shoals of the most sought-after edible fish. Oceanographic exploration based partly on Plymouth may be as fruitful in the endeavour to elucidate the life-histories of these fish as antarctic exploration has been in unravelling the life-history of the whale.

Archæological Investigations in Syria

SIR LEONARD WOOLLEY'S report on the work of the British Museum's archæological expedition to Sueidia, near Antioch, immediately before closing down work for the season (*The Times*, July 31) records the completion of excavation in the reserved area of the harbour site and the cutting of trial trenches on and around the hill station at Sabounia, two and a half miles inland. At the latter point, while the existence of a walled town at least as early as the Mycenæan age is established, the fall of the walls through the disintegration of the sandstone cliffs, on the edge of which they were erected, has effectually disposed of the possibility of profitable excavation. Here, however, a find of vessels of copper and implements of bronze and iron has afforded instructive evidence of agricultural practice in Syria in the Byzantine age. At Sheikh Yusuf al Gharib further evidence was afforded of the activity of the port in the second half of the fourth century B.C., in the form of merchants' magazines, which had been burned, but had preserved a detailed picture of trade. A lamp store was stocked with lamps of both the imported and the locally made varieties, lamp fillers and Syrian oil bottles copying Greek models, while the stock of painted Attic *aryballi* bore witness to a common origin in common characteristics which made it possible to trace a definite shipment by a single firm and to date it within a few years. Gold and silver beads and silver coins of Athens, copper ingots and loose quicksilver marked a jeweller's shop. Back to the ninth century this is the most important Greek colony so far excavated. The absence of evidence from the earlier Mycenæan age is to be attributed to the forces of Nature, which have washed away the earlier portions of the site. Yet there is a link in a local copy of a Mycenæan vase and a single sherd of fine hand-made burnished black ware, which alone would suggest an earlier date. Though no inscription has been found, it is suggested that this is the ancient Posidium, mentioned by Herodotus as founded before the Mycenæan age.

Bronze Age Burials in Scotland

A NUMBER of bronze age burials with some remarkable and unusual features, recently disclosed by building operations at Doonfoot, Ayr, and at Riccarton, Ferniegair, Lanarkshire, are described by Mr. Ludovic Mann in *The Scotsman* of July 20. At Doonfoot, no evidence of a cairn was discovered, but at Ferniegair, a structure of stone, of which the overground portion had been demolished, had covered a group of burials. Some eighty tons of loose stones, some water-rolled, formed an understructure in which horizontal layers of turf had filled the interstices and survived in the form of black carbonized matter. Both cemeteries have yielded pottery vessels of various types, assignable to successive phases of the bronze age and, therefore, pointing to an occupation covering a considerable period of time. The earliest form is a small squat hand-made food-vessel, with incised and impressed zonal ornament. Traces of carbonized cereal adhere to the interior. The bodies had been placed in the contracted position, looking toward the rising, or, in one instance, the setting sun, at Midsummer. Over one body at Ferniegair was sheeting made from the twisted and plaited stems of the Scottish moss, *Polytrichum commune*. Other examples of this textile material have been found at Mount Vernon, Glasgow, in a bronze age cairn near Stranraer, and a few weeks ago at Craignish, Argyll. Mr. Mann states that the dimensions of the stones of the tomb structures conform with an ancient linear measure, as do the interior dimensions of the chamber; and also that the position of the urn-fields, and other remains, ancient roads and tracks, conform, in a geometric convention, also based on a common unit. Both Doonfoot and Riccarton, adjoining burials containe large cinerary urns, with cremated remains, inverte over squared stone slabs. These overlie burials the earlier inhumation period. At Doonfoot thr burials were superimposed. A further find recorde is at Catacol, Lochranza, Arran, where a six-fo skeleton was found in the extended position in a lon narrow chamber, constructed of small side slabs an heavy roofing stones. An iron object was found wit the body.

The National Central Library

THE twelfth annual report of the National Centr Library refers to anxiety regarding the financi position of the Library due to inability to replac from any other source the £4,000 previously receive as an annual grant from the Carnegie United Kingdo Trust. Fortunately, the Treasury grant-in-aid ha been increased from £3,000 to £5,000 for a perio of five years from April 1, 1936, and as a result th Carnegie Trustees have renewed their previous annu grant for a similar period. The continuance of bot grants is conditional upon an increase in annu subscriptions from libraries by at least £2,000 b March 31, 1938. In consequence of the financia situation, expenditure on books has been only £2,33 but in addition to 3,110 volumes purchased, 5,45 volumes have been presented. The total number o volumes lent during the year was 118,288 and ther are now 158 outlier libraries containing 6,303,00 volumes from which 10,002 volumes were borrowed Reference is also made in the report to the extensio of the regional system to cover the counties o Cornwall, Devon, Dorset, Gloucester, Hampshire Oxford, Somerset and Wiltshire. When this syste is established, the whole of England and Wales wi be covered in eight regional systems, in addition t the London Borough libraries inter-lending system Volumes lent to university libraries increased by 9 to 2,506. The system was used by 53 universit libraries and 1,201 of the volumes were supplied b the National Central Library, 77 by foreign librarie and 1,228 by other university libraries, 80·52 pe cent of the inquiries being supplied. The book supplied consist mainly of highly specialized an expensive books, books out of print, foreign books back numbers of periodicals, or unpublished university theses.

National Research Council of Canada

THE eighteenth annual report of the National Research Council, Dominion of Canada, covers the activities of the Council in 1934–35. During the year, the Associate Committees on Aeronautical Research and on Trail Smelter Smoke were re-organized and three important conferences were held, one on problems of the honey industry, another to formulate a programme of cold-storage investigations, and the third to investigate the potato situation and the utilization of a surplus. The work at the laboratory for laundry research conducted by the Council since 1930 has now led to the formation of a Canadian

Research Institute of Launderers and Cleaners. Reports from the various laboratory divisions summarizing work in progress refer to investigations on chemical weed killers, including a review of the literature, and on the biochemistry of rust resistance. The Division of Chemistry has devoted a considerable amount of attention to problems relating to carbon black, leather, paints and rubber. It has developed a method for plucking poultry which has received many favourable notices. A special wax has been prepared which can be used for removing the pen-feathers, and by its use poulterers can prepare birds for market which are cleanly plucked and attractive. Much work has been done on the conservation of Alberta's natural resources, while in the Fire Hazard Testing Laboratory of the Division of Physics and Engineering, the testing and listing of domestic oil burners has been studied and the drafting of safety codes has received attention. A joint Associate Committee with the Dominion Department of Agriculture has investigated field crop diseases while another such committee is concerned with grain research including the frost injury of wheat, methods of determining moisture in grain and the effect of carbon tetrachloride on the quality of damp wheat in storage. Other associate committees are concerned with the storage and transport of food, weed problems, wool, parasitology and engineering standards.

Organon

THE first number of a new international review, *Organon*, has just been published in Warsaw by the Mianowski Institute. It is printed in French and English although all the authors are Polish, in order that a wide public may become familiar with the progress of scientific thought in Poland. The general character of the new publication can be gathered from the first group of contributions—"The Science of Science", "La Science, la religion et l'art", "The Man of Action and the Student", "Documents sur la psychologie de l'invention dans le domaine de la science", "Science and Scholarship in Poland to the Close of the Sixteenth Century", "Copernic", "Organisation de la science polonaise" and "Marja Sklodowska-Curie". The term 'science' is used in the widest possible sense, so that the new review will not be limited to contributions dealing only with the natural sciences. Two of the four historical articles have for their subjects the best known of Polish scientific workers, namely, Copernicus and Mme. Curie. It will be observed that the international character of science is well illustrated by the life and work of Mme. Curie. Polish by birth and French by marriage, her great discoveries were made with material from Bohemia which had been put at her disposal by Austrian authorities.

The Science of Science

THE first contribution to *Organon* attempts to analyse the 'science' of scientific investigations. We are reminded that the problems of science can be grouped according to different principles. Thus, they may be classified as being connected with the philosophy of science, with its psychology or with its sociology. Such groupings and others in which further subdivisions are made do not avoid overlapping but, according to Drs. M. and S. Ossowski, they do serve to indicate that there can be a 'science of Science'. Against this view it can be urged that these problems already have their positions in well-defined fields (psychology, sociology, the theoretical parts of the separate sciences, etc.) but the Polish authors argue that the scope of this 'science of Science' comprises investigations concerning very widely separated subjects and brings them into internal harmony. The problems are attacked by many different means, but even here new links can be forged to bring the whole of science into one harmonious whole. The growth of science requires an extremely wide and many-sided supplementary apparatus, and the building of this apparatus requires theoretical studies.

A Landmark of Horticulture

THE names of J. C. Loudon and his wife Jane Loudon will always be remembered gratefully by gardeners. Such exhaustive publications as the "Encyclopædia of Plants", the "Encyclopædia of Gardening", and the "Encyclopædia of Agriculture" led up to their culminating triumph, the "Arboretum et Fruticetum Britannicum". This was published in sixty-eight parts between January 1835 and July 1838, so that it is approximately one hundred years since this typographical monument was given to the public. Mr. W. Roberts, writing on "The Centenary of Loudon's 'Arboretum'" (*J. Roy. Hort. Soc.*, 61, Part 7, July 1936), gives some interesting information about the methods by which the extraordinary amount of knowledge upon trees and shrubs was brought together. About three thousand questionnaires were circulated, in the days before the penny post, and Loudon received a very gratifying number of replies, the originals of which have been consulted by Mr. Roberts. Many of them bear striking testimony to the popularity of the Loudons, for invitations to stay at country seats were very numerous. An application to the Duke of Wellington resulted in his lordship mistaking the word Beeches for Breeches, and the signature for C. J. London. This he interpreted as from the Bishop of London, and accordingly dispatched the famous Waterloo breeches to that puzzled gentleman. The "Arboretum" and the other publications contain a great deal of information which is still of the greatest use at the present time. It is inevitable that the march of knowledge should add considerably to these solid foundations, but one feels that the £10,000 which the Loudons paid in amassing the knowledge and publishing the text of the "Arboretum" are still bearing handsome interest for the horticultural fraternity.

Survey of India

THE General Report of the Survey of India for 1935 directs attention to the need for quicker revision of the maps of India. It was in 1905 that the Survey embarked on a scheme of 1 inch to 1 mile maps of

India, which was to be completed in twenty-five years and then revised every thirty years. Subsequent events led to a modification of the scheme. In 1913 it was realized that the allotted time was too short, and a smaller scale of map was sanctioned for the less populous areas. But the Great War and subsequent financial stringency still further curtailed the plan. By 1935 only two-thirds of the programme had been completed. Surveys are being carried out at the rate of about thirty-nine thousand square miles a year, and if this can be maintained the programme will be completed in about sixteen years. Meantime, the maps of a large part of India, except on a small scale, are much out of date and printed mostly in black only. The Report contains a key map showing the degree of obsolescence of various sheets. Maps of India, Burma and adjacent countries on the 'one million' scale are now practically complete and the sheets of the Carte Internationale are approaching completion. A separate publication of the Survey of India is an Index to Annual Reports, 1904–5 to 1926–27.

Discoveries in Antarctica

Some valuable details of new discoveries in Antarctica accompanied by photographs are contained in an article in the *National Geographic Magazine* for July by Mr. L. Ellsworth on "My Flight across Antarctica". It will be remembered that in December of last year, Mr. Ellsworth reached the Bay of Whales in the Ross Sea after a flight from Dundee Island, Graham Land. This took him over an entirely unknown part of Antarctica to the Pacific side of the Pole. South of Stefansson Strait he discovered a lofty rugged mountain range with an apparent trend between north-north-west and south-south-east. Farther on, other peaks appeared, one rising to 13,000 feet. Mr. Ellsworth made several landings in about lat. 80° S. and found a plateau at an elevation of more than 6,000 ft. He gave the names Hollick-Kenyon plateau to this elevated country, and James W. Ellsworth Land to the whole area between Hearst Land and Marie Byrd Land. The photographs of the new mountains do not suggest the block faulted mountains of Queen Maud Ranges, but rather the Andean ranges of Graham Land which, from Admiral Byrd's recent discoveries, would seem to continue into Edward Land.

Further light on this problem is shed by an article by Mr. W. L. G. Joerg in the *Geographical Review* of July on "The Topographical results of Ellsworth's Trans-antarctic Flight". Mr. Joerg has mapped the direction of the new ranges as far as available data allow, and his map appears to confirm the suggestion of R. Staub that the axes of the Antarctic Andes of Graham Land spread fanwise in Hearst Land. Each of the newly discovered ranges seems to be a continuation of one of the three-fold lines of Graham Land. The relation of these folds to the plateau land of Antarctica has still to be determined, and Mr. Joerg's suggested direction does not continue into Edward Land. Mr. Ellsworth's photographs also suggest that Stefansson Strait is narrower than previously supposed, or possibly that it is an embayment on the east of Graham Land and not a strait. Its eastern entrance lies mainly north of the seventieth parallel. The discoveries open a field for future ground exploration.

Recommended Values of Illumination

The Illuminating Engineering Society has issued a list of the values of illuminations which are recommended for various purposes. It has been prepared by the Technical Committee of the Society, and copies of the full recommendations can be obtained from the Honorary Secretary, I.E.S., 32 Victoria Street, S.W.1, price 6*d*. Since the candle-powers of electric lamps are known and the distance of the lamps from the work bench can easily be estimated, it is not difficult to estimate the candle-power. The committee recommends that if the task requires both discrimination and response, the foot-candle value should be at least 50. For severe and visual tasks such as fine engraving, sewing of dark goods, and discrimination of fine details of low contrast, the foot-candle value should not be less than 25. For prolonged critical visual tasks such as proof-reading, type-setting, drawing, reading, fine machine-work, fine assembling and use in large stores, a foot-candle value between 15 and 25 is recommended. A foot-candle value of 8–15 would be suitable for visual tasks such as detailed office work, skilled bench work and sewing on light goods and for retail shops. For less-exacting visual tasks, such as general office, large assembly work and classrooms, 5–10 suffices. For work of a simple character not involving close attention of fine details, 3–5 foot-candles is suitable. For casual observation where no specific work is performed, 2–4 foot-candles is regarded as sufficient.

Streamlined Trains

People who have travelled in the new lightweight high-speed trains may have wondered why this new development has not come into wider use, and look forward to the time when most passenger trains will be similarly streamlined. According to a report issued by Science Service of Washington, D.C., L. K. Sillcox, the engineer of the New York Brake Company, discusses this point in a report to the American Society of Mechanical Engineers. He says that only about 20,000 route miles of the main lines of the railroads of the United States are fitted by their curves, grades and traffic to be usable for lightweight trains that can go at 100 miles an hour. This length of railway is only about ten per cent of the total mileage of railroads in the United States. It is well known that crowds will gather to see a passenger locomotive go by if it is fitted with a metal shroud that helps its streamlining or presents what the public thinks is a streamlined appearance. But this shroud adds 13,000 lb. to the weight of the locomotive. Another drawback is that the equipment has to be built very robust. Like motor-cars, the internal equipment has to be turned over and renewed every few years. In addition, any new railroad rolling stock has to be designed so that it is in keeping with the older equipment. A large reserve of the old equipment has to be maintained to meet the changing traffic demands made on it. Some engineers are afraid that there may be a public reaction after the very pleasant boon which the railways afforded when streamlined trains were first used. There is evidence of dissatisfaction when the public learns that a 100–120 miles an hour train is placed in revenue service on a 50–60 miles an hour schedule. Even although the maximum speed has been attained *en route*, the public feels that it has been misled.

Agricultural Research Institutes in Great Britain

THE Ministry of Agriculture has now published the report of the work of the agricultural research institutes in the United Kingdom for 1933–34 (London: H.M. Stationery Office; 5*s*. net). Besides describing the investigations carried out at the forty-four principal institutes, the report deals with the work at various advisory centres and special State-aided researches carried out in different parts of the country. The problems concerned cover a wide field, including soils, plant nutrition, physiology, breeding and disease, dairying, animal nutrition, breeding, diseases and pests, food preservation and transport, and agricultural engineering. Should anyone desire further information, a list of papers published from each centre is supplied so that reference to the original source of the work is available, and inquiries may also be addressed to the director of the institute or person concerned, the names and addresses of whom are listed.

The American Amaryllis Year Book

THE American Amaryllis Society has issued vol. 2, its Year Book for 1935 (from the Editor, Dr. Hamilton P. Traub, Mira Flores, Orlando, Florida, U.S.A.). It is dedicated to Theodore L. Mead, in recognition of his pioneer work with hybrid *Hippeastrum* plants. Gardeners are familiar with narcissi, they bestow a rather occasional interest upon day lilies (*Hemerocallis* spp.), they cultivate *Alstrœmeria*; but most horticulturalists have not yet realized the wonderful beauty displayed by the new hybrids of *Hippeastrum*. The Society has an international outlook, for a large part of the volume is devoted to regional activities in Australia, Kenya, Europe, and all parts of America. A section on "Description and Phylogeny" quotes *inter alia* from Dr. J. Hutchinson's recently published volume on the classification of monocotyledons. Robert F. Ruthruff contributes a paper describing the alkaloids found in various Amaryllidaceæ, and the late Dr. David Griffiths directs attention to "Opportunities for Breeding with Daffodils". Two valuable papers by Miss Ida Luyten and Dr. Traub introduce new methods of vegetative propagation of amaryllids. Fifteen papers deal with culture, five with curing, storage and forcing, and a similar number with marketing. The editor has introduced the idea of quoting one or two abstracts from scientific papers relevant to *Amaryllis* culture, and though the index shows nearly sixty papers, no subject appears to have inadequate treatment. Plans have already been made for publishing year books so far ahead as 1938; the Society occupies a position of great utility and high æsthetic value.

Early Photographs

THE June issue of the *Alumnus Chronicle* of the University of St. Andrews contains an article by Mr. J. H. Read describing a collection of prints by early photographers which illustrate the local development of the art and have been presented to the University by Mr. James Thomson of Inverness. The oldest photographs of the collection are of buildings in St. Andrews produced by the Calotype process about the year 1840. Portraits of St. Andrews worthies, for example, Sir Lyon Playfair and Sir David Brewster, by the process date from about 1850. The majority of the photographs are albumen prints from wet collodium plates taken during the next twenty years, and include portraits, scenery and reproductions of pictures. The article is illustrated by reproductions from paper negatives by Thomas Rodger of a St. Andrews fishing quarter in 1843, and a portrait of Prof. George Day, professor of medicine, 1850, both of which are remarkably good.

Films and their Utilization

THE current number of *Film Progress* is in two parts. It contains the usual supplementary bulletin to the National Encyclopædia of Films. In this section are noted a good number of films, both 35 mm. and 16 mm., of G. B. Equipments and Pathé. Silent films of Ensign and C.I.B.E.F. are also listed. The other section deals mainly with the educational value of the sound film. This is in effect a résumé of the arguments put forward by C. F. Hoban in a symposium on "Sound and Silent Films" held at the University of Chicago. The arguments are well stated, but the article reads too much like special pleading, seeing that the arguments for the silent film presented to the symposium are not mentioned. We hope that they will be stated in a future number.

Third World Power Conference

THE following official delegates have been appointed to represent the Government of the United Kingdom at the Third World Power Conference and Second Congress, International Commission on Large Dams of the World Power Conference, to be held concurrently in Washington, D.C., on September 7–12: Viscount Falmouth, Mr. N. G. Gedye, Mr. T. Hardie, Mr. J. M. Kennedy, Dr. F. M. Lea, Mr. Charles H. Merz, Sir Archibald Page, Mr. C. Rodgers, Dr. F. S. Sinnatt and Mr. E. T. Williams. The final time-table for the Conference has now been announced. The joint opening session will be held in Constitution Hall, Washington, on Monday, September 7, at 8.30 p.m. Business sessions will be held earlier on the same day and throughout the week. There will be an address by the President of the United States on September 11 at 2 p.m. followed by a garden party and reception at the White House.

Building Exhibition at Olympia, London

THREE HUNDRED AND FIFTY firms and associations have already booked space in the twentieth biennial Building Exhibition which is to be held at Olympia, London, on September 16–30. This number of exhibitors is in excess of the number which exhibited on the last occasion in 1934, and an increase of about 10 per cent in the total number may be expected. The Department of Scientific and Industrial Research is again to have a large exhibit, and this will cover not only the work of the Building Research Station, but also that of the Forest Products Research Laboratory, Princes Risborough, and the National Physical Laboratory, Teddington. The Building Research Station exhibit will deal with plastering materials; common types of failure caused by using unsuitable material or by faulty construction; concretes, with special emphasis on light-weight concrete; further work on the driving of concrete piles; the measurement of strain on masonry structures; and the weathering of building stone. The work of the Forest Products Research Laboratory illustrated in the Exhibition will deal with the correct moisture content of timbers for various purposes; wood-working, with special reference to new and difficult timbers; and wood preservation and protection against the death-watch and other beetles. The National Physical Laboratory's exhibit will deal chiefly with building acoustical problems, models being shown of typical quiet and noisy rooms. Short-length films are to be shown by the Department on its stands.

Observations on Comets

A CONSIDERABLE number of observations of Peltier's comet are now available, and the Rev. Dr. M. Davidson has computed a new orbit, using observations from May 16 to July 15, the latter being made by Dr. W. H. Steavenson and independently by Mr. Will Hay. The period appears to be about 1500 years, but observations from the southern hemisphere, in which the comet can be followed up to October, will enable computers to obtain a more accurate period. The comet is rapidly moving south, and will not be visible in these latitudes after August 6. A comet of sixth magnitude was discovered by Kaho on July 17, and a number of observations have since been made at various observatories and also by members of the British Astronomical Association. The orbit given below was computed by Whipple and Cunningham, but as the observations used were very rough, the orbit is only approximate. Dr. Crommelin, having received more accurate observations, is now engaged in computing a general orbit. The comet is receding from the earth and sun and is fading rapidly.

Orbit of Comet 1936a (Peltier)
Computed by Rev. Dr M Davidson

T	1936 July 8 95141 U.T.	
ω	148° 28′ 32 0″	1936·0
Ω	134 02 18 8	
ι	78 32 51 6	
a	130·681	
e	0 991584	
q	1 099743	

The period is nearly 1,500 years.

Orbit of Comet Kaho
Computed by Messrs. Whipple and Cunningham

T	1930 July 13·700 U.T.	
ω	40° 56′	1936·0
Ω	262 02	
ι	123 08	
q	0 5220	

Announcements

ROBERT ESNAULT-PELTERIE has been elected a member of the Division of the Applications of Science to Industry of the Paris Academy of Sciences in succession to the late Jean Rey.

AT the quarterly meeting of the Royal College of Physicians held on July 30, the Weber-Parkes Medal and Prize were awarded to Sir St. Clair Thomson for his work on tuberculosis of the larynx, and the Moxon Gold Medal to Prof. Edward Mellanby for his work on the problems of nutrition. The Harveian Oration will be delivered by Sir Walter Langdon-Brown on October 19, at 4 p.m. Dr. Arthur Hurst has been appointed Harveian Orator for 1937 and Dr. E. A. Cockayne Bradshaw Lecturer for 1937.

THE Royal Academy of Belgium has made the following awards: Lefebvre Prize to MM. Wattiez and Sternon; Laurent Prize to M. R. Bouillenne; Van Beneden Prize to M. J. Brachet and grants from the De Potter Fund to M. A. Gardedieu, M. Capron, M. van den Bruel and M. Florkin.

DR. GOTTLIEB HABERLANDT, emeritus professor of botany in the University of Berlin, has been made an honorary member of the Academy of Sciences of Vienna.

THE Austrian Society for Roentgenology will hold its annual meeting at Vienna on September 4–8. Further information can be obtained from Allgemeines Krankenhaus, Zentral-Roentgen Institut, Alserstrasse 4, Wien 1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

Junior assistants (physics or chemistry) in the Chemical Defence Research Department (War Department)—The Chief Superintendent, Chemical Defence Research Department, 14 Grosvenor Gardens, S.W.1 (August 12).

A lecturer in electrical engineering in Walsall Technical College—The Director of Education, Education Offices, Council House, Walsall (August 15).

An assistant lecturer and demonstrator in civil engineering in University College, Cardiff—The Registrar (August 19).

A part-time assistant lecturer in the Department of Physics and Applied Physics in the Technical College, Cardiff—The Director of Education, City Hall, Cardiff (August 24).

An assistant director of the Plant Pathological Laboratory, Harpenden—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1 (August 31).

A senior assistant in the Department of Surgery of the Royal Veterinary College—The Secretary (August 31).

An assistant curator in the Royal Albert Memorial Museum, Exeter—The Town Clerk, Exeter (August 31).

A lecturer in physiology in the University of Western Ontario, London, Ontario, Canada—The Dean of the Medical School.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 250.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Energy of Formation of 'Cyclol' Molecules

ACCORDING to the cyclol theory of the structure of proteins[1]—a *working hypothesis* recently put forward in these columns—the polypeptide, the essential unit in the molecule on the classical theory, is replaced by the cyclized polypeptide (Fig. 1): correspondingly the classical peptide links (joining one pair of C,N atoms) are replaced either by the double peptide links (joining two pairs of C,N atoms) or by the triple peptide link (joining three pairs of C,N atoms) (Fig. 2). The reaction

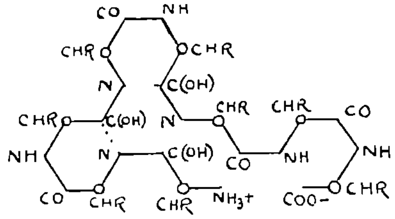
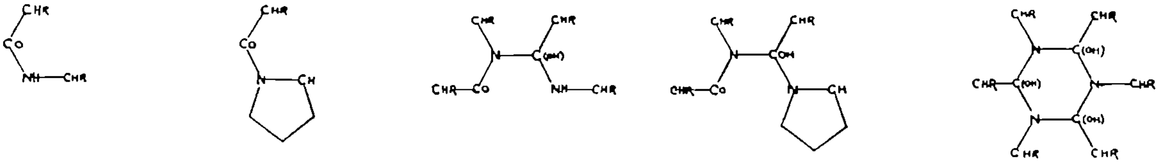


FIG. 1.



Single peptide links. Double peptide links. Triple peptide link.

FIG. 2.

polypeptides $\rightleftharpoons$ proteins

is thus regarded as a ring chain tautomerism[2], which takes the form

$$\geqslant\mathrm{N}\quad(\mathrm{HO})\,\mathrm{C}\leqslant\ \rightleftharpoons\ >\mathrm{N}-(\mathrm{HO})\,\mathrm{C}< \qquad (1)$$

if the appropriate groups are in the imide form, and the form

$$>\mathrm{NH}\quad\mathrm{O}=\mathrm{C}<\ \rightleftharpoons\ >\mathrm{N}-(\mathrm{HO})\,\mathrm{C}< \qquad (2)$$

if they are in the amide form.

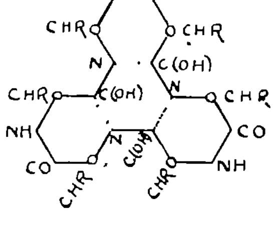


FIG. 3.

The precise data required for an estimate of the energy balance in the process of formation of cyclol molecules from polypeptides are not yet available, but we may consider cyclol 6 (Fig. 3) as an indication of the situation, in the hope of directing attention to the fact that certain data are urgently required.

The figures[3] for heats of formation of various links, in kilogram calories, are as follows:

C—O	82·8	(alcoholic ethers)	C=N	119·6	('estimated')
C=O	177·8	(ketones)	O—H	109 5	(H_2O)
C—N	61·5	(amines)	N—H	83·3	(NH_3)

With these figures, the energy changes are as follows:

One amide to imide transformation,

$$(177{\cdot}8+61{\cdot}5+83{\cdot}3)-(82{\cdot}8+109{\cdot}5+119{\cdot}6)=+10{\cdot}7.$$

One transformation of type (1),

$$(119{\cdot}6)-2(61{\cdot}5)=-3{\cdot}4.$$

One transformation of type (2),

$$(177{\cdot}8+83{\cdot}3)-(82{\cdot}8+109{\cdot}5+61{\cdot}5)=+7{\cdot}3.$$

According to these figures, the formation of cyclol 6 from a closed polypeptide consisting of 6 residues requires 21·9 kilogram calories if the polypeptides are in amide form throughout; if the three links concerned are already in the imide form, energy amounting to 10·2 kilogram calories is emitted. In these calculations, no allowance is made for resonance, which amounts to 20 kilogram calories for acetamide.

The calculation for the process of linkage (1) suggests that if the synthesis of proteins is a process of cyclization of polypeptides (or indeed if it is a process of polymerization of substituted diketopiperazine molecules), it is facilitated if the appropriate groups are in the imide form. The implication is that certain enzymes operate directly on the substrate by imposing on some of its (CO,NH) groups, the imide form $-C(OH)=N-$. This deduction from the cyclol hypothesis gains support from the researches of Bergmann and his co-workers on dipeptidase, which led them to assume[4] that the "hydrogen atom becomes rearranged under the influence of the enzyme in such a way that the amide form of the dipeptide is changed to the imide form $-CO-NH- \rightarrow -C(OH)=N-$".

The implications of the calculation for the process of linkage (2) are explored in the accompanying letter by my colleague, F. C. Frank.

D. M. WRINCH.

Mathematical Institute,
Oxford.

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[1] D. M. Wrinch, NATURE, **137**, 411 (1936).

[2] See, for example, J. W. Baker, "Tautomerism" (1934), p. 38.

[3] The figures of Pauling and Sherman given in *J. Chem. Phys.*, 1, 606 (1933), calculated on the basis of the value of 208 kilogram calories for the heat of dissociation of N_2, have been modified to take account of the revised value of 169 kilogram calories (see Mulliken, *Phys. Rev.*, **46**. 144 (1934); Herzberg and Sponer, *Z. phys Chem.*, B, **26**, 1, though this modification is without effect on these calculations.

[4] *J. Biol. Chem*, **109**, 325, 329 (1935).

WRINCH[1] recently proposed that in monolayers or globular molecules of proteins, polypeptide chains are knitted into a fabric by the bonding process

$$>C=O + HN< \rightleftharpoons >C(OH)-N<,$$

which Frank[2] had shown to be required in keratin to make permissible the structure Astbury deduced for it by X-ray crystallography. It is desirable to estimate the energy balance of this process, which is chemically analogous to lactam-lactim tautomerism, or to the ring closure in sugars associated with mutarotation.

Taking link values of heat of rupture from Pauling and Sherman[3], we find the process of linkage represented above is endothermic by about 7·3 kcal., while a lactam-lactim transformation is 10·7 kcal. endothermic, without allowance for resonance energies in either case. Resonance in the lactam form increases both these figures by some 20 kcal., if taken as the same as in acetamide: there must be a similar but presumably smaller resonance energy in the lactim, but the 'cyclol' molecule in itself offers no chance of constructing a resonant system.

Though these are not free energies, and in any event not very accurate, they appear certainly too large to allow the equilibrium to rest close to the right hand of the equation, as the theory requires, so that we must either abandon the theory or find some compensating source of energy. This is provided in the keratins by strain in the side-chain cross-linkages, which Astbury[2] and Speakman[4] have shown to provide the main driving force of contraction from the β-form. In the proposed 'cyclol' monolayers, we have a similar source of energy which we may call a heat of crystallization, for the cyclization into a compact strainless form is evidently at the same time a process of two-dimensional crystallization; but this by itself cannot be sufficient.

An additional source is provided by hydration (or association through hydroxyl bonds generally), which is well known to stabilize lactims, non-chelate enols, and hydroxylic tautomeric forms in general[5], a fact directly related to their superior solubility in water and other hydroxylic solvents. Not only the hydroxyls but also the nitrogens, which are more aliphatic in nature in the cyclized form, are available for hydration: protein hydroxyls can also associate with each other. Each hydroxyl bond formed may be supposed to provide energy of the order of half the internal latent heat of vaporization of ice, thus about 5 kcal., so that the whole may be a sufficient compensating source of energy, about 20 kcal.

Thus it appears that if the protein molecules are fabricated with the aid of this linkage, they can only be stable when hydrated. Any conditions tending to dehydration will render the protein excessively liable to opening into chain forms, unless restrained by side chains or deprived of catalysts necessary for transformation. Mildly dehydrating conditions should be most effective because water is a catalyst for transformation as well as a stabilizer of one form. So long as the rings only occasionally open they can re-form in the same configuration, but as soon as the opening becomes too frequent this will cease to be the case and they will then re-form in altered structures, derived more directly from open chains. This conforms with all observations on the processes of degeneration and denaturation, including Astbury's X-ray studies of these processes[6,7]. Thus what seems at first to be a destructive obstacle to the theory may be capable not only of reconciliation with it, but even of enhancing its effectiveness.

F. C. FRANK.

Engineering Laboratory,
Oxford.
July 7.

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[1] D. M. Wrinch, NATURE, 137, 411 (1936).

[2] See W. T. Astbury, *Proc. Textile Inst.* (1936), in the press.

[3] L. Pauling and J. Sherman, *J. Chem. Phys.*, 1, 606 (1933).

[4] J. B. Speakman, *Proc. Textile Inst.* (1936), in the press.

[5] See, for example, J. W. Baker, "Tautomerism" (1934), p. 38.

[6] W. T. Astbury and R. Lomax, *J. Chem. Soc.*, 846 (1935).

[7] W. T Astbury, S. Dickinson and K. Bailey, *Biochem. J.*, **29**, 3351 (1935).

Insect Coloration

IN the article on the Oxford Congress of the South Eastern Union of Scientific Societies in NATURE of July 11, p. 88, reference is made to the address of the president, of which the main topic was the coloration of insects by natural selection. Prof. Hale Carpenter is reported as saying:

"Sometimes it pays an insect to change its appearance according to whether it appears in a dry or in a wet season. Poulton pointed out that a dry season is one of scarcity of food, and certain butterflies then remain inconspicuous and of skulking habits, whereas in a wet season they are conspicuously coloured, and they can afford to allow some of the species to be eaten by reason of their number."

Prof. Hale Carpenter referred to an African *Charaxes*, which is conspicuous in the wet season but in the dry assumes a dead-leaf-brown and deliberately hides itself among clusters of dead leaves. To assert that an insect *deliberately* hides, is going far. When bug hunting in Australia and Sumatra, it seemed to me that the butterflies all made for shade behind leaves, when not madly careering in the sun. May not the food in the two seasons vary, not merely in quantity but in quality? It certainly will. The temperature also. As we know nothing about the relation of coloration to quality of food, the subject is beyond discussion, at present. Darwinian discussion is largely on 'Alice' lines. No chemist can believe in change by any process of direct mimicry—nor even a MacBride. Nature is held under strict enzymic control, though inspection of any good collection shows the actual variations are very wide. Discussions too are often wide of the mark: if they were all scientific, our shelves would have an easy burden. Are the morals of the insect world on so high a plane that it can be asserted that there has never been a cross of mimetics? Mistakes, we know, are made even in the best regulated families.

HENRY E. ARMSTRONG.

55 Granville Park,
Lewisham, S.E.13.

PROF. ARMSTRONG's criticisms are easily met. It is *not* going too far to "assert that an insect *deliberately* hides". The taking temporary shelter from sun is a different matter from assuming a position of complete rest in surroundings best suited to concealment for long periods. The case I mentioned was undoubtedly deliberate choice of a cluster of dead leaves, among others, by a *Charaxes*. I have repeatedly watched the Pierine butterfly *Eronia cleodora*, having been disturbed from undergrowth where it had settled late in the evening, deliberately settle again, after previously fluttering around, among the half-dead leaves from which it had been disturbed and with which its patchy yellow underside closely matched. The late Dr. G. B. Longstaff recounts the same experience on p. 194 of his book, "Butterfly Hunting in Many Lands", and gives a very accurate coloured plate to illustrate the point.

Has Prof. Armstrong never studied photographs of procryptic geometrid moths on the bark of trees, which do not rest in haphazard positions but take up an attitude bringing the edges of their front wings into line with the edge of a crack in the bark, and putting the main features of their pattern into harmony with the surface on which they rest ?

Prof. Armstrong says that "No chemist can believe in change by any process of direct mimicry". It is a little difficult to understand precisely what is meant. Is he aware of the facts concerning *Papilio dardanus* ? In this butterfly the light yellow pigment of the male, and the ancestral form of female like it, fluoresces in ultra-violet light, but in the mimetic forms of female the fluorescence has been lost : this surely implies a chemical change.

The last point raised by Prof. Armstrong is a form of the old and out-of-date argument that mimicry is merely an expression of affinity.

No one, I think, would venture to assert that the close mimetic likeness of a moth to a Hymenopterous insect such as an ichneumon-fly is due to hybridization ! Would Prof. Armstrong account for the likeness of a moth or a beetle to a bird-dropping in the same way ? Such a resemblance is of the same class as mimicry, and an explanation other than natural selection which accounts for both has yet to be found.

G. D. HALE CARPENTER.

University Museum,
Oxford.

Palæozoic Seismicity

EVIDENCE of contemporaneous disturbances during the deposition of Ordovician strata has recently been collected at localities in the Irish Free State including Portraine, Balbriggan, Raheen Bridge and Tramore. This comprises breaking up and slumping of limestone beds, rapid alternations of shale and graded sand (greywacke sedimentation), breccia beds between sub-parallel undisturbed layers, and anti-dune wave-crests in mud. The cause probably lies in seismicity associated with the instability of the Lower Palæozoic geosyncline.

It now seems possible to demonstrate that the 'crush-conglomerates' and 'thrust-conglomerate' distinguished by Reynolds and Gardiner[1] at Portraine are paene-contemporaneous effects, since the Portraine limestone contains unbroken layers intercalated between beds brecciated *in situ*, and 'landslip' masses (Fig. 1). North-west of Balbriggan, one has a repetition of several of the features which Henderson[2] at Girvan ascribed to seaquakes and tidal waves. In County Waterford, greywacke beds with breccias have been examined on the coast north of Raheen Bridge. The shaly fragments in these remain so sharply angular that they must have become embedded in their present sandy matrix almost as soon as they were disrupted. The possibility of tsunamis, after earthquakes, carrying shore sand out to sea among disturbed shaly sediments, as suggested by Bailey and Weir[3], must be carefully considered. In the Carrigaghalia Series of Reed[4], on the north side of Doneraile Cove, Tramore, wave-crests of mud, in the anti-dune phase, have been discovered preserved in tuffaceous sand. The only explanation in this case seems to be that the sandy detritus was deposited by a tsunami, the swift passage of which induced the anti-dunes. Examination of one wave-crest about ¾ inch high, indicates that it is in no way a compressional structure due to pressure by an overlying column of sand differentially weighted, but shows loosening out of the muddy laminæ.

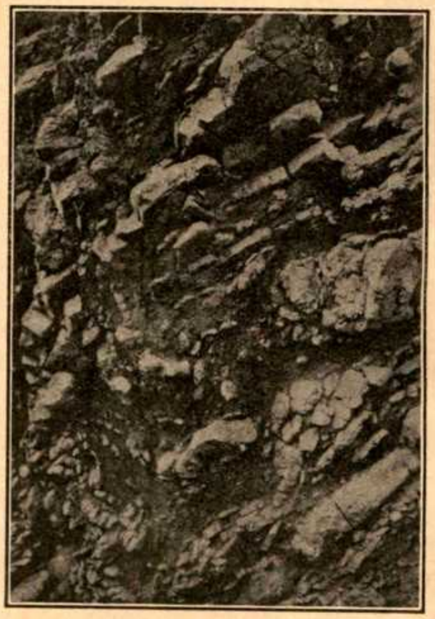

FIG. 1. Slumping of limestone beds in shale. Height of section, about 8 feet. Priest's Chamber, Portraine, Co. Dublin.

This work casts grave doubt on the views of Kilroe and McHenry[5] regarding 'intrusive tuffs' in south-eastern Ireland. These anomalous clastic beds probably originated as water-laden sand which, under seismic conditions, might behave with the mobility of an igneous rock.

The Irish disturbances I have noted are of Caradocian age—the Portraine beds may be correlated with the Robeston Wathen limestone in Wales —and this epoch may be regarded as one of marked seismicity.

There is no doubt that seismic activity must have prevailed at many stages during the development of the Lower Palæozoic geosyncline. Certain breccias in Arenig greywackes of the west of Ireland are unquestionably attributable to it. One example figured by Gardiner and Reynolds[6] from Glensaul may be taken as typical. It occurs sharply bounded between undisturbed layers, the narrowness and unbroken nature of which exclude the contingency of frictional brecciation. A similar interpretation seems to apply to the 'crush-conglomerates' described by Lamplugh[7] from the Manx Slate Series. In the Lower Cambrian (?) of Howth, near Dublin, greywackes and shaly breccia—'sherd-schist'—appear to me to provide at a still earlier period an indication of contemporaneous disturbances.

As an example from another geosyncline, there are the graded sediments of the Middle Devonian of New South Wales. From these, Benson[8] figures an example in which a claystone layer has two anti-dune wave-crests picked out in tuffaceous sand. He describes the latter as 'intrusive'. But it is more likely to have been carried into place by a tunami. The specimen, I believe, has been figured upside down.

It may be added that a recurrence of seismic conditions in carboniferous times in the Dublin district seems to be indicated by anti-dune wave-crests in mud which have been found in beds of Yoredale age at Loughshinny. These beds show rapid alternations of shale and graded sand. Their evidence is corroborated by brecciation *pari passu* with deposition in D_2 limestone at Curkeen Hill quarry.

ARCHIE LAMONT.

Department of Geology,
University,
Glasgow.
June 25.

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Density and Compressibility of Solid Hydrogen and Deuterium at 4·2° K.

IT has been shown by Bennewitz and Simon[1] that the influence of zero-point energy on the properties of a condensed substance is very great for substances of low boiling point. The effect is most marked in helium[2], where it actually plays the chief part in determining the properties; but it is large, too, in hydrogen, a substance which is particularly interesting as it possesses two isotopes which have identical binding forces but very different zero-point energies.

Certain of the properties of the solid phases have been measured already, by Simon and Lange for hydrogen[3] and by Clusius and Bartholomé for deuterium[4], among them being the specific heats at constant pressure, the heats of evaporation and melting, and the molar volumes at the triple points. Clusius and Bartholomé have discussed in their very interesting paper the influence of zero-point energy by comparing the properties of the two isotopes. Nothing was hitherto known, however, of the compressibilities. These are of special interest because the zero-point energy gives rise to a pressure $p^{(\circ)}$, and its variation with volume to a compressibility[2] $K^{(\circ)}$, which, as a preliminary estimate shows, will be an important part of the total compressibility. At the same time, a knowledge of the molar volumes at the boiling point of helium will give us very nearly their values at absolute zero, and, using the known values at the triple points, the mean thermal expansions.

For obvious reasons, we had to use a pyknometer method. The only substance available as a filling liquid is liquid helium, and since its compressibility is very much greater than that of solid hydrogen, the method cannot be one of high accuracy. But as hitherto even the order of magnitude was not known, we thought it worth while to carry out the experiment.

A vessel of known volume (about 4 c.c.) was attached to a helium liquefier of the expansion type; it was nearly filled with condensed hydrogen (or deuterium), and when this was solid, completely filled with liquid helium at a pressure of about 100 kgm./cm.^{2}. By letting out successive amounts of helium and measuring them as a gas at room temperature, and afterwards measuring in the same way the hydrogen, the density of the solid hydrogen at each pressure could be calculated. The results are given in the accompanying table.

	Hydrogen	Deuterium
Density (gm./cm.^{3}) at 1 kgm./cm.^{2} and 4·2°	0·0890 ± 0·0004	0·2059 ± 0·0010
Molar volume (cm.^{3}) at 4·2°	22·65 ± 0·1	19·56 ± 0·1
Compressibility (cm.^{2}/kgm.) at 4·2° (average from 1 to 100 kgm./cm.^{2})	(5·0 ± 0·5) × 10^{-4}	(3·3 ± 0·7) × 10^{-4}

As to the compressibilities, it may be remarked that the curve of volume against pressure is, as expected, not a straight line. In the above table, however, only the mean compressibility between 1 and 100 kgm./cm.^{2} is given, since it is known more accurately than the compressibility at any given pressure. But it may be noted that the compressibility at 100 kgm./cm.^{2} is for both isotopes roughly half that at 1 kgm./cm.^{2}. For the thermal expansion, assuming for a rough estimate that it is proportional to C_p, and combining the molar volumes at 4·2° with those at the triple points, we find that at a given temperature the expansion coefficient of deuterium is about half that of hydrogen.

We intend to publish a more detailed account of these experiments, and will postpone until then the theoretical discussion of our results, which we hope to consider also from the point of view of F. London's treatment of helium[2]. Here we should like to point out only that, for hydrogen, $p^{(\circ)}$ amounts to about 1,000–2,000 atm., and $K^{(\circ)}$ accounts for a very great part of the total compressibility.

Our sincere thanks are due to Dr. N. Kürti for his constant help in carrying out the experiments.

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Quantum Relationship of the Light-emitting Process of Luminous Bacteria*

WE have studied the relation between the oxygen consumption and the light intensity of a suspension of luminous bacteria (*Photobacterium phosphoreum*) by measuring simultaneously, at different concentrations of potassium cyanide, the oxygen consumption by the ordinary Warburg method and the light intensity with the aid of a photometric method.

It could be shown that the oxygen consumption consisted of two main parts: one of which was inhibited completely by about 0·001 mol. potassium cyanide, whereas the other decreased slowly with increasing concentration of the cyanide and in proportion to the light intensity.

In plotting the light intensity against oxygen consumption, the lower part of this curve was a straight line, giving the percentage of oxygen consumed in the light-emitting process. This proved to be 19 per cent of the total amount of oxygen consumed.

As the light emission could be measured in absolute units, the number of molecules of oxygen consumed per quantum of light emitted could be computed. At 16° C. the mean value obtained was 500 molecules of oxygen per quantum.

It seems remarkable that, whereas the percentage of oxygen consumed in the light-emitting process proved to be constant under different conditions and at different temperatures, the light intensity varies a great deal. It must be concluded, therefore, that the efficiency of the light-emitting process is dependent on various, as yet unknown, factors.

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* Preliminary communication from the Rockefeller Biophysical Research Group under the direction of Prof. L. S. Ornstein (Utrecht) and Prof. A. J. Kluyver (Delft).

The Lower Regions of the Ionosphere

IN our recent letter to NATURE[1], we did not mean to infer that reflections from the 60 km. level had not been found before. So early as 1930, Appleton[2] noticed reflections of this type. In 1935, Mitra and Syam[3] recorded reflections from this level using the pulse method of Breit and Tuve. The only addition we made to existing knowledge was that this high level forms the top of a region extending from 40 km. to 55 km. and that there is a lower region from 5 km. to 30 km. high. Practically the same discovery was made in England by Watson Watt and his co-workers[4]. In accordance with Mitra's suggestion[5], we propose to call these the *D* and *C* regions.

The following observations may be of interest. The height of the lower boundary of the *C* region is less in summer than in winter; it rises slightly during the night. The *C* region is so strongly reflecting in the summer months that it weakens the reflection from the *D* layer. Hence the *D* layer is usually found in the winter season. When thunderstorms or strong winds are present, the *C* region is very turbulent.

On April 22, 1936, a violent magnetic disturbance was recorded at Cheltenham, Md. On the same day, we observed that the *C* region was fluctuating violently (Fig. 1) and its lower edge approached very close to the earth's surface (1–5 km.). At that time no signals were received upon the 20-metre transmission band from any distant stations.

When the U.S. stratosphere balloon *Explorer II* passed through the 60,000 ft. level, its signals became weak[6]. Our explanation of this phenomenon is that the balloon was actually above the top of the *C* region; hence the signals, which had been reflected back to the earth when the balloon was in the *C* region, were later reflected out into space.

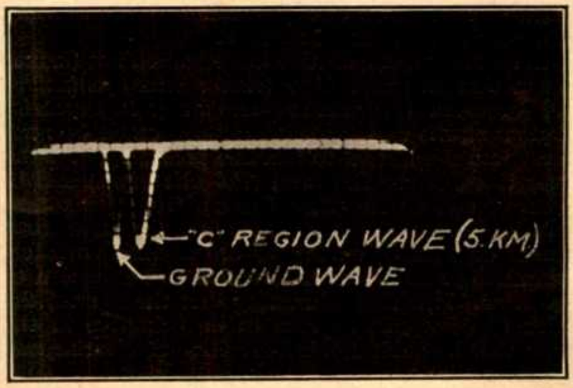

FIG. 1. Ground pulse and its reflection from the *C* region. On this scale, the *E* layer would appear about three inches and the *F* layer about six inches to the right.

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Stereoisomeric Nature of Oxidation and Fermentation

I HAVE investigated with the aid of the Warburg technique the action of optically isomeric nicotines upon alcoholic (*Torula utilis*, *Saccharomyces exiguus*) and lactic (*Bacterium Delbrücki*) fermentations of glucose dissolved in the external solution; upon oxidation of exogeneous glucose by *T. utilis*, *S. exiguus*, *Oidium lactis*, *Bacillus subtilis*, *B. mycoides*, *Sarcina lutea* and *Bacterium Schützenbachi*; upon oxidation of lactate by *O. lactis* and of ethyl alcohol by *B. Schützenbachi*; and upon respiration of stored glycogen in *T. utilis*, *S. exiguus* and *B. subtilis*. It was found that in these microbes all fermentations are more strongly depressed by *l*-nicotine than by *d*-nicotine, but all oxidations are, conversely, more strongly depressed by *d*-form.

I have also investigated the action of optically isomeric nicotines upon the metabolism of slices of mouse tissue. The respiration of the stored glycogen in the liver of the mouse proceeds in two linked phases, the first of which (anaerobic) is more sensitive to nicotine poisoning and accounts for the fact that *l*-nicotine inhibits the whole respiration more strongly than *d*-nicotine. The oxidation of exogeneous glucose and of lactate in the slices of starved liver are direct, and therefore more sensitive to *d*-nicotine. Glycolysis of the grey substance of the brain in mice is *l*-sensitive to nicotine and of the same order of magnitude as the endogeneous respiration in the liver, and it is therefore probable that lactic acid production is the limiting anaerobic link in the latter case.

An extensive comparative investigation has further shown that in green Algæ (*Rhitoclonium fontanum*) and Protozoa (*Palamecium candatum*, *P. Cursaria*, *Euglena viridis* and *Eudorina elegans*) oxidations are direct and *d*-sensitive to nicotine poisoning. At the same time, in the flatworm (*Polyulis nigra*) and in livers of adult pike (*Esox lucius*), frog (*Rana temporaria*), green linnet (*Chloris chloris*), and fowl (*Gallus domesticus*) oxidations are coupled with fermentations, and are more sensitive to the action of *l*-nicotine. It is also interesting that the liver of the chick (3 days old) appears to be primitive in the sense that its oxidation is *d*-sensitive to nicotine and therefore direct.

The precision of the results obtained in the analysis of oxidation and fermentation with the aid of optically isomeric nicotines may perhaps be due to the fact that both the pyridine and pyrrol groups of nicotine enter into the composition of enzymes catalysing carbohydrate breakdown[1] which are therefore in some way specifically destroyed by the nicotine.

A complete account of these investigations will be published shortly.

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Warburg *et al.*, *Biochem. Z.*, **282**, 157 (1935).

Interaction of Heavy Nuclear Particles

SOME time ago, it was suggested that the interaction between neutrons and protons goes on via particles of small mass—electrons (positrons) and neutrinos—somewhat in the same way as electromagnetic interaction (compare Coulomb's law) is transferred by photons[1]. After a recent discussion of the problem by Heisenberg[2], who pointed out the necessity for changing the r^{-5} law to one involving r^{-7} or r^{-9}, it seems desirable to perform the calculations for the magnitude of interaction in the most simple manner.

Indeed, the most essential point proves to be the fact of energy transfer *by a pair of particles*, and not by a single photon as in the usual electromagnetic case. For the magnitude of the interaction at the small distances which are of interest, even the statistics of the transferring particles is not important, or even the kind of partners implied (electron and neutrino, or two neutrinos). We have worked with simple scalar equations of wave type, or of the type of Schrödinger's second order relativistic equation. Starting with Fermi's assumption for the interaction between heavy particle and neutrino-electron field ($g\,\varphi_1\varphi_2$), or with a more general expression $\left(g\,\frac{\partial^n\varphi_1}{\partial t^n}\,\frac{\partial^m\varphi_2}{\partial t^m}\right)$ and applying the elegant method of Dirac's quantum electrodynamics, we get for the magnitude of interaction expressions proportional to $\frac{g^2}{r^5}\,I_1(r)$, or $\frac{g^2}{r^{2m+2n+5}}\,I_2(r)$. The integrals $I(r)$ are equal to 1 for $r \ll h/mc$ and vanish at great distances. Thus we get the remarkable result that the interaction depends chiefly on the presence of two particles, just as does the probability for β-decay[3]. If needed, one can introduce the relativistic equations for heavy particles and work with an interaction formula which is very similar to Breit's, but not identical with it.

So far as the order of magnitude is concerned, we can compare the interaction at the distance r_0, equal to the radius of a heavy particle, with the self-energy μc^2. For $r_0 \sim 10^{-13}$, which is assumed to be the most reasonable, the best choice is the energy expression, proportional to $\frac{g^2}{r^{11}}$ or $\frac{g^2}{r^{13}}$, which results from that form of the interaction between heavy and light particles and is that found to be the best for the purposes of β-decay theory[3].

We may note that until now no classical analogy for the field of two particles has been found, so that the above considerations rest on essentially non-trivial results of quantum electrodynamics.

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Dependence of the Herschel Effect upon the Surrounding Gas Medium

THE Herschel effect—the weakening of the latent photographic image by means of light—is observed, as a rule, in the red and infra-red region of the spectrum. Recent investigations, however, show that under certain conditions the Herschel effect is observed in regions of the spectrum, where usually a normal photographic effect prevails. If, then, the Herschel effect is stimulated by the parallel reaction which accompanies the main photographic process, it is reasonable to suggest that the surrounding gas medium is involved in the reaction.

It was suggested to me by Prof. Narbut that an investigation of the influence of the gases oxygen, nitrogen, hydrogen and carbon dioxide and also of a vacuum upon the Herschel effect would repay investigation. Diapositive plates of the "Photo-Khim-Trust" works of Moscow and Kiev were used. The Herschel effect was obtained by red light (a photographic lamp of 25 candle-power).

Investigations were carried out with seven series of plates, with the following results:

(1) In oxygen, the Herschel effect is much more intensive.

(2) In nitrogen and carbon dioxide, the Herschel effect has almost disappeared.

(3) In hydrogen, the red light gives but a normal photographic effect—additional darkening of the plate. Hence the medium is apparently essential in

the mechanism both of the normal photographic effect, and also the Herschel effect.

Further work with other photographic materials is in progress.

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Ozone as a Heating Factor in the Atmosphere

THE vertical distribution of temperature in the upper layers of the atmosphere as affected by ozone has been carefully calculated. Taking the vertical distribution of ozone as found by Gotz, Meetham and Dobson, and using new absorption coefficients, it was possible to derive the energy absorbed in the course of one day. Four days were selected to show the yearly change.

The solar radiation below 3000 A. was assumed to be a black-body radiation of 5,910° K.; for all the other wave-lengths, the values given by Abbot were used.

Secondly, the nocturnal radiation has been studied. For each layer the absorption of radiation from the earth and from all the other layers, and the re-radiation of this layer have been calculated. The atmosphere was divided into six layers.

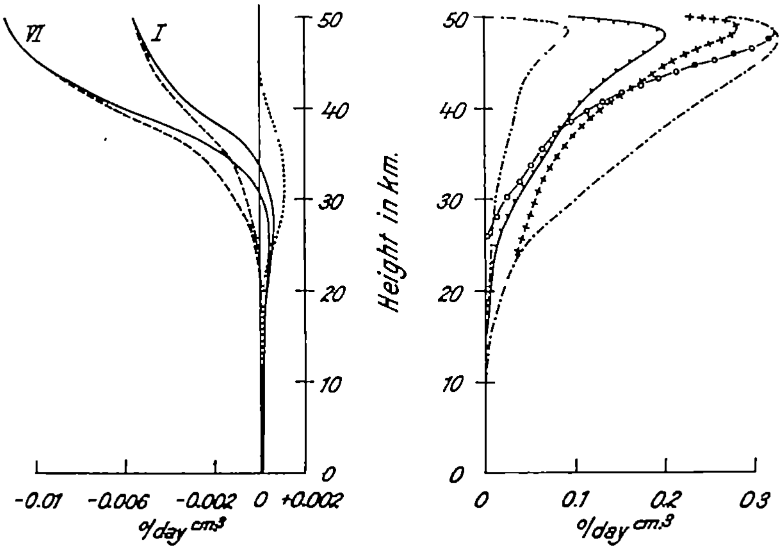

FIG. 1. Left. Cooling effect as affected by long-wave radiation. Two examples for different temperature distribution in the stratosphere are shown. Nocturnal radiation ———. Ozone radiation — — —. Terrestrial radiation . . . . . .
Right: Heating effect as affected by absorption of solar radiation. March 21 + + + + June 22 — · — · — · September 23 ┬┬┬┬┬ December 22 — · · — · · — · · Ultra-violet absorption only (for June 22) —o—o—o

The results are shown in Fig. 1. It is seen that the heating effect is about ten times the cooling effect at a height of 50 km. Below 25 km. no remarkable influence could be found. Despite the fact that the centre of gravity is situated at 25 km., the maximum lies at 50 km. This demonstrates the importance of an exact determination of the ozone concentration in the highest layers. The maximum corresponds to many assumptions on the constitution of the upper atmosphere.

The results summarized here will be published elsewhere in a more detailed account of these and other phenomena concerning atmospheric ozone.

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Value of the Acid Silver Nitrate Reaction as a Test of Ascorbic Acid

SZENT-GYÖRGYI observed that the suprarenal cortex reduces silver nitrate, and attributed this property to the ascorbic acid (vitamin C) which it contains[1]. Many workers have observed that this reaction disappears in scurvy and comes back if ascorbic acid is given to the scorbutic animal[2]; the reaction was also used for histological detection of vitamin C, and, the specificity of silver nitrate being increased by acidification with acetic acid, an accurate cytological study of its repartition could be made[3].

The value of the silver nitrate reaction as a test of ascorbic acid has been questioned. Harris and Ray[4], noticing that the liver and the suprarenal medulla, though rich in ascorbic acid, failed to be coloured by silver nitrate, concluded that the absence of this reaction was very little guide as to the presence or absence of vitamin C. Many investigators consider the reaction valueless[5,6]. For example, in a recent review of the question[7], King says: "Silver nitrate staining is not reliable qualitatively or quantitatively as an index of vitamin C in tissues."

In order to clarify this question, we have to consider:

(1) *The occurrence of a reaction with acid silver nitrate.* The reduction of this reagent, without any action of light or heat, is a very specific test of ascorbic acid for the following reasons: the marked reductions are observed only in the organs which by the chemical and biological methods appear to be rich in ascorbic acid (suprarenal cortex, corpus luteum, interstitial cells of the testis and anterior pituitary). In these organs, the cells appear filled with the granules of reduced silver. In organs poor in ascorbic acid, a slight reaction, frequently with a deposit of the silver precipitate at the Golgi apparatus (suprarenal medulla, epididymis), or no reaction except along the walls of the blood vessels, is observed.

When large quantities of ascorbic acid are given to a guinea pig, new reactions appear in the epithelial cells of the intestine, and in the convoluted tubules of the kidney, corresponding chiefly to the increase in absorption and elimination which can be demonstrated by chemical methods.

If guinea pigs are given a diet without ascorbic acid, the reactions disappear quickly, so that after ten days none can be observed in their organs. Biological experiments confirm the absence of ascorbic acid in these conditions.

If ascorbic acid is injected into a guinea pig which is scorbutic and therefore depleted of its reserve, all the reactions reappear within a few hours after the injection.

It may be concluded that all the reactions observed after action of acid silver nitrate are due to ascorbic acid, and, as the histological localizations of the reactions are exactly the same in the animals which, like the rat, are able to synthesize ascorbic acid and therefore cannot be depleted of it, it is logical to assume that in these animals, too, these reactions are caused by ascorbic acid.

However, there is one exception: the melanin granules in the Langerhans cells and the Malpighian layer of the skin show a reaction which may not be attributed to ascorbic acid, since it persists after methyl alcohol extraction, and does not disappear in the scorbutic guinea pig. This single exception ought not to cause confusion because of the easily recognizable pigment granules.

(2) On the other hand, *the absence of reaction* with acid silver nitrate may indeed be observed in some tissues rich in ascorbic acid (suprarenal medulla, liver . . .), so that a negative result must not be necessarily interpreted as indicating the absence of ascorbic acid.

The chief reason for this failure to reduce silver nitrate is the presence in the organs of factors inhibiting the reduction of ascorbic acid; these 'inhibiting factors' have been described by Huszak[8] in the suprarenal medulla and by de Caro and Giani[9] in other tissues.

In short, the absence of a coloration by acid silver nitrate does not necessarily mean the absence of ascorbic acid, but a positive reaction is a very specific test for this substance.

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[3] The formula of the reagent used is: Glacial acetic acid, 1 c.c.; Silver nitrate, 10 gr.; Water up to 100 c.c. A Giroud and C. P. Leblond, *Arch. d'Anat. Microsc.*, **30**, 105 (1934); *Arch. d'Anat. Microsc.*, **31**, 111 (1935).

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Kerr Constants of the Hydrogen Halide Gases

ON the basis of a recent note dealing with the polarization ellipsoids of the hydrogen halide gases[1], it becomes possible to calculate their Kerr constants (Na–*D* line, 20° C., 760 mm.), numbers which should be directly capable of experimental verification.

We take the Boltzmann constant $k = 1{\cdot}371 \times 10^{-16}$ erg per degree per molecule, $T = 293°$ K., $\pi = 3{\cdot}1416$, $N = (6{\cdot}064 \times 10^{23} \times 273)/(22{,}414 \times 293) = 2{\cdot}522 \times 10^{19}$, and $\Delta_{\text{HX}} = 0{\cdot}0119$. Further experimental and estimated constants, different for the four halides, are taken as follows:

Di-atom	n_{D}	n_{∞}	μ	b_1	b_2
HF HCl HBr HI	1·000140 1·000446 1·000612 1·000919	1·000136 1·000435 1·000594 1·000883	$1{\cdot}58 \times 10^{-18}$ 1·06 0·80 0·41	$0{\cdot}96 \times 10^{-24}$ 3·07 4·19 6·24	$0{\cdot}72 \times 10^{-24}$ 2·30 3·14 4·68

The following relations are applied[2]:

$$K_1 = \frac{2\pi N}{15kT}\left[(b_1 - b_2)^2\,\frac{n_{\infty}^2 - 1}{n_{\text{D}}^2 - 1}\right] = 2{\cdot}629 \times 10^{32}\left[(b_1 - b_2)^2\,\frac{n_{\infty}^2 - 1}{n_{\text{D}}^2 - 1}\right] \quad . \ (1)$$

$$K_1 = \frac{3\,\Delta}{2\pi kNT(6 - 7\,\Delta)}(n_{\infty} - 1)(n_{\text{D}} - 1) = 9{\cdot}477 \times 10^{-8}(n_{\infty} - 1)(n_{\text{D}} - 1) \quad . \ (2)$$

$$K_2 = \frac{2\pi N}{15k^2T^2}\mu^2\,(b_1 - b_2) = 6{\cdot}545 \times 10^{45}\,\mu^2\,(b_1 - b_2) \quad . \ . \ . \ . \ . \ (3)$$

$$K = K_1 + K_2 \quad . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ . \ (4)$$

where the symbols have their usual significance.

The value of K_1 by (1) is probably more accurate than by (2), and is independent of the result Δ_{HX} = a constant. As an approximate check on the theory by which these numbers are derived, however, the value of K_1 by (2) is substituted in (1) to obtain a calculated value of $b_1 - b_2$, for comparison with that derived from the estimated b_1's and b_2's given above. Comparison of the last two columns of the following scheme shows the general run of the numbers to be in agreement.

Di-atom	K_1 by (1), K_2, K ($\times 10^{15}$)			K_1 by (2)	$b_1 - b_2$ ($\times 10^{24}$)	
					est.	calc.
HF HCl HBr HI	0·015 0·152 0·281 0·615	(3·922) 5·662 4·399 1·717	(3·94) *5·81* *4·68* *2·33*	0·018 0·184 0·345 0·769	0·24 0·77 1·05 1·56	0·26 1·18 1·16 1·96

K_{HCl} agrees closely, as expected, with the experimental value $5{\cdot}75 \times 10^{-15}$ (Hansen[2]). The constants for other wave-lengths can be estimated by this method as required.

It is noteworthy that HCl appears to have the highest constant in the group. As, however, K_2 is very sensitive to changes in μ, this may not be significant. If μ_{HF} were as large as 2·0 (Smallwood[3]), $K_2 = 6{\cdot}282$, $K = 6{\cdot}30$, making the gradation continuous from HF to HI.

The present results appear to support the theory put forward in the former communication[1].

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June 25.

[1] C. H. Douglas Clark, NATURE [July 18, p. 126].

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The 2·73μ Absorption Band in Fused Silica

LYON and Ellis in a recent note[1] refer to the absence of the 2·73 μ infra-red absorption band in specimens of fused silica examined by them, and suggest that the band found at this wave-length by previous investigators may be due to an impurity, possibly CO_2 or H_2O.

It is certainly unlikely, as I have previously pointed out[2], that it can be due to vitreous SiO_2, since the absorption coefficient at the centre of this band was widely different in specimens examined by Parlin[3] (K = 0·52), Dreisch[4] (K = 0·33) and me[5] (K = 0·03) and, further, crystalline quartz shows no trace of such a band whilst every other band in fused silica between 1 and 7·5 μ has its counterpart in the crystalline quartz spectrum.

Fused silica, in the course of manufacture, comes in contact with hot carbon and reacts with this with the evolution of gas. This makes contamination with CO_2 seem likely, and the band in question does fall in the centre of the region of CO_2 absorption at about this wave-length[6]. This suggestion is open to the criticism that the next strong CO_2 band, that at $4{\cdot}28\,\mu$, is definitely absent from the fused silica spectrum and that the $2{\cdot}73\,\mu$ band is single and broad while the corresponding structure for gaseous CO_2 appears as two doublets under similar resolving power. Nevertheless, solution of CO_2 in a solid may radically modify its absorption spectrum.

Another possibility is that the band may be due to another crystalline modification of silica, that is, a cristobalite or tridymite. This seems unlikely as in readings taken on the same set of specimens during one or two years no ageing effect was detected, and further, of specimens cut from one initial melt, some were used immediately without additional heat treatment while one was re-melted to improve its optical homogeneity without any significant difference being introduced in the intensity of this band in the material. A very slight difference was observed between different initial melts in this respect. It would be of interest to know whether the specimens examined by Lyon and Ellis were prepared without contact with carbon, as if this was the case the theory of the CO_2 impurity is decidedly strengthened by their result.

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[1] Lyon and Ellis, NATURE, **137**, 1031 (1936).
[2] Drummond, NATURE, **134**, 739 (1934).
[3] Parlin, *Phys. Rev.*, **34**, 81 (1929).
[4] Dreisch, *Z. Phys.*, **42**, 426 (1927).
[5] Drummond, *Proc. Roy. Soc.*, A, **153**, 328 (1936).
[6] Barker, *Astrophys. J.*, **55**, 391 (1922).

African Honey Bees

SKORIKOW[1] has published a map showing the distribution of the three main types of ordinary honey bees, *Apis mellifera* L., occupying the Palæarctic region, *A. indica* Fabricius, the Oriental, and *A. adansoni*, Latreille, the Ethiopian. Madagascar is inhabited by still another form, *A. unicolor* Latreille. Alpatov, of the University of Moscow, has published statistical studies of South African honey bees, separating two races, called *A. adansoni* and *A. unicolor*, the latter being the form with black abdomen and scutellum. But his *A. unicolor* came from near Cape Town, and were surely not the true *unicolor*, but the race which Buttel-Reepen (1906) named *intermissa*. This insect differs from *A. unicolor* in having bands of tomentum on the abdomen, these being usually conspicuous, but sometimes not evident, when the specimens are worn, or the abdomen is much contracted.

I have just examined the honey bees of the 1933–34 expedition by Mr. and Mrs. J. Ogilvie to South Africa, and I find eight *A. adansoni* (from Bot River, Belmont, Kirstenbosch, Upington and Seeheim) and fifteen *A. adansoni intermissa*, from Lions Head, Cape Town and from Bot River, but the majority from an uncertain locality, owing to a mistake in labelling at the British Museum. From the expedition of 1931, I find four specimens from Victoria Falls, which I had overlooked. Three are ordinary *A. adansoni*, but of two collected by my wife on Livingstone Island, one is *A. adansoni*, and the other, abruptly different, is to all appearances *A. unicolor*, though the surface of the abdomen is duller than in a specimen from the Seychelles Islands.

No doubt the African bees are being crossed with different forms of the European species, introduced by man; hence it is desirable that material should be collected as soon as possible in all parts of Africa and deposited in the British Museum or elsewhere, where it will be available for minute statistical studies, such as those of Alpatov. Enderlein, in his revision of *Apis* (1906) distinguishes the African forms by the smaller size (body 10–12 mm. long, 3½ mm. broad, front wings 8–9 mm. long) and then divides them into those with black abdomen (*unicolor* and *intermissa*, as just given, and also a form *friesei*, Buttel-Reepen, differing from *intermissa* by the average smaller size and the yellowish-brown scutellum), and those with a largely fulvous or yellow abdomen, the true *adansoni*, closely resembling the familiar Italian race. The variety *friesei* comes from Mombasa, East Africa.

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June 29.

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[1] "A New Basis for a Revision of *Apis*", 1929.

Vernalization

THE phenomenon of 'vernalization', namely, the acceleration of ear formation in winter varieties of cereals by exposing the germinating seed to low temperature, is now well known[1]. The underlying cause of this effect of low temperatures is by no means clear. Enzymatic changes in the fruit external to the embryo have been postulated by Richter and others. Experiments to test such possible changes or hormone effects have been performed by Krasnoseljskaja-Maxomova in which endosperm of winter and spring varieties has been interchanged. Similar experiments have been repeated by Sereiskii and Sluckaja, and interchange of embryos has also been tried. The former investigator claims positive results which, however, the latter investigators failed to substantiate.

Experiments recently carried out by us have shown conclusively that excised embryos separated completely from the endosperm and grown on agar containing 2 per cent glucose and mineral nutrients alone can nevertheless be vernalized in the same way as complete 'seeds'. Such separated embryos kept at 1° C. for six weeks and then planted out produced normal plants earing ten weeks later, whereas similar embryos kept at 18° C. until they had reached the same stage in development (coleoptile developed, but first leaf not emerged) showed no signs of 'shooting' after a further ten weeks of growth.

It would appear therefore that the 'cause' of vernalization by low temperature is entirely inherent in the embryo, and is not dependent in any way on the metabolism of the endosperm or aleurone layer.

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[1] Vernalisation and Phasic Development of Plants. Bull. 17 Imperial Bureau of Plant Genetics.

Points from Foregoing Letters

IN further development of her working hypothesis of protein structure, according to which a network ('cyclic') structure is postulated in place of the branched chain ('polypeptide') structure, Dr. D. M. Wrinch calculates the approximate energy of formation of 'cyclol' molecules from polypeptides. The calculations suggest that the process of linkage is facilitated if the appropriate groups are in the imide form, —C(OH)=N—, a state which may be brought about by the action of certain enzymes. F. C. Frank, commenting on Dr. Wrinch's theory, estimates the energy balance in the process and, to account for the deficiency in the necessary energy, postulates the existence of an additional source of energy similar to that provided by the strain in the side-chain cross-linkages found in keratin. He further points out that hydration also provides part of the necessary additional energy, and helps in explaining certain properties of the proteins, observed in 'degeneration' and 'denaturation'.

Criticizing Prof. Hale Carpenter's description of the behaviour of the African insect *Charaxes*, Prof. H. E. Armstrong states that an insect cannot *deliberately* hide itself, and suggests that 'mimicry' may be caused by changes in food, temperature, or by hybridization. In reply, Prof. Hale Carpenter gives further examples of *deliberate* action and of mimicry which cannot be explained by the factors suggested by Prof. Armstrong.

Indications of the occurrence of earthquakes and of accompanying seismic sea-waves (tsunamis) in Ordovician times (Caradog age) are described by Dr. A. Lamont, from observations of strata in the Irish Free State. These may involve revision in the interpretation of certain features, such as crush-conglomerates and intrusive tuffs, the origin of which has hitherto been ascribed to other agencies.

Miss H. D. Megaw and Prof. F. Simon have determined the approximate values of the density, compressibility and thermal expansion of ordinary and heavy hydrogen (deuterium) in the solid state (at 4·2° K.), by comparison with helium, in order to show the influence of the 'zero point energy' (inferred from Planck's second quantum theory) on those properties.

Part of the oxygen consumed by certain luminous bacteria (*Photobacterium phosphoreum*) is apparently directly connected with the amount of light emitted. K. L. van Schouwenburg and J. G. Eymers find that, at 16° C., about 500 molecules of oxygen are used per quantum of light emitted, but the efficiency of the light-emitting process varies with conditions.

Some further notes on the behaviour of and variations in the ionized *C* layer of the atmosphere (5–30 km. high) are given by Prof. R. C. Colwell, A. W. Friend, N. I. Hall and L. R. Hill. The authors explain the weakening of the radio signals from the stratosphere balloon *Explorer II*, when it passed through the 20 km. level, as due to its having reached the top of the *C* layer; a portion of the radio waves would then be reflected outwards into space, instead of being reflected towards the earth.

Of the two optically active forms of nicotine, Dr. G. A. Gause finds that the lævo-form has a greater inhibition power upon the fermentation of glucose by various microbes than the dextro-form. Oxidation processes on the other hand are more strongly inhibited by the dextro-rotatory nicotine. The author also finds differences in the action of the two optically active nicotines upon similar processes taking place in green Algæ and in various animals.

Formulæ for the magnitude of interaction between neutrons and protons (via particles of small mass—positrons and neutrinos) have been worked out by D. Iwanenko and A. Sokolow, with simple scalar equations of the type of Schrödinger's second order relativistic equation. The process is supposed to be somewhat on the lines of electromagnetic interaction.

Mrs. A. Vnukova finds that the antagonistic action exerted by light of certain wave-lengths, which weaken the latent image on a photographic plate ('Herschel effect'), is more effective in the presence of oxygen and becomes negligible in nitrogen or carbon dioxide.

From the difference between the energy absorbed by ozone from sunlight during the day, and that lost by radiation during the night, allowing for the absorption of radiation from the earth and from other layers, R. Penndorf calculates the heating effect due to the presence of ozone in various layers of the atmosphere. The calculations indicate a maximum heating effect at a height of 50 km. where the heating is about five times the cooling effect.

Having investigated the conditions under which silver nitrate can be relied upon as a test for vitamin C (ascorbic acid), A. Giroud and C. P. Leblond conclude that while the absence of a coloration by acid silver nitrate does not necessarily mean the absence of ascorbic acid, a positive reaction, with few exceptions, is a specific test for this substance.

In a test of the theory of the polarization ellipsoids of the hydrogen halide gases, Dr. C. H. Douglas Clark and Dr. E. C. Humphries have estimated the constants *K* for these gases occurring in the Kerr (magneto-optic) effect. These numbers are capable of experimental verification, and appear to confirm the theory.

In explanation of the origin of the absorption band (wave-length 2·73 μ) in the infra-red spectrum of certain specimens of fused silica, Dr. D. G. Drummond favours the suggestion that it is due to the presence of carbon dioxide, with which the silica may readily become contaminated during the process of manufacture.

With reference to the various forms of African bees described, Prof. T. D. A. Cockerell records several specimens of *A. adansoni* and *A. adansoni intermissa*, and one specimen of *A. unicolor* in the British Museum collection. He directs attention to the desirability of collecting further material for genetic studies before the African bees become crossed with different forms of European bees introduced by man.

Dr. F. G. Gregory and O. N. Purvis have carried out experiments with embryos of cereals separated from the rest of the seed and grown on agar (containing 2 per cent glucose and mineral salts) kept near the freezing point (1° C.) for six weeks and then planted out. They find the same subsequent acceleration in the ripening process (vernalization) as in the case of whole seeds similarly treated, which indicates that the cause of 'vernalization' is inherent in the embryo.

Research Items

Physical Characters of the Bedouin

DR. WILLIAM M. SHANKLIN, of the American University of Beirut, in the summer of 1934 made an expedition into the Syrian desert with the object of studying the members of the Rwala tribe, who appear to conform to the definition of a Bedouin as "a nomad who breeds and keeps camels and . . . able to trace his descent from certain recognized pure-bred Bedouin tribes". The Rwala are a subdivision of the Al-Glas, one of the major branches of the Anazeh nation, who are found more especially in the Hejaz and Syrian deserts. In recording his results (*J. Roy. Anthrop. Inst.*, 65, Pt. 2; 1935), Dr. Shanklin summarizes the evidence of the blood-groups, published more fully elsewhere, as showing a high percentage of blood group *O*, indicating that the Bedouin belong to a race of very considerable antiquity. The American Indians also belong to the blood-grouping *O*. The Rwala in their physical characters have retained features which are regarded as having characterized the primitive Mediterraneans; but elsewhere in the Near East, Egypt, Arabia, etc., this type has been overrun by the brachycephalic element, to which observers have directed attention. Thus among their average measurements are: head-length, 191 mm., breadth, 144 mm.; cephalic index, 75 (range 67 to 82); nasal height, 55 mm., nasal breadth, 35 mm.; bizygomatic breadth, 130 mm.; bigonial breadth, 106 mm. They are white, but have brown, or brunet skin, straight black, or brown, hair, brown eyes and high, straight, narrow noses. If the view that holds that the agglutinogens *A* and *B* are of relatively late origin is accepted, the evidence of the blood-groups would corroborate the evidence of physical character in showing that the Bedouin may well be representatives of the primitive Mediterranean race, who have preserved their racial character over a long period. On the other hand, the earliest known skulls of the American Indians, as pointed out by Hooton, are also dolichocephalic, and this, with their blood-grouping, accepting the conclusion of their Asiatic origin, may point to the fact that they and the Bedouin are the descendants of a remote, but common, primitive stock.

New British Bird

THE rather remarkable number of scarce American birds that have appeared in the British Isles in the past two years—yellowshank, American pectoral sandpiper, and others—is further increased by the recent addition to the British list of Audubon's little shearwater (*Puffinus assimilis-l'herminieri* Leason) which J. J. Harrison describes in the July issue of *British Birds* as of the West Indies form. The bird was found alive on the beach at Bexhill-on-Sea by Mr. W. E. Dance on January 7, being mobbed by gulls. When taken home it soon collapsed and died. The record is of importance because Gould recorded a specimen from Dover, but owing to insufficient verification it was never accepted, and he himself excluded it from his later works on British birds. It was in the April issue of *Ibis* that Mr. W. P. Lowe described another new British bird, the Franklin's gull, which was watched among a flock of herring and black-headed gulls on Exmouth beach, Devon, on January 19, 1936. The British razorbill has recently had its status as a separate sub-species established owing to comparisons of British with Swedish and Greenland skins showing that the British birds are definitely smaller in measurements than the Continental ones and that the Faroe birds belong to the British race; hence the alteration in nomenclature to *Alca torda britannica*.

Periodicity in Algæ

IN certain districts of India, the regularity of the seasonal changes, especially as regards temperature and rainfall, offers an opportunity for the study of algal periodicity which would never arise under the variable conditions of the English climate. M. S. Randhawa (*Proc. Indian Acad. Sci.*, 3, No. 5, 1936) has now followed the periodicity of the freshwater Algæ in the Saharanapur District over the greater part of two years, and has obtained some very definite results. Many of the Algæ rest through the hot dry summer months in the form of thick-walled oospores; these germinate with the rain of the Monsoons and continue to grow vegetatively through the cooler autumn and winter months. With the rise of temperature in the spring a period of sexual reproduction sets in, ending with the production of thick-walled oospores. The gradual rise in temperature after a long period of vegetative growth is evidently particularly favourable to sexual reproduction, which is apparently strikingly prolific. Under these more consistent climatic conditions, the Algæ fall into step with the seasons and thus show marked periodicity, which is masked in more variable climates by small changes which affect the algal growth. It is of interest that the filling up of the ponds and streams by flood waters after the dry season is accompanied by a peak in the development of Myxophyceæ, an effect which has also been recorded in British Lake District waters when much debris is carried down by heavy rain.

Electric Heating of Garden Frames

A PAPER by Dr. J. Grainger and T. F. Armstrong (*Gardeners' Chronicle* of June 13 and 20) shows that the use of soil heating by buried electric cable is quite satisfactory for raising seedlings of green crops such as lettuce and endive, for the forcing of special crops, as mint and rhubarb, but not for root crops such as radishes, which tend to flower rather than to swell their roots in heated soil. A valuable table showing detailed consumption of electricity for raising the soil temperature by varying amounts is given. Heating cables have also been used to heat the air within deep propagating frames, and although this was successful from a horticultural point of view, it requires an average of 1·06 units of electricity per cubic yard per day to raise the temperature 10°–15° F. above that outside the frame. With electricity at ½*d.* per unit, this works out about twice the cost of heating similar structures by a coke fire in a hot-water system. The paper also shows that heating the soil may aggravate the effects of crown rot disease of rhubarb, during forcing.

Autopolyploidy

THE evolutionary significance of autopolyploidy, based on the numerous cases now investigated, has been considered by Dr. A. Muntzing (*Hereditas*, 21, 263). About one hundred species are now known to show intra-specific variation in chromosome number, autotetraploidy being the most common condition. Such tetraploids usually show *gigas* characters, being generally stouter and slower in development. Both morphological and physiological changes result from the larger cells, but hexaploids frequently and octoploids generally show dwarfing, indicating that the optimum chromosome number has been exceeded. Intra-specific tetraploids are also ecologically different from the diploids, and they usually have a different geographical distribution, being generally, but not invariably, more northern. Such polyploids appear to be generally more hardy and adapted to a northern, alpine, xerophytic or coastal habitat, into which the corresponding diploid does not extend. Experimentally induced autotetraploids show essentially the same features as natural ones. Chromosome association at meiosis is the same in both, ranging from almost complete bivalency to almost complete quadrivalency. Wild autopolyploid races are usually fertile, while experimentally induced ones generally show poor fertility. This difference may be accounted for by the effects of natural selection. The perennial species in a genus have a higher average chromosome number than the annuals. Autopolyploidy has played an important role in the evolution of higher plants.

Tokyo Earthquakes in 1935

WE have received the last of the quarterly *Seismometrical Reports* for 1935 issued by the Earthquake Research Institute. These refer only to earthquakes that were sensible in Tokyo. After the great earthquake of 1923, a system of eight seismological stations was founded in and around Tokyo. During the year 1924, 60 earthquakes were felt in Tokyo, and the records obtained were sufficient to determine the epicentres of 52 and the focal depths of 42 earthquakes. In 1935, the number of stations had risen to thirteen, the number of sensible shocks was 78, the epicentres of all and the focal depths of 67 earthquakes were ascertained. In Tokyo itself, most of the shocks (55 in number) were just perceptible, and none at any station reached even semi-destructive strength. The mean depth of the foci was 28 miles, the greatest depth measured being 75 miles.

Oxidation-Reduction Potential

COMPARATIVELY few accurate measurements of the potentials of oxidizing-reduction systems have been made, one of the main difficulties being the ease of hydrolysis usually observed with the higher valency ion. One of the best investigated systems is that of the thallic and thallous ions, $Tl^{\cdots}/Tl^{\cdot}$, which was investigated in 1905 by Abegg and J. F. Spencer. Later investigators showed that the potential appeared to vary considerably with the nature of the anion, doubtless owing to the formation of anion complexes. Two recent investigations of the electrode, by J. R. Partington and H. I. Stonehill (*Trans. Faraday Soc.*, 31, 1357; 1935) and by A. A. Noyes and C. S. Garner (*J. Amer. Chem. Soc.*, 58, 1268; 1936), have included precautions to avoid this effect. The former investigators used the sulphates in sulphuric acid solution, and the latter the nitrates in nitric and perchloric acids. The two values for the normal potentials, 1·20–1·22 volts, and 1·230 volts, respectively, are in satisfactory agreement. Since there is little likelihood that complexes are present in the nitrate and perchlorate, the results show that the formation of sulphate complexes by thallic sulphate is not very extensive. An interesting feature of the work of Noyes and Garner was the use of ozonized oxygen for the oxidation of the thallous to the thallic salt in concentrated nitric acid, thus avoiding the introduction of extraneous substances into the solution.

Experiments with Neutrons

C. H. COLLIE and J. H. E. Griffiths (*Proc. Roy. Soc.*, A, 155, 434) have investigated the absorption of fast and of slow neutrons using an arrangement in which the effect of mere scattering was largely eliminated. The absorption cross-sections for fast neutrons were nearly the same ($1–1·5 \times 10^{-24}$ cm.^{2}) for a number of elements tried. The experiments with detectors sensitive to slow neutrons showed an increase in activity when the absorber was put in, and this probably means that new slow neutrons were produced by collision of the fast neutrons with the absorber nuclei. S. Kikuchi, H. Aoki and K. Husimi (*Proc. Physic. Math. Soc. Japan*, 18, 115) have studied the production of γ-rays from numerous substances bombarded by fast neutrons (2×10^6 e.v.). Slow neutrons were excluded from the specimen. The cross-sections calculated for γ-ray production vary unsystematically with atomic number, the absolute values are of the order 5×10^{-25} cm.^{2}, and it seems that γ-ray production is responsible for a considerable part of the absorption of fast neutrons by many elements. The γ-ray energies seem to be fairly similar in all cases, but they are not monochromatic. The γ-rays excited by slow neutrons appear to be of a different type, they are usually harder, and are to be ascribed to the capture radiation associated with nuclear transformations.

Statistical Research Memoirs

THE first volume of a new publication entitled *Statistical Research Memoirs* appeared in June of this year, edited by Prof. E. S. Pearson and Dr. J. Neyman, and published by the Department of Statistics at University College, London. The *Memoirs* will contain only papers prepared in that Department. The series will not be strictly periodical, but it is hoped that a volume of more than 150 pages will be issued about once a year. The price is 15*s.* a volume, or 12*s.* 6*d.* to those who signify in advance their intention to purchase the next volume. The *Memoirs* are intended to advance the general theory of statistics, which at present is not yet on firm foundations. It is the ambition of the Department to contribute towards the establishment of a theory of statistics on a level of accuracy which is usual in other branches of mathematics. The present volume contains seven papers, two by J. Neyman and E. S. Pearson, and the others by P. P. N. Nayer, B. L. Welch, P. O. Johnson and J. Neyman, P. V. Sukhatme, and R. W. B. Jackson. All of these deal with closely related subjects, connected with the well-known methods of Neyman and Pearson for testing statistical hypotheses. The *Memoirs* will, as a general rule, be restricted to the general theory. Papers dealing with the applications of statistics serve their purpose best when they appear in journals devoted to the particular fields of application.

Forestry in Kenya

THE annual forest report for 1934 for the Colony and Protectorate of Kenya (Nairobi: Government Printer, 1935) is of interest on the subject of reservation of forests. The total reserved forest area in 1921 was 3,207 square miles; in 1934 it amounted to 4,711 square miles. During this period, some areas of reserve forest have been given up.

From the report, the reasons for giving up areas of forest already reserved is not clear. The common reason for such returns to the Civil Department is that the land is required, and can be more profitably used for, agriculture. This is not given as the reason in Kenya. The Conservator writes: "In making these excisions from the forest very careful consideration is given to each case, and no land that is thought to be of value to the forest, climatically or commercially, is given up". It is somewhat difficult to visualize the uses to which land of no value to the Forest Department can be put. In spite of this statement and the admission that there is a certain amount of anxiety in the Colony as to the adequacy of the forest area, "and a feeling that this area is being seriously diminished by constant excisions", the report states that, during the year, the Kenya Land Commission recommended that approximately 13,500 acres should be excised from forest reserves in settlement of various claims. The Department considers that "little real damage was done"; but the Commission itself records in its report that "We agree with the conclusion that the items shown in the schedule [that is, the land that was surrendered] should be regarded as the limit of sacrifice which the forest should be required to suffer".

This appears to be strange reading. In the administration of a country, nowadays, a clear understanding of the position played by the forests, both economic and climatic, should be possible and form part of the policy of governance. Either the forest is required to fulfil these vital interests of the population or it is not. Once the maintenance of the water supplies of a country, provision for local requirements of the population, and such commercial interests as may be considered advisable to provide for have been arranged, the rest of the forests may be sacrificed, in other words, felled and suffered to disappear with equanimity in the interests of other and more serviceable utilization of the land. But such disposal of the land does not and should not entail "the limit of sacrifice which the forest should be required to suffer". It would appear in Kenya that, for some reasons not apparent in the report, land previously forming forest reserves is being alienated at some danger to the maintenance of a correct proportion of forest, even though there appears to be some 800–1,000 square miles still to reserve, lying mainly within the native reserves of Meru, Masai, Cherangani and Marakwet.

The cuts in expenditure account for much during the last few years; but in view of the fact that there has been an expert forest service in Kenya for some considerable period, it is depressing to read that "it was still impossible to detail an officer or officers for the special work of enumerations and compilation of working plans; divisional staffs cannot be expected to make much progress in such important work".

The chief work in connexion with regenerating the forests is by exploiting the forest produce indigenous to the areas it is desired to plant, and then, by means of controlled shifting cultivation or *toungya*, replanting suitable trees in regular plantations. In such work, as the report states, definite plans are required. But plantations will not replace square miles of indigenous forest, even if they are putting back a greater potential tonnage than that of the present annual cut. To know what is standing in the forests should be the vital factor antecedent to exploitation. Until this factor has been ascertained, it appears irrelevant to consider markets available for export.

Rural Custom in Civilized Communities

IT is an interesting coincidence that the claims of ancient custom and conservatism in civilized communities as worthy of observation and record should be urged almost simultaneously from three different sources, of which one is far removed from the other two—England, France and South Africa.

Mr. R. U. Sayce in *Man* of April, emphasizing the importance for anthropology of the study of civilized, as well as uncivilized, peoples, refers as a case in point to the remarkable variety shown in British agricultural implements in response to local conditions and requirements. Not all, indeed, are of British origin. Some have been introduced by foreign workmen, as, for example, the implements used in cutting peat near Manchester and the implements of the sugar-beet industry, both of which are of Dutch origin. The bill-hook affords an interesting example of this variation. Mr. Sayce figures no less than forty-eight distinct varieties of the bill-hook, all of which are now manufactured, and are in use, in different parts of England and Wales. That Mr. Sayce is not entirely ploughing a lonely furrow is indicated by the fact that in the same month of April a collection of implements illustrating the changes in agriculture during the last hundred years was presented to the Colchester and Essex Museum.

Apart from its cultural value, the study of traditional types of agricultural implements may have a distinctly practical bearing on the work of the archæologist in affording a clue to the character and purpose of a find of unusual or previously unknown type. This latter function of the study is stressed by M. L. Franchet in an introductory sketch of agricultural ethnography (*Revue des Sciences*, 111, April

11, 1936), in which he dwells on continuity in type as a regional characteristic. Analogies to archæological finds, he points out, have been sought among primitive peoples, geographically remote, and often have led to erroneous results; whereas investigation in the area in which they were found, among the people of to-day, would have revealed in many instances the identical type, or a derivative, in everyday use. M. Franchet himself has interpreted his archæological finds by this method with illuminating effect, and he has also traced modern implements back to their origin in the bronze age. His researches in the forest of Montmorency find an ancestry for certain implements which leads back to the stone age, while the equipment of viticulture and wine-making goes back, with the industry, to Gallic times, though, of course, not all the implements in use are of an equally remote origin. There is a pregnant reminder that the conversion of the sword into a ploughshare is more than a rhetorical trope in the observation that in primitive conditions the weapons of war do become the implements of peaceful occupations when hostilities cease.

A legitimate pride of descent and a half-humorous, but wholly determined, practice of traditional ways of doing certain things is attributed to the Cape population of Dutch descent in a record of surviving customs by Eric Rosenthal ("Old Time Survivals in South Africa". Government Printer, Pretoria, 1936. Pp. 38). The survival of so much that, on a superficial view, is obsolete may seem remarkable in a community that is now essentially up to date, and of which some of the industries are highly mechanized. To some extent this may be due to a racial pride and race consciousness; but the real explanation lies deeper. It is part of an enduring environmental adaptation. The clue is afforded by the survival of the old ox-wagon, virtually unchanged since its first introduction from Holland by Jan van Riebeck in 1632, except for the addition of a brake in the eighteen-sixties, yet of which there are more than a hundred thousand in use in South Africa side by side with the automobile. This apparent anomaly may be explained by the fact that the ox wagon has been the efficient cause in the development of the characteristic South African civilization. When built in the traditional way and from the traditional materials, it is still the best, and indeed the only, means of transport which is fully adapted to the geographical conditions and the social and economic needs of the country. One useful feature of ox-wagon travel, the 'outspan' for night camping, still found in every community, serves both the old and the modern need in a country where distances are great and hotel facilities few.

Empire Surveys

FORMERLY it was difficult for surveyors, more or less isolated in the Dominions and Colonies, to keep in touch with the advances in technique which are constantly occurring both as regards instruments and methods, cut off as they are from their fellow surveyors.

The institution of periodical conferences, held in the heart of the Empire, under the auspices of the Colonial and War Offices, has changed all this. Surveyors from different parts of the Empire meet and get in touch with each other as they never did before. Nothing but good can result from this. There has also been established a quarterly journal, the *Empire Survey Review*, devoted to survey technique and the discussion of matters of interest to the surveyor. At last year's conference, all the Dominions (except New Zealand), India and Colonies possessing survey departments, were represented, as well as many British scientific societies and universities.

At the conference, the report of which has lately been published*, some forty papers bearing on all branches of surveying and dealing with the latest instrumental developments were read and discussed. Of these, no less than eight dealt with matters connected with air survey, showing the importance now attached to this branch of the subject.

From such a mass of matter it is not easy to single out for notice particular subjects. Major M. Hotine has an interesting paper on signals for triangulation. Sufficient attention is not always paid to signals where accurate work has to be done. As the author points out in the case of opaque signals made of wood, it is very necessary in order to avoid warping and the movement of the signal due to the drying of material after erection, that they should be made of seasoned timber, instead of, as is usually done, from wood cut on the spot. Incidentally, Major Hotine points out that if primary triangulation is undertaken at all, it should be of first-class order and not "only good enough for immediate purposes". Someone is sure to want to extend it in the future, in which case it may have to be done all over again. Therefore every precaution should be taken with the observations, the best instruments should be used and suitable signals well centred over the marks, or the work will not conform with first-class triangulation. A new type of electric night projector is being brought out by Messrs. Cooke, Troughton and Simms, Ltd., which can be worked by a 12-volt accumulator such as is carried on a motor car. We understand it is being used by the Ordnance Survey in the retriangulation of Great Britain now in progress.

Many papers are read chiefly with the view of encouraging discussion. For example, a new instrument is experimented with; it is of considerable advantage to know what the experience of others has been with an instrument of the kind. When we consider how grudgingly money is allotted for survey purposes in Great Britain, it is astonishing to read that more than £6 per acre is spent on the survey of Georgetown and Malacca in the Federated Malay States. The value of survey out there is evidently known and appreciated.

Perhaps one of the most remarkable papers read before the conference was by Lieut. E. H. Thompson, R.E., on "An Automatic Plotting Machine for Air Photographs". This machine is from the designs of Mr. Fourcade, who has been working at this difficult problem for some years. Lieut. Thompson has constructed a most ingenious model from Meccano to illustrate the working of this complicated instrument. Without something of the sort, it is very difficult to understand how it functions.

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* Conference of Empire Survey Officers 1935. Report of Proceedings. (Colonial No. 111.) Pp. vi+377+36 plates. (London: H.M. Stationery Office, 1936.) 20s. net.

Brigadier MacLeod pleads for the co-ordination of African surveys. He points out that some kind of arrangement should be come to among the various nations possessing African territory with the view of adopting uniformity of scales and projection of maps, before it is too late. So far, this has been achieved only in the case of the International "Carte du Mond" on the 1/1,000,000 scale. He also urges the adoption of the metric unit. The progress of aviation has made this necessary since the airman passes so quickly from one territory to another. Unless something is done, Africa of the future will be saddled with a multiplicity of scales, styles and projections. As no other nation is likely to adopt the British units of measurement, unless we change to the metric system, yet another complication will be added to the map difficulties of the airman.

Before the conference terminated, resolutions were passed recommending that a central pool of survey instruments should be formed from which Dominions and Colonies could borrow on certain terms; that the *Empire Survey Review* should be continued notwithstanding some loss, as a means of keeping up the standards of surveying technique; a resolution emphasizing the necessity for basing all categories of survey on a proper geodetic foundation; a resolution recording the opinion of the conference as to the value of its proceedings for the discussion and interchange of views on the improvement of survey technique. The conference also decided that it is desirable to hold triennial conferences lasting for two weeks.

H. L. C.

Electrical Interference with Broadcasting

THREE years ago the Institution of Electrical Engineers appointed a special committee to consider the trouble caused by the interference of various kinds of electrical devices with radio reception. This nuisance has been gradually getting worse owing to the growing sensitivity of modern receivers. The report has now been published (Inst. Elec. Eng., Savoy Place, W.C.2. 6*d*. post paid) and was commented upon in NATURE of August 1. The committee was fully representative of all sections of the industry on both the radio and engineering sides.

A method of measurement of interference has been agreed upon, and instruments have been developed capable of indicating with sufficient accuracy the amount of interference caused by much of the electrical apparatus which causes trouble. The technical position has been cleared up, and it is considered that no undue extra expense will be involved in the design and construction of apparatus that will bring the interference caused within an acceptable standard. The apparatus which is likely to cause the most interference is classified as follows: (1) lifts in buildings; (2) trolley-buses and trams; (3) household electrical appliances; (4) small electric motors; (5) 'neon' display signs; (6) certain rectifiers for power plant and (7) electro-medical apparatus. In an appendix to the report, a brief account is given of the researches undertaken in connexion with these seven groups.

In addition, although there is at present little interference with ordinary broadcast reception due to the ignition systems on motor-vehicles, it is probable that, unless corrected, it will interfere with the television reception of the future. There are other causes of radio interference such as electric signalling gear on railways, but at present they produce only minor effects. Real progress has been made in finding the most effective methods of correction in each of the seven groups given above. As a result of Post Office activity, a considerable amount of radio interference correction has been taking place during the last few years.

The first case where radio interference correction was in effect made compulsory was that of traffic signals. The Ministry of Transport now requires all traffic signals to be fitted with components which effectively prevent interference. This was achieved without much difficulty. The second case was that of trolley-buses, where much practical progress has been made. It is now clear that the various technical aspects of the problem are approaching solution, and it is necessary to consider whether compulsory powers should be conferred on some authority so that radio interference may be suppressed in those cases where it can only be done with the help of such an authority. The manufacturers of appliances and plant definitely support the view that there should be some recognized 'mark' which could be affixed to all portable apparatus as a guarantee that the apparatus complies with non-interference requirements. They consider that the sale of appliances which do not meet those requirements should be prohibited. It is essential that imported articles should be subject to the same regulations as home-produced articles and should bear the 'mark'. It is only through legislation that this question can be dealt with successfully. As a rule, it is not the man who buys and uses the apparatus, but his neighbour, who suffers from the resulting interference.

In view of the fact that it is generally cheaper to incorporate suppression devices in the original design of the equipment than to fit them after installation, it is recommended that compulsory powers should be conferred on some authority. It is anticipated that there will be only a small number of owners of interfering equipment who will refuse to apply remedial measures. It is recommended that the Electricity Commissioners should be the authority to issue regulations regarding both new and existing equipments and that the Post Office be charged with enforcing them. British Standards Specifications have already been issued giving the standard ratings for condensers, 'resistors', inductors and similar apparatus for incorporation in suppression devices. The specification for a standard interference-measuring instrument will cover the characteristics and performance requirements recommended by the Special International Committee on Radio Interference. It will include a detailed design for a portable instrument which will enable manufacturers to ascertain what values of components should be used to reduce interference within the prescribed limits.

In a statement made by Mr. C. C. Paterson, the chairman of the Committee, concerning the report, he points out that should the regulations be put into force, the normal procedure would be very much as at present. There would not be an army of inspectors searching out for trouble. Action would only be taken by the Post Office on receipt of a complaint of interference, and these complaints would become fewer in number as new apparatus bearing the 'mark' came into use.

Industrial Development in South Africa

THE Department of Commerce and Industry of the Government of the Union of South Africa has published a review of the material, scientific and educational progress made in connexion with the development of industry during the twenty-five years up to 1935*. Primarily, its purpose is to give an accurate picture of the conditions and prospects in what are described as the secondary industries, for agriculture and mining are otherwise dealt with and are only referred to in so far as they have a bearing on the other and less firmly established industries. The information it contains as to the conditions, facilities, costs, etc., in various districts and the progress of the numerous industries which have been established will also be found to supply a valuable scientific interpretation of the facts for the use of those who are or may become interested in the industrial future of the country.

In round numbers, the following figures give a picture of the expansion that has taken place in the twenty-five year period—employees have increased from 66,000 to 195,000, horse-power from 140,000 to 1,400,000, and total wages from 4 to 27 million pounds. The classes of industries dealt with and analysed statistically include fuel industries, iron and steel production, heavy chemicals and food production (sugar, wines and fisheries), together with other important developments which are taking place in connexion with the introduction of such manufactures as cement, pottery, clothing and textiles.

In these changes, the importance of research appears to be fully realized, and it is being fostered as an aid and guide in obtaining the best results. At Mount Edgcumbe, the sugar industry has, at a cost of £13,000, established an experimental station, which is run at an annual charge of about £9,000. On the agricultural side, its main function is the search for new canes of superior sugar content and of higher resistance to disease. There are also a chemical side, dealing with manufacturing methods and processes, and an engineering section to investigate mechanical problems.

The Union Government conducts research in connexion with the fisheries, investigating life-histories and the intensity of operations and engaging in technological research on canning, smoking and other processes. Marine biological work is carried on in the specially designed research ship *Africana*, which took over the duties in 1931, while shore investigations in this department are conducted at the Laboratory and Aquarium at St. James, near Cape Town.

In a country making rapid advances towards industrialism, and possessing rich stores of natural wealth, much special research is necessary in order to ascertain the best methods of making use of and adapting its resources to its own needs and that of export trade. Such work is being done on the coal supplies, the phosphates, the clays and other materials offering scope for increased usefulness. The use of gas, for example, might be greatly increased and developed.

The value of standardization has been recognized, and the editor takes the opportunity of impressing on his local readers its importance in eliminating ambiguous and misleading descriptions, in preparing dimensional standards and in specifying physical and chemical properties of materials, methods of testing, and safety codes. The South African Standards Institution, which is associated with the British Standards Institution, is conducted by a main committee representative of Government departments, technical societies and trade and industrial bodies, and there are five sectional committees dealing with mechanical, electrical and civil engineering, chemical and fuel matters respectively. In any work undertaken, the initiative lies with the interests concerned, and after tentative standards have been prepared they are submitted to the associated institutions, and those chosen are circulated for comment and recommendation. It is claimed that in this way the final standards approved should meet local conditions and requirements and then the industry or trade concerned may, if it desires, adopt them in its daily policy and practice.

It is to be noted also that a comprehensive scheme of training and technical education is now in being. The adoption, in 1922, of the Apprenticeship Act, marked the beginning of a new era in industrial legislation, and since then, 15,000 lads have completed their apprenticeships in accordance with its provisions and under the supervision of the committees of employers and employees which assist in its administration. The Act is operative in twelve groups of industries, and the general practice is a five-year training of young people after completing the primary and, in some cases, part of the secondary school course. They are then indentured to individual employers and are required to enrol for part-time courses at the technical colleges, a portion of their attendance there being timed to take place during ordinary working hours. For those resident in places far removed from centres where technical colleges exist, the Government has arranged for correspondence courses under the ægis of the Witwatersrand Technical College and, where students show satisfactory diligence, employers are responsible for the class or correspondence fees. It will thus be seen that South Africa is making every endeavour to provide for the needs of her technical students in the most practical way, and it may be premised that these preparations will react most favourably upon future industrial developments.

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* Industrial Development in South Africa and Facilities for the Establishment of Factories Published by the Department of Commerce and Industries. Edited by Dr. Vernon Bosman. (Pretoria: Government Printer, 1936) 1s

Science News a Century Ago

The Reef at Pernambuco

FROM Ascension, H.M.S. *Beagle* sailed for Bahia in order to complete the chronometrical measurement of the world. Arriving there on August 1, 1836, she sailed for the Cape Verde Islands on August 6, but being delayed by unfavourable winds on August 12 put in at Pernambuco, anchoring inside the reef. Of this reef, Darwin wrote: "I doubt whether in the whole world any other natural structure has so artificial an appearance. It runs for a length of several miles in an absolutely straight line, parallel to, and not far distant from, the shore. It varies in width from thirty to sixty yards, and its surface is level and smooth; it is composed of obscurely stratified hard sandstone. At high water the waves break over it; at low water its summit is left dry, and it might then be mistaken for a break-water erected by Cyclopean workmen. . . . Although night and day the waves of the open Atlantic, turbid with sediment, are driven against the steep outside edges of this wall of stone, yet the oldest pilots knew of no tradition of any change in its appearance. This durability is much the most curious fact in its history; it is due to a tough layer, a few inches thick, of calcareous matter, wholly formed by the successive growth and death of the small shells of Serpulæ, together with some few barnacles and nulliporæ. These nulliporæ, which are hard, very simply-organised sea-plants, play an analogous and important part in protecting the upper surfaces of coral-reefs, behind and within the breakers, where the true corals, during the outward growth of the mass, become killed by exposure to the sun and air. These insignificant organic beings, especially the Serpulæ, have done good service to the people of Pernambuco; for without their protective aid the bar of sandstone would inevitably have been long ago worn away, and without the bar, there would have been no harbour". Darwin in 1841 described the bar in detail in the *London and Edinburgh Philosophical Magazine*.

Monument to Champollion

ON August 13, 1836, the *Athenæum* said: "The monument erected at Figeac to the memory of Champollion, is an Egyptian obelisk of the purest and severest style, of very hard granite from a quarry near Figeac. It bears an inscription to the following effect: 'To the memory of F. J. T. Champollion, who first penetrated into the mysteries contained in the writing and monuments of ancient Egypt, and who was taken from Science by a premature death on the 4th of March 1832. He was born at Figeac the 23rd of September 1791'." Champollion died in Paris, and was buried in the Père-Lachaise cemetery. His grave is marked by an obelisk bearing a medallion.

Aerial Surveying from Balloons

IN the *Mechanics' Magazine* of August 13, 1836, is a note from the *Scotsman* referring to the work of Charles Green (1785–1870), the aeronaut who up to that time had made 218 ascents. On the last occasion when Lord Clanricarde went up with him, he observed, it was said, that surveyors and architects could with greater facility take plans of noblemen's estates by ascending in a balloon, as they could have a bird's-eye view of every locality, and if they only once adopted that method they would never relinquish it. Since the suggestion was made, an artist named Burton had called on Mr. Green to obtain the plan of a balloon constructed so as to be used for this purpose. The inventor proposed to fasten the car to the balloon by a swivel and to build a waggon to which the balloon could be attached. The waggon could be conveyed to any place a surveyor required, where, on a calm day, he could take plans, carrying with him the proper instruments.

Sir Charles Bell leaves London

SIR CHARLES BELL, the eminent surgeon, having accepted the chair of surgery at Edinburgh left London in August, 1836. One of the last letters he wrote from his residence, 30 Brook Street, was to his sister Miss Bell. In this he said: "The house is in a hustle. Books gone—pictures packing. People surveying the house! This does look like a change. All my sacred corners usurped—a naked house not a home. . . . I leave no enemy behind me, and Marion is universally beloved. . . ."

"While the season lasts, our society is all we could wish; but now our friends hurry to their better houses in the country, where they invite us, but where we cannot go. Many a long day we have been left solitary in a crowd, losing spirits and health."

"Without independent fortune, the relations which we have formed with society are not without their drawbacks. I must be independent and through exertion more than fortune. I must pursue that course through which I have attained station to feel comfortable. I could have made a fortune, and so my friends say, but I could not also attain to what I am, and to what they would have me. . . ."

Statistical Desiderata

IN the Section of Statistics at the sixth meeting of the British Association held at Bristol in August 1836, Mr. W. R. Greg brought forward proofs of the total deficiency of statistical information in some subjects of international importance, and the unsatisfactory nature of that which had been collected by public authority in others. From examination of population tables, tables of births and deaths, criminal statistics, the statistics of education, of illegitimate birth and of stolen property, the author was led to conclude, that "with the exception of the revenue and commercial tables, no general documents yet exist in England from which any philosophical influences can be safely drawn, and that till the materials are wholly re-collected, all attempts to elicit such inferences can only end in disappointment and error". In order to obtain more satisfactory results in future, he deems it highly necessary to depart from the plan so commonly resorted to, of issuing circular queries, and to commit the task of obtaining authentic and complete information to individuals who shall make the execution of it their professional duty and whose labours shall be remunerated accordingly.

County Natural History Societies

IN a paper entitled "A Proposal to Establish County Natural History Societies for Ascertaining the Circumstances in all Localities which are

Productive of Diseases or Conducive to Health", Dr. J. Conolly, late professor of the practice of medicine in the University of London, after pointing out the advantages which the country practitioner possessed over those living in towns, especially as regards the intimate acquaintance he gradually acquired concerning every circumstance in the locality, suggested the formation in every county in England of a society consisting of scientific men of every class and description and comprising the following sections: (*a*) statistics, (*b*) geology and mineralogy, (*c*) geography, (*d*) meteorology, (*e*) agriculture, (*f*) botany, (*g*) archæology, (*h*) chemistry and (*i*) medical topography and statistics. The business of this last section would be "to apply all the exact knowledge furnished by the other sections to the subject of health and disease; to note, with extreme care, the relation of phenomena developed in the human body to the natural or statistical or historical and political and moral circumstances in which the subjects of such phenomena were placed". (*Trans. Prov. Med. and Surg. Assoc.*, 1, 180; 1836.)

Societies and Academies

Paris

Academy of Sciences, June 29 (*C.R.*, 202, 2109–2220).

Jean Tilho: The present condition of the zone of capture of the Logone by the Bénoué. Further measurements and observations confirming the possible danger of the capture of the Logone (Tchad basin) by the Bénoué (Niger basin).

Vito Volterra: The integration of the equations of biological fluctuations.

Claude Chabauty: Certain ternary diophantic equations.

Farid Boulad Bey: The general forms of equations of nomographic order 6 and 5 representable by conical nomograms.

S. Bucheguennce: The deformation of Bianchi surfaces.

Georges Giraud: A general class of equations with principal integrals.

Alexandre Ghika: The interpolation of analytical functions.

Emile Merlin: The nature of the trajectories of certain perfect heterogeneous fluids.

Henri Mineur: The galactic rotation of globular clusters.

Jean Jacques Trillat and Mlle. Renée Vaillé: A method of measuring the adsorption of oils by metallic surfaces.

Pierre Cibié: A method of laboratory control of the light projectors of motor-cars.

A. Hautot: The K-radiation of crystallized boron. It is concluded that the remarkable variation of the electrical conductivity of boron with temperature is due to a variation of the energy distribution of the conductivity electrons.

Jacques Errera Pol Mollet and Mary L. Sherrill: The infra-red absorptions of liquid hydrocarbons. The influence of the double linkage.

Henri Bizette and Belling Tsaï: The thermal variation of the magnetic double refraction of nitric oxide (NO) and of compressed oxygen.

Mlle. Madeleine Gex: Variations in the ultra-violet spectrum of phenol as a function of the *p*H. Over a range of *p*H from 1 to 12, the changes in the ultra-violet spectrum suggest four changes in the structure of the phenol molecule.

F. Hammel: The analogy of the monohydrated sulphates of the magnesium series. Results of X-ray studies of the monohydrated sulphates of magnesium, manganese, iron, cobalt, nickel, copper and zinc.

François Bourion and Mlle. Odile Hun: The cryoscopic determination of the total hydration of the ions of hydrochloric acid.

Mlle. Cécile Stora: The mechanism of the Becquerel effect of organic molecules.

Tr. Négresco and W. J. Crook: The equilibrium relations of the oxides of iron in the slag of refinery furnaces.

Mlle. Jeanne Boulanger: The systems zirconyl oxalate, alkaline oxalates and water.

Pierre Carré and Louis Peigné: The relative mobilities of the normal alkyl radicals in their chlorothioformates.

Henri Wahl: The chlorination of *p*-chlortoluene. The chlorination of *p*-chlortoluene gives a mixture containing 58 per cent of the 2,4.dichlortoluene and 42 per cent of the 3,4.compound. This proportion is not affected by the nature of the catalyst, or by variations of temperature between 20° and 40° C.

Pierre Legoux: The origin of the gold of the Guinea-Sudan borders.

Louis Dongieux, Louis Dubertret and Henri Vautrin: The Oligocene and Burdigalian of the Syrian desert.

Maurice Parat: The Oxfordian and Kimmeridgean of Milne Land (Eastern Greenland).

André Aurio: The suitability of a cycle of 334 years for meteorological predictions.

Henri Colin and Marcel Simon: The proportion of ash and its alkalinity in the beetroot.

Etienne Foex and Maurice Lansade: A bacteriosis of the banana tree.

M. and Mme. Fernand Moreau: The toxicity of some cations for the Saprolegnieæ.

Léo Espil and Gabriel Mandillon: The action of bromacetates on various alkaloids. Sodium bromacetate reacts with strychnine sulphate, giving a non-toxic product. The toxicity of this alkaloid would appear to be connected with the existence of a free amino group.

Mme. Véra Dantchakoff: Sex hormones and the role of the placenta in the ontogenesis of mammals.

Israel and Michel Magat: The ultra-violet spectrum of normal and leucæmic blood.

Fred Vlès: The conditions of stimulation of fluorescence of proteins.

Ernest Kahane and Mlle. Jeanne Lévy: The origin of the choline of sperm. The existence in sperm of free choline is a secondary phenomenon due to the action of a diastase on a precursor of choline.

Ali Mustapha: The action of the cholera vibrion on milk and cholerigen power.

Georges Blanc and Marcel Baltazard: The influence of privation on the development of the virus of murin typhus in the flea (*Xenopsylla Cheopsis*)

Alexandre Besredka and Michel Bardach: The intra-cutaneous immunization of rabbits against epithelioma inoculated in the eye. Intra-cutaneous epithelioma, a benign tumour, acts as a true vaccine against epithelioma of the eye, a malignant tumour.

Amsterdam

Royal Academy (*Proc.*, 39, No. 6, June 1936).

W. H. KEESOM and G. SCHMIDT : Researches on heat conduction by rarified gases. (1) The thermal accommodation coefficient of helium, hydrogen, neon and nitrogen on glass at 0° C.

J. BOESEKEN : The oxidation products of thiourea. The dioxide as derivative of sulphoxylic acid (H_2SO_2).

E. D. WIERSMA : Physical resemblance in connexion with mental similarity (1). Researches on the inheritance of temperament and resemblance of offspring and parents.

K. MAHLER : An analogue to a theorem of Schneider (2).

H. FREUDENTHAL : (1) A class of rings in Hilbertian space. (2) The abstraction of the concept of an integral.

W. BLEEKER : Meteorological data from the three Dutch expeditions to the Karakorum (1). Observations of pressure, temperature, humidity, etc., at various stations in the Karakorum range.

T. WEEVERS : A consideration of some phytochemical problems. The phytochemical characteristic of a species, genus or family of plants is not a single compound, but a particular combination of several compounds.

T. E. DE JONGE-COHEN : Radix præmolarica unilateralis.

N. SUZUKI : The diencephalic and some other systems in *Xantharpyia amplexicaudata* (1).

B. VAN DER EYKEN : Dentition and teeth development in the irisforelle (*Salmo irideus*) (6). Teeth development.

A. CHARLOTTE RUYS : The isolation of typhoid bacilli from water. Wilson and Blair's medium readily permits of the isolation of the typhoid bacilli from infected water.

D. VAN DANTZIG : Ricci calculus and functional analysis.

Geneva

Society of Physics and Natural History, May 7.

KURT H. MEYER and W. LOTMAR : Note on the elementary lattice of crystallized caoutchouc. From a study of the interferences, the dimensions of the elementary lattice of crystallized caoutchouc can be calculated. It is monoclinic ($a = 8\cdot54$ A.; $b = 8\cdot20$ A.; $c = 12\cdot65$ A.; $\beta = 83°$). The arrangement of the atoms in this lattice, which includes eight isoprene radicals, can be established. Thus, caoutchouc should be classed in the C^{5}_{2h} spatial group.

A. WEINSTEIN : The equations of vibration of a plate. Calculation of close upper and lower limits for the frequency of the overtone of a square clamped plate.

ERNEST C. G. STUECKELBERG : Continuous γ-radioactivity and unitary field theory. The Fermi explanation of continuous $\beta+$ radioactivity allows for a recombination between the created positive electron and an orbital electron. The annihilation radiation can escape from the atomic system even if there is not enough energy available to produce a positive electron. Thus there is a pure and continuous γ-ray emission. Considering electron, neutrino, proton and neutron as different quantum states of one elementary particle, only four different transitions are possible if conservation of charge and Dirac's equation are postulated. They explain the Fermi formula of β-decay and the nuclear exchange forces of Heisenberg and Majorana. If a neutrino theory of light is developed, the electric field and the material field (particles) can be described by the 16 components of a unitary spinor field (see also NATURE, June 20, p. 1032, and June 27, p. 1070).

B. SUSZ and S. FRIED : The Raman spectrum of gallic acid, of some of its derivatives and of tannin. The authors give the Raman spectrum of gallic acid, of methyl gallate, methyl trimethylgallate, triacetylgallic acid and Chinese gallotannin with some interpretations of the frequencies found.

Moscow

Academy of Sciences (*C.R.*, 1, No. 7, 1936).

S. SOBOLEV : Evaluations concerning the families of functions having derivatives with integrable squares.

L. KANTOROVICH : The general theory of operations in semi-ordinated spaces.

A. I. ALICHANIAN, A. I. ALICHANOV and L. A. ARZIMOVICH : The law of the retention of impulses at the annihilation of positrons.

V. ARKADIEV and A. MOROSOVA : Photographic representation of a Hertzian dipole.

N. SELJAKOV : To what class of symmetry does ordinary ice belong ? There are two modifications of ice ; α-ice is hexagonal and β-ice is rhombohedral.

M. ELIASHEVICH : The rotation-vibration wave equation for a polyatomic molecule.

D. RAUZER-CHERNOUSOVA : The Fusulinidae and the stratigraphic subdivision of the oil-bearing limestones in the Sterlitamak district.

J. M. URANOVSKIJ : The role of the nervous system in the regeneration of the extremities in axolotl.

Sydney

Royal Society of New South Wales, June 3.

A. H. VOISEY : The Upper Palæozoic rocks around Yessabah near Kempsey, N.S.W. The various rock types in an area of about thirty square miles are described, classified and mapped, these rocks being mainly of sedimentary origin. This work reveals a very interesting story of bygone ages. More than three hundred million years ago there existed a shallow sea abounding in life ; but many organisms were killed by showers of ash from violently explosive volcanoes. Later came uplift, and then another subsidence again ushered in marine conditions. The climate then was cold, and icebergs floated about on this sea fringed with active volcanoes. Further uplift and depression followed, with a gradual dying out of volcanic activity. After a final uplift, came extraordinary changes—pressure folded the rocks into great arches and troughs, and huge rock masses were displaced along cracks. Then for perhaps two hundred million years the land surface was gradually but effectively worn down, until it was but little above sea-level : uplift followed, and out of the highlands so formed the present Macleay River cut its valley.

GERMAINE A. JOPLIN : The Ben Bullen Plutonic Complex, N.S.W. The Ben Bullen complex consists of two intrusions of partial magma. The earlier mass is of noritic composition, and has differentiated *in situ*. The later intrusion is a quartz-mica-diorite, and this has reacted with the solid norites and given rise to a series of cognate hybrids. Five chemical analyses show that the complex is closely related to the Hartley series, and possibly represents a northerly extension of the Hartley-Bathurst bathylith.

H. G. RAGGATT: Geology of the north-west basin of Western Australia, with particular reference to the stratigraphy of the Permo-Carboniferous. The stratigraphy and lithology of the Permo-Carboniferous system in the north-west basin of Western Australia are described in detail, and a subdivision into series and stages suggested. Correlation of these rocks with the Permo-Carboniferous of the Irwin River is discussed. An outline of the stratigraphy of the Cretaceous and the geological history and structure of the region are given.

WINIFRED MANKIN: An attempt at quantitative analysis of silver-gold alloys. Arc spectra were obtained from alloys of silver and gold in various proportions in the attempt to find a definite relation between the ratio of the intensities of corresponding lines in the spectra of the two metals and their proportions in the alloy. The alloy formed a bead in the crater of a carbon arc. Three pairs of corresponding lines were examined. No regular relations were obtained, and this is due mainly to the relative rates of volatilization varying considerably with slight changes in the arc conditions. Chemical analysis showed that the relative proportions of the metals were changed considerably, and in an erratic manner, by the passage of the arc. Suggestions are made for modifications of method.

H. FINNEMORE and JOYCE M. COOPER: Cyanogenetic glucosides in Australian plants (4). *Zieria lævigata.* The leaves of this rutaceous plant yield by the action of its own enzyme 0·2 per cent of hydrocyanic acid, and approximately twice this amount with additional enzyme. It is shown that this is due to the decomposition of zierin, the glucoside of meta-hydroxybenzaldehyde cyanhydrin.

Official Publications Received

Great Britain and Ireland

Rubber Growers' Association. Rubber and Agriculture Series, Bulletin No. 2: Pneumatic Equipment for Horse Drawn Vehicles. By Alexander Hay. Pp 20. (London · Rubber Growers' Association) [137

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1675 (T. 3602) · Graphical Method of Calculating Performance of Airscrew. By C. N. H Lock. Pp. 30+8 plates. 2*s.* net No. 1677 (S and C. 453): Flight Tests on an Atlas fitted with Auto-slots having various Link Arrangements. By W. G. Jennings. Pp. 7+5 plates. 9*d.* net. No. 1695 (2076) Effect of Static Pressure along the Axis of an Open Jet Tunnel of (a) Nozzle Flare, and (b) a Ring in the Collector. By F. B. Bradfield and G. F. Midwood. Pp. 3+4 plates. 6*d.* net. (London: H.M. Stationery Office) [187

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 33 Method of Infection of Oat Grain with *Ustilago avenæ* and the Influence of External Factors on the Incidence of the Disease. By Robert McKay. Pp. 297–307+plate 7. 1*s.* 6*d.* Vol. 21 (N.S.), No. 34: The Inhibition of Chemical Reactions. Part 6: The Influence of Ether and Nitrobenzene on the Absorption of Ethylene by Sulphuric Acid. By Dr. Kenneth Claude Bailey and William Edwin Calcutt Pp. 309–315. 6*d.* (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) [157

Harper Adams Agricultural College. Farm Guide, Season 1936, with Notes on the Crop Variety Trials. Pp. 24. Advisory Report No. 11: Report of the Harper Adams College Advisory Department, April 1935–March 1936. Pp. 29. (Newport, Shropshire: Harper Adams Agricultural College.) [157

The National Central Library. 20th Annual Report of the Executive Committee, 1935–36. Pp. 60. (London: National Central Library.) [167

Proceedings of the Royal Society of Edinburgh, Session 1935–1936. Vol. 56, Part 1, No. 4: Some Experiments having Particular Reference to the Flow of Water along Short Capillary Tubes connecting Two Vessels with Free Surfaces. By J. Allen. Pp. 26–37. 1*s.* Vol. 56, Part 1, No. 5 · The Revised Prepared System of the Quadratic Complex. By Prof. H. W. Turnbull. Pp. 38–49. 1*s.* Vol. 56, Part 1, No. 6: On Singular Pencils of Zehfuss, Compound and Schläflian Matrices. By W. Ledermann. Pp. 50–89. 3*s.* 6*d.* (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [167

Other Countries

Uganda Protectorate. Annual Report of the Geological Survey Department for the Year ended 31st December 1935. Pp. 19. (Entebbe: Government Printer) 2*s.* [67

Memoirs of the Kyancutta Museum. No. 2: Further Notes on Archaeocyathi (Cyathospongia) and other Organisms from the Lower Cambrian of Beltane, South Australia By R. and W. R. Bedford. Pp. 9–20+plates 7–20. (Kyancutta: Kyancutta Museum.) [67

Survey of India. General Report 1935, from 1st October 1934 to 30th September 1935. Pp. xi+74+14 plates. 1.8 rupees; 2*s.* 6*d.* Index to Annual Reports of the Survey of India, 1904–5 to 1926–7. Compiled by Lieut.-Colonel A. H. Gwyn Pp. 21. (Calcutta: Survey of India) [67

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Science and Armaments

NOTHING could demonstrate more completely what the Prime Minister recently termed the madness of re-armament than the fact that in the recent debate on defence in the House of Commons, Government spokesmen failed to reply to the two questions which are uppermost in everyone's mind: What is the limit of the expenditure involved, and against whom is the programme directed? The questions indeed cannot be answered. There is no limit; and to express one's fears in definite words might well be to start the conflagration universally dreaded. Unless intelligence once again takes control over passion and prejudice in the relations of nations, and force is relegated to its proper function of maintaining law and order, there can be no escape from a conflict which would involve ruin for all. Nor can we hope for peace among nations any more than among individuals if we encourage the view that wrongs cannot or will not be dealt with by reason or persuasion and can only be redressed by force.

Even the staunchest supporter of the present programme of re-armament and defence in Great Britain can scarcely avoid misgivings as to its eventual outcome. Unless at the same time we can ensure that some real attempt is made to eliminate the root causes of international friction and misunderstandings, to control the mischief wrought by economic nationalism, and to secure a settlement of difficult economic and racial questions on a basis of social justice and not of *force majeure*, the attempts to strengthen armaments, however sincerely aimed at national defence, can only bring conflict nearer. Collective security is in fact the only possible form of security to-day. All else is merely a matter of relative insecurity and how soon the crash will be.

The most serious feature of the recent debate was, however, the absence of reference to the imperfection of defence against modern methods of warfare. Responsible technical and scientific opinion is at one in agreeing that any protective measures for the general population against air attack by chemical means is at best imperfect and inadequate, and scientific workers cannot evade their responsibility for warning the population of the limitations of the measures now being considered by the Air Raid Precautions Department of the Home Office. There could be no greater calamity than for the population to be deluded into believing itself to be largely immune from the consequences of such attacks in the event of an outbreak of war. The proposals to transfer part of Woolwich Arsenal to western and northern districts of the country, and to duplicate the coal oil plant at Billingham in South Wales instead of on the same spot, indicate in themselves that the effective defence even of munition centres is problematic.

To this extent, therefore, scientific workers will be in general sympathy with a resolution which was submitted at the meeting of the British Medical Association at Oxford in July. The resolution, however, proceeded further, and recommended the Association to take the initiative with the object of securing the co-operation of the medical profession of all countries to prohibit the manufacture of poison gas. Scientific workers would undoubtedly join in condemning the use of poison gas in conjunction with other forms of warfare as inhuman and degrading to civilization, even though they may doubt whether it is worth while to endorse too hastily proposals to discriminate against one particular kind of warfare.

The impossibility of effective defence measures against chemical warfare for the civil population should not blind us to the difficulty of securing its prohibition if resort was once made to warfare. Events in Abyssinia have demonstrated afresh the impossibility of relying on the pledges to a particular form of warfare when once a nation has broken its general pledge, even under conditions when provocation or retaliation in kind are impossible. Despite this impracticability, which was emphasized by speakers in the discussion at the British Medical Association, an amended resolution was passed which, condemning gas warfare, called on the Council to do everything in its power to secure the co-operation of the medical profession in all countries to prohibit the use of poison gas.

Apart from the serious doubts entertained by authorities as to the practicability of chemical warfare being prohibited, it is even open to doubt whether the restriction of particular methods of warfare is desirable. The very ruthlessness with which war is prosecuted with modern weapons, and the cynical disregard of international obligations or of any standard of humanity or chivalry in the conduct of a campaign, may even prove a gain to mankind in the end if the lesson is learnt that the real problem is that of eliminating and not merely of mitigating warfare. As Sir Henry Thuillier, who during the Great War was Controller of Chemical Warfare, has suggested, the interests of humanity might be better served if the whole populace appreciated in advance that the direct effects of resort to warfare would not be confined to the combatant services.

The lecture to which we refer has now been published in the *Journal of the Royal United Services Institution* for May last, and it will well repay study by all those who are really concerned with constructive efforts to establish peace and co-operation, and to secure the surrender or abatement of these national claims or rights which most hinder the working of a system of collective security and constitute the gravest danger to peace. Sir Henry Thuillier does much to stimulate clear thinking on questions where side issues have so long diverted attention which should have been given to the major question of eliminating the use of war altogether.

Proposals to restrict methods of warfare have arisen from economic considerations, as in regard to the battleship, but much more commonly on humanitarian grounds. In regard to the latter, a clear answer has rarely been given to the fundamental questions: Will the proposed restriction actually reduce the inhumanity of war, and will the agreement be effective? The voluminous discussions which have taken place on chemical warfare, the submarine, the use of tanks, have not led to any general agreement on the answers which should be given. On the contrary, there is abundant evidence of the muddled thinking which Sir Henry Thuillier warns us is a most serious danger to peace and security.

Certain questions have to be frankly faced in any discussion on restrictions if clear thinking is to be ensured. Since all war is indescribably inhumane, is it to the benefit of the human race to try to reduce its inhumanity in two or three minor directions only? Nothing can really lessen its horrors, and it may well be better that the peoples should realize this in order that they may make every effort to put an end to it altogether. If it were known in advance that the effects of warfare would fall as ruthlessly on all classes of civilians, whether on the statesmen who had bungled diplomacy, or financiers or manufacturers or others whose desire for trade expansion or profits had contributed to its outbreak, as on members of the fighting services, much more serious and constructive efforts to prevent it might be made. On the question whether the proposed restrictions could really reduce the inhumanity at all, not only is there need for a close sifting of opinion but also for a frank facing of facts. The desire to abolish submarines or poison gas is largely based on lack of knowledge, false sentimentality, conservatism, fear of unknown methods and perhaps especially the fear that our adversary may prove more efficient in these new methods than ourselves. To the third question, whether we could have a reasonable guarantee that agreements of this sort would not be evaded, or even openly repudiated under stress of defeat, events in Abyssinia suggest a very definite and depressing answer. The only hope seems to be to organize a society in which constructive effort will be used to eliminate war altogether and to make civilized peoples realize the horrors and inhumanity of any such conflict between nations.

It is well that scientific workers should, as was done in the recent discussion at the meeting of the British Medical Association, dissociate themselves from the prostitution of scientific results in warfare or for other nefarious purposes: it is equally their duty, however, to do all in their power to ensure clear thinking on such matters. The pertinent remarks of Sir Henry Thuillier about the alleged inhumanity of gas warfare, or even of the use of the submarine, should be welcomed by all scientific workers, and they reveal the essential childishness of much of the discussion on this point.

All war is inhumane ; and to fritter away effort discussing the relative inhumanity of different kinds of warfare is rapidly becoming intolerable. What has to be recognized is that war is not only inhumane but also under modern conditions its renunciation as an instrument of national policy, and as a means of dealing with international disputes, is absolutely essential if civilization is to survive. The question really is whether there is yet time to carry out the constructive work involved both in developing adequate machinery for settling international disputes, and for removing the causes of international friction and misunderstanding, before the world is overwhelmed in another outbreak. Scientific workers owe it to themselves, no less than to their science and to their civic responsibilities, to strain every effort to ensure constructive thinking in these matters and to promote the formulation and execution of policies adequate to secure that the enormous powers now at our disposal are used for the advantage of mankind instead of its destruction.

A Sketch of World History

World History : the Growth of Western Civilization. By R. Flenley and W. N. Weech. Pp. xix + 757. (London : J. M. Dent and Sons, Ltd., 1936.) 12*s*. 6*d*. net.

WORKS on general history have often been noticed in NATURE, especially from the point of view of the space and the position which they assign to science. There has undoubtedly been a marked improvement in the matter, and the very attractive book under notice is a good example, suggesting also one or two points of criticism in its presentation. It is certainly the best thing of the sort that we have seen in English—a sketch of world history in some seven hundred pages with abundant illustrations and excellent maps and diagrams and written throughout by both authors with full knowledge and an almost perfect impartiality.

The questions of how to present the vast mass of material, and for whom one is writing, are, in this kind of book, supremely difficult. In this one, the readers who will gain most from it are those who have a fairly good knowledge beforehand and are glad to have it revived in a well-ordered summary up to date. For students who are approaching the subject for the first time, the language, ideas and implications of the writers are probably too difficult. This is the case more especially with Mr. Flenley, who does the modern portion. One often feels that the essential points could be conveyed without such an array of long and abstract words and in shorter sentences. On the other hand, Mr. Flenley grapples valiantly with the problem of including all sides of history—music, art and literature as well as science—and his allowance for science is relatively generous. Yet even so, how can one excuse in such a survey the complete omission of the marvels discovered in the heavens and presented so clearly in the Astronomer Royal's recent "Worlds Without End" ?

Mr. Weech, who is an old schoolmaster, has a crisper and simpler style. Some of his short sayings are admirable ; for example, "It was the spoken word, not the written, that counted with the Greek and made him the teacher of the western world. . . . He was an excitable, quarrelsome, kind-hearted creature. He was continually fighting his neighbour in the next valley, but when he had finished, he did not, like other conquerors, mutilate, crucify or scalp his captives, nor did he convert them into gladiators." On the other hand, Mr. Weech is much less adequate in his account of ancient science. The wonderful discoveries which have recently been made of the mathematics of Babylonia, and the medicine of ancient Egypt, find no place. The institution of the calendar is naturally mentioned, but not its connexion with the heliacal rising of Sirius. More should have been given of the sort of matter which Prof. Gordon Childe has just put out in his "Man Makes Himself"—the origins of civilization—even if further cuts had to be made in the political sections. It is also doubtful in the later portion whether the Impressionist and Post-Impressionist painters deserve the several pages which they get.

There is room, however, for wide difference of opinion as to such relative values, and the book is strongly to be commended in the sense mentioned above. The sober hopefulness of the "Conclusion" —after a summary of the successes and failures of the League of Nations—hits the mark very well.

F. S. MARVIN.

Classical Dynamics

Theoretical Mechanics:
Dynamics of Rigid Bodies. By Prof. William Duncan MacMillan. Pp. xiii + 478. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 36*s*.

WITH the publication of this volume on rigid dynamics, Prof. MacMillan has completed a task of first-rate importance. This work, together with its companion volumes on statics and particle dynamics and on the theory of the potential, constitute a trilogy which, for a long time to come, will be welcomed by successive generations of honours students of physics and of engineering. Despite the fact that the centre of interest has in some measure shifted from such studies, there was a real lack of a treatise which should serve the needs of this generation as Routh served those of an elder line of students. Routh's works, and Thomson and Tait, have become classics, and as is the fate of most classics are rather read about than read. No more brilliant introductions to the advanced study of mechanics are to be found than those of Horace Lamb. It is rare indeed to find a first-rate intellect which combines an almost unexampled power of exposition with a sympathetic appreciation of the needs of the average student and a capacity for keeping mathematics in touch with physical reality. Lamb had these gifts in full measure, and his treatises on mechanics are an invaluable expression of these gifts.

But a work was needed which should carry the story farther and should view the subject from a rather different angle, and Prof. MacMillan's book fulfils this want. His treatment is severely classical; "the three laws of motion as given by Newton furnish the foundation for the entire structure"; and the section 'E' of the author index contains but the names of Eisenhart and of Euler. Both the geometrical and the purely analytical methods of attack are developed, and the author's preliminary account of the algebra of vectors is a model of clarity and of compression.

A chapter on moments of inertia follows, and here, perhaps, a digression on a point of very elementary, and yet of very general interest, may be permitted. The author defines the moment of inertia of a system of particles *with respect to a plane, line or point* as the "sum of the products of the mass of the particle into the square of the perpendicular distance of the particle from the plane, line, or point (or merely the square of the distance in the case of a point)". In doing so he has followed the example of Routh and of other classics. But many authors and teachers seem to be obsessed by the notion that the term *moment of inertia* has no meaning apart from an *axis*. Hence they lose the chance of developing that most instructive method of calculating the moment of inertia of a sphere about a diameter, which consists in calculating it *about the centre* by the simplest of all integrations—that of $4\pi r^2\rho.dr.r^2$ through the volume of the sphere, hence leading to $\frac{3}{5}Ma^2$ as the required value. The moment of inertia (I) about a diameter follows at once from the consideration that I_x is equal to $\Sigma m(y^2 + z^2)$ with two similar (and equal) expressions for I_y and I_z. Hence, by addition, we arrive at the value $\frac{2}{5}Ma^2$ with no more equipment than is required for the integration of $x^n.dx$ and for a knowledge of the geometry of a common brick. This simple method is obviously the one to be followed in elementary teaching. Which of the heroes who lived before Agamemnon invented it, the reviewer knows not, and would like to know; Binet (*teste* Routh) introduced the notion of moment of inertia with respect to a *plane* so far back as 1813.

The chapter on moments of inertia is followed by a series of chapters which deal with systems of free particles, general theorems on the motion of a rigid body, motion parallel to a fixed plane, the motion of a rigid body in space, integrable cases of motion about a fixed point, rolling motion and impulsive forces. This portion of the volume extends to some three hundred pages.

The hundred and seventy pages that remain are devoted to three important chapters, the first of which deals with Lagrangian equations, their application to holonomic systems and their extension to non-holonomic systems. The chapter closes with a brief account of Appell's equations, which are applicable equally to holonomic or to non-holonomic systems.

The penultimate chapter deals with the canonical equations of Hamilton, and the work closes with a discussion of the method of periodic solutions. Here, as in the more elementary parts of the book, the author extends a helping hand to the student by giving him a very clear résumé of the amount of matrix theory necessary for the comprehension of the argument. This chapter, one of the most interesting in the volume, deals with a method of attack which is both long and difficult, but which, as was remarked by its originator,

H. Poincaré, "is the only worth-while method that is known for a wide class of problems".

The book is by no means an easy one to read, but the difficulties which the reader will encounter are inherent in the subject. The author has the teacher's instincts, and has made the going as smooth as may be. Further, he has provided a large number of illustrative examples, of all degrees of difficulty, on which the student may try his hand.

If a word of general criticism be permitted, it is that the book would be considerably improved if its subject matter were more fully illustrated by examples taken from physical and engineering practice. True, the billiard ball, the top and the pendulum play a large part in the illustrations in the text, but the practical side of pendulum work is drawn from Routh, and in this, as in many other instances, examples are better studied in the light of modern practical work of precision.

The book fills a gap in the literature and may be heartily commended. A. F.

Mineral Resources of the French Colonies

Les ressources minérales de la France d'outre-mer

Publications du Bureau d'Études géologiques et Minières coloniales. 3 : Le zinc, le plomb, l'argent, le cuivre, l'or, les minerais radioactifs, le mica, les pierres précieuses, substances diverses. Pp. ii+394+5 plates. 40 francs. 4 : Le phosphate. Pp. ii+207+3 plates. 20 francs. (Paris : Société d'Éditions Géographiques, Maritimes et Coloniales, 1935.)

THE issue of these two volumes on French colonial mineral resources by the Bureau d'Études Géologique et Minières Coloniales will be welcomed by readers who have already made themselves acquainted with vol. 1 on coal and vol. 2 on iron ore.

Vol. 3 covers a number of important metals and minerals, including zinc, lead and silver by F. Blondel, copper by P. Lion, gold by P. Delaître, radioactive minerals by H. Buttgenbach, mica by P. Chomette, precious stones by A. Lacroix, and various other metals and minerals, namely, aluminium, asbestos, antimony, arsenic, barytes, diatomite, mercury, nitrate, platinum, pyrite, rock-salt, potash and mineral waters, by F. Blondel.

As the lead-zinc ore deposits of French North Africa may be regarded as forming a Mediterranean circuit with those of Spain and Italy, M. Blondel includes all three in a useful account of the lead-zinc ore deposits of the western Mediterranean generally. On the whole, this region is one of much importance from the point of view of the supply of these base metals. M. Blondel concludes this section by a statistical account in which he examines the national position in France as regards supplies of lead and zinc.

The importance of copper in modern industry, the large necessary imports and very small production in France, makes M. Lion's account of the French position as regards copper one of much interest. Of considerable interest also is his description of the geology of the copper deposits of the Niara basin to the west of Brazzaville in French Equatorial Africa, and his account of the economics of copper from the historical point of view as well as with regard to the present position.

In the section on gold, M. Delaître gives an account of the geology and distribution of gold in the French colonies, and explains the simpler methods of exploitation applicable by prospectors in opening up superficial deposits in newly-discovered gold areas. In a brief section on radioactive minerals, M. Buttgenbach mentions deposits other than those of the French colonies, and gives a very useful description of the important deposit of uraninite (pitchblende) and its alteration products at Chinkolobwe in the Belgian Congo. In the section on mica, M. Chomette deals with mica generally, but briefly, and refers particularly to Madagascar deposits of muscovite and phlogopite, of which the latter are the more important. Madagascar produces phlogopite of superior quality and appears to have large reserves.

The section on French colonial occurrences of gemstones by M. Lacroix makes an attractive feature, chiefly on account of the remarkable assortment of beryl, tourmaline and other minerals of gem quality in Madagascar pegmatites, which are especially interesting from the mineralogical and petrological points of view. It is interesting to read in this section of the doubts that were entertained up to about a century ago as to whether diamonds really existed in Africa. Since then, Africa, especially South Africa, has produced nearly all the world's diamonds; but it is a very curious fact that, although important discoveries of exploitable diamond deposits have been made in recent years in the Belgian Congo, Angola, South-West Africa Territory, Tanganyika, Gold Coast and Sierra Leone, no find of any importance has hitherto been recorded in French Africa. No diamonds have been found in Madagascar, and the occurrences in French Equatorial Africa are as yet of no economic importance.

In the closing section of vol. 3, M. Blondel states that the auriferous stibnite mine at Lucette in Mayenne, France, became exhausted and was closed in 1934, a reminder to us, if one be needed, of the wasting nature of the earth's mineral assets.

In vol. 4, which is devoted entirely to phosphate, the important deposits of phosphate in Morocco are accounted for by A. Beaugé, who deals with their geology and explains the working of the organization of the Office Chérifien des Phosphates; and E. Lenhardt, who deals with methods of exploitation and transport.

A separate section is devoted to Algeria and Tunis by P. Reufflet, and another to the marketing of phosphates by H. de Bailliencourt-Courcol. In another section, A. Lacroix deals with phosphatized land-surface deposits such as those due to the replacement of limestones by the action of solutions arising from leached coverings of guano, and corresponding aluminium phosphates formed by the action of similar solutions on trachytes and other igneous rocks.

Not the least interesting section of this volume from a scientific point of view is the one given to a discussion of the origin of sedimentary phosphate beds of marine origin by L. Cayeux. These beds have been formed at intervals from the earliest geological times, and on account of their importance as a source of phosphate fertilizers may be regarded as among the front-rank mineral resources from the point of view of human welfare. The problem of their origin is a puzzling one. M. Cayeux has long held the view that the formation of marine phosphate beds could only take place after a disturbance of the equilibrium of the sea floor. To this *sine qua non* of sea-floor disturbance, he now adds bacterial action as essential. In some way or other, which is not clear, the bacteria are roused from a state of dormancy to one of action by the disturbance of the sea floor, and set about elaborating phosphoric acid from the sea water, while phosphoric acid attacks any calcium carbonate that may be available, forming calcium phosphate. In this environment, he tells us, fish may flourish abundantly, and the accumulation of their remains is added to that of the phosphate deposited on the sea floor; but the extent to which they contribute is very variable. To the question "Are phosphate beds now forming on the sea-floor?" M. Cayeux replies very emphatically in the negative, and claims that the conditions essential for their formation do not exist at the present day.

Both volumes are well illustrated and indexed, are provided with useful bibliographies, and are likely to be serviceable for many years as works of reference on French colonial resources of the minerals with which they deal.

Formulæ of Medieval Painters

The Materials of Medieval Painting
By Daniel V. Thompson. Pp. 239. (London: George Allen and Unwin, Ltd., 1936.) 7*s*. 6*d*. net.

MR. DANIEL THOMPSON has been engaged for many years in the study of the large number of medieval MSS. containing recipes for carriers, grounds, pigments and mediums which are to be found in the libraries, both in Great Britain and elsewhere in Europe. The actual number of MSS. examined amounts to 157, and in this simply written book we have the outcome of a laborious research, involving problems in translation, and the testing out of many recipes in the laboratory and the studio.

Mr. Thompson has already given us the most perfect text of Cennino Cennini's book on painting and an excellent translation, a book on tempera painting which was the result of many years practice based on Cennino Cennini, and many other contributions to the literature of the subject, and this is his latest contribution. Those who wish to look further into the subject will find in *Speculum* of October, 1935, references to actual MSS. and recipes.

A German scholar would have doubtless written many fat volumes on the material collected by Mr. Thompson, and it is to be hoped that he will still undertake this work. In the meantime, this book, based on a course of lectures given in the Courtauld Institute, enables the connoisseur, artist and collector to obtain the distilled essence of his researches in an easily read and simple form. The classical work on the subject is "The Ancient Practice of Painting" by Mrs. Merrifield, and since then excellent editions of special MSS. have been made. Ernest Berger published certain MSS. in his learned volumes on the history of painting, and we have from Wilhelm Theobald an excellent edition of Theophilus, and there are others.

Valuable as these publications are, they have two defects. Many valuable recipes may be missed, and too much importance may be given to a single recipe. By making a critical examination and comparison of a large number of MSS. which have so far been neglected, not only are new recipes discovered, but so wide a survey also results in a more trustworthy judgment of what was the actual practice.

It is perhaps unnecessary to say that a book like this starts as many questions as it answers. The paragraphs dealing with verdigris alone, for the preparation of which many recipes exist, call for an investigation into organic basic salts of copper and their properties as pigments. The absence of recipes for certain pigments is also of interest. A copper resinate made by dissolving verdigris in a pine oleoresin was used so early as the close of the eighth century, yet no recipe has yet been found earlier than that given by Dr. Mayerne in the seventeenth century.

Very few recipes, and those of little value, are given for the preparation of madder lakes, yet fine madder lakes which have stood remarkably the test of time are found so early as the late fifteenth century, and it is difficult to decide how they can have been prepared. The use of madder as a dye was confined to certain dyers in Marseilles, and they may have possessed secrets which were unknown to the painter.

The publication of this book is singularly opportune, when we have at last in the Courtauld Institute a laboratory equipped for research on these lines. Mr. Thompson has provided for this work with a rich mine of material.

A. P. LAURIE.

Vasodilator Substances in Animal Tissues

Gefässerweiternde Stoffe der Gewebe
Von Prof. J. H. Gaddum. Eingeleitet von H. H. Dale. (Monographien zur Pharmakologie und experimentellen Therapie, herausgegeben von Philipp Ellinger.) Pp. xii+200. (Leipzig: Georg Thieme, 1936.) 18 gold marks.

THE basic problem can be stated by pointing out that in the animal body there is a central mechanism for cutting off the blood supply to the different organs; but, so far as present knowledge goes, no central mechanism for increasing it. How then is an active organ, for example, a particular group of muscles in the leg, to obtain a greater blood supply than it received when resting? It was formerly believed that the liberation of acid as the result of tissue activity caused local vasodilatation; it is now thought that vasodilatation follows the liberation of various bases such as histamine, adenosine and others not yet identified.

The old and the new views are linked by the probability that the actual liberation of the bases is a secondary consequence of acid formation. Not, be it observed, that the problem has been recognized and attacked as a problem directly. A series of attempts have rather been made to isolate from tissue extracts substances responsible for various physiological properties possessed by these extracts. Just as biochemical progress has come from the identification of substances having a characteristic colour reaction, so by identifying substances having a characteristic vasodilator reaction, pharmacological progress has followed. This work is both difficult and laborious and demands much experience of the pitfalls of pharmacological analysis. Prof. Gaddum's book is an extremely valuable account of the chemical and pharmacological properties of the substances which have hitherto been investigated. A great part has been the work of Sir Henry Dale and his very able collaborators, and it is due to his persistence that the subject has been extended so as to throw light on many other aspects of physiology. A stimulating introduction comes from Sir Henry's pen.

The book deals in succession with histamine, acetylcholine, adenosine and then with substances of unknown composition. The author then strains the title by including a chapter on the chemical transmission of nervous impulses, but this will be perhaps its most useful feature to those not working in the special field. The book is a fitting testimonial to Prof. Gaddum. Nothing seems omitted, opinion is not withheld, and when given it is fully supported by evidence; the writing is modest and precise. The best tribute one can pay to the German translation by Dr. Feldberg is that it is very easy to read, but one may make the comment that it is strange to find in German the first general account of work so largely done in Great Britain.

J. H. B.

A Text-Book of Inorganic Chemistry

Edited by Dr. J. Newton Friend. (Griffin's Scientific Text-Books.) Vol. 11 : Organometallic Compounds. Part 3 : Derivatives of Phosphorus, Antimony and Bismuth. By Archibald Edwin Goddard. Pp. xxviii+318. (London : Charles Griffin and Co., Ltd., 1936.) 20*s.* net.

VOL. 11 of Dr. Friend's "Text-book of Inorganic Chemistry" deals with organometallic compounds, and the author is Dr. Goddard. It is divided into four parts, the first dealing with derivatives of elements of Groups I to IV of the Periodic Classification of the elements, and the second part with derivatives of arsenic. The present volume describes the organometallic derivatives of the other elements of Group V, namely, phosphorus, antimony and bismuth, leaving the elements of Groups VI–VIII for Part 4, now in preparation.

The book under review is planned on simple lines. Thus the first two chapters deal with fatty and aromatic derivatives of phosphorus, followed by a chapter on miscellaneous phosphorus compounds; fatty and aromatic compounds of antimony, and organometallic derivatives of bismuth are described in the remaining chapters of the book. Of these six chapters, the last two deal with groups of compounds which have formed the subject of original researches by the author.

The wide range of the subject is shown by the fact that reference is made to 2,600 derivatives of phosphorus, 700 of antimony, and 100 of bismuth. The most interesting chapter is perhaps the one which deals with the miscellaneous compounds of phosphorus, since, when this element is used in the form of chloride to bring about a simple replacement of OH by Cl or $>O$ by Cl_2, it often gives rise instead to addition compounds, which can then be hydrolyzed to phosphinic acids. In this and similar ways the chemistry of phosphorus is extended, until it almost begins to bear comparison with that of nitrogen, with which it is also associated as an essential element of plant and animal life.

This important group of organic compounds has been dealt with by Dr. Goddard in the same efficient manner in which Dr. Sidgwick described the organic derivatives of nitrogen, in a volume which has unfortunately been out of print for some years. By doing so, he has not merely contributed an additional volume to a well-known text-book, but also has earned the gratitude of his colleagues by giving (perhaps for the first time) an adequate account of an unfamiliar section of organic chemistry.

The Medicine-Man of the American Indian and his Cultural Background

By Prof. William Thomas Corlett. Pp. ix+369+14 plates. (Springfield, Ill., and Baltimore, Md. : Charles C. Thomas ; London : Baillière, Tindall and Cox, 1935.) 22*s.* 6*d.*

AN unfortunate currency given to the popular term 'medicine man' to designate the shaman or priest-magician of the Amerindian tribes has given rise to much misunderstanding as to the true function of this important figure in the Indian social organism. Although the healing art comes within his province, his theory and practice are based on psychology and theology rather than on pathology and pharmacology. In fact, the cure of disease is not his primary function, but an incidental of his relation to the spirit world, in which he acts as the tribal specialist and go-between. Apart from the sweat-house, and a not very extensive acquaintance with simples, magic, which does not differ in essentials from the practices of other parts of the world, is the beginning and end of his diagnosis and treatment. The medicine man, like the shaman of the north-eastern tribes of Asia, to whom indeed he is closely related in many of his functions and attributes, is the spiritual guide of the tribe and its leader in emergency, in many instances holding a position analogous to that of the war chief.

Notwithstanding the basic identity of the conception of the medicine man's function throughout the North American tribes, there is no little variation in detail, both in the position they hold and in their methods of action. Dr. Corlett's purpose has been to place before his readers a conspectus of the evidence and to demonstrate the variations to be found in passing from one to any other of the areas of cultural differentiation into which the Indians of North America have been classified by anthropologists.

The Phenomena of Polymerisation and Condensation :

a General Discussion held by the Faraday Society, September 1935. Pp. vi+412. (London and Edinburgh : Published for the Faraday Society by Gurney and Jackson, 1936.) 22*s.* 6*d.* net.

THIS publication records the first symposium in Great Britain specially convened to deal with fundamental aspects of polymers, among which synthetic resins and rubber are important industrial examples. The volume will naturally appeal to those workers on plastics who appreciate the importance of a knowledge of the principles underlying formation of their products.

The first section employs the weapons of X-ray spectrography, mechanical properties and kinetics of chain formation in elucidating structures, and is concerned with general concepts of polymeride formation. In general, the latter term is used in the modern sense to imply substances containing repeated units of definite structure not necessarily identical with the starting materials. An attempt by Dr. W. H. Carothers to connect, in a mathematical manner, polyfunctionality with polymer formation, and a study by Dr. K. Meyer of an inorganic polymer from phosphonitrilic chloride, deserve special mention.

The second section contains more specific cases, among which is a most suggestive contribution by Dr. H. Staudinger on the so-called 'insoluble polystyrene'. Although papers on phenol-aldehyde, amide-aldehyde and acetylene products are included, it is an unfortunate, but perhaps unavoidable necessity, that gives such prominence to polystyrene, at the expense of those more complex materials which have formed of late years the basis of industrial plastics development.

N. J. L. M.

An Introduction to Contemporary German Philosophy

By Dr. W. Brock. Pp. xx + 144. (Cambridge: At the University Press, 1935.) 6*s*. net.

THE study of German thought, which has been so popular in Great Britain, has been encouraged lately by the introduction of German philosophy as an optional subject in the syllabus of a first degree in German in the University of London. The interest taken by this University in German studies is further exemplified by its invitation to Dr. Brock to give a course of lectures on German contemporary thought. The book under notice is a direct result of this invitation.

German humanism and the development of the separate sciences are considered to be the background of contemporary German philosophy. Two new philosophical movements have asserted themselves since Hegel: the first covers the numerous attempts towards a philosophical synthesis of scientific results, and the second concerns epistemological inquiries. Then Nietzsche and Kierkegaard have cast their shadow over subsequent thinkers as well as over their contemporaries. These Dr. Brock considers in turn with an objective though sympathetic mind. But their conflicting conclusions leave still undecided the position of philosophy among the determining factors in human life. It would have been interesting to analyse the intellectual factors which have brought German thought to that peculiar position in which it has to renounce its very freedom of action and expression. T. G.

Kursus der Kristallometrie

Von Prof. Dr. Victor Goldschmidt. Aus dem Nachlass herausgegeben von Dr. Hans Himmel und Dr. Karl Müller. Pp. viii + 167. (Berlin: Gebrüder Borntraeger, 1934.) 10 gold marks.

THIS is essentially a practical guide to crystal measurement, drawing and calculation based on the established methods of the Victor Goldschmidt school of crystallography.

Following the general introduction, which deals with the various methods of projection, single-circle goniometry, illustrated mainly by the Penfield contact goniometer, is simply described and two examples are given. This section occupies six pages.

The remainder of the book is devoted to two-circle goniometry and is divided into two parts. Part 1, which provides an admirable introduction to the methods, deals with the two-circle contact goniometer designed by the author. The procedure involved in crystal measurement, drawing and calculation together with the preparation of crystal models is fully discussed and examples from each of the six systems are given in full. Part 2 illustrates the use of the two-circle reflection goniometer and provides examples of more advanced studies of simple and twinned crystals.

This posthumous work of the late Prof. V. Goldschmidt bears the characteristic marks of care and attention to detail which all his work illustrated, and is a very complete and lucid guide to the crystallographic methods evolved in great part by the author.

Die Fermente und ihre Wirkungen

Von Prof. Dr. Carl Oppenheimer. Supplement, Lief. 4 (Band 1, Specieller Teil: Haupt-Teil 9–12). Pp. 481–640. (Den Haag: W. Junk, 1936.) 28*s*.

THE fourth part of this work has appeared with commendable punctuality. It deals with the polyases, which are the enzymes which split the complex carbohydrates, the nucleases, the amidases and the first sections of the proteases.

Now that we possess at least an approximate knowledge of the structure of the more complex carbohydrates, it should be possible to make progress also in regard to the enzymes which attack them: for example, the increasing study of the polyfructoses, of which there are apparently several besides inulin, may teach something about inulase. The same applies to such enzymes as lichenase, chitinase, cytase and pectinase, and this section, which gives also a brief indication of the latest views in regard to the structural formulæ of these polysaccharides, will be found to be stimulating.

Recent work has more or less cleared up the structure of the nucleic acids: their appropriate enzymes either convert the acids into nucleotides or these latter into nucleosides and phosphoric acid, or effect the final degradation of the nucleosides into a base and a sugar: there is still much to learn about these and the way in which they work.

The amidases are those enzymes which break the bond between carbon and nitrogen as, for example, in adenine and guanine. They include arginase, of which a good deal is known, also those enzymes which hydrolyze acid amides and lastly urease.

The protein section is of an introductory character.

Grundlagen der Quantenmechanik

Von Dr. H. Dänzer. (Wissenschaftliche Forschungsberichte: Naturwissenschaftliche Reihe, herausgegeben von Dr. Raphael Ed. Liesegang, Band 35.) Pp. xi + 163. (Dresden und Leipzig: Theodor Steinkopff, 1935.) 12 gold marks.

THIS brief but excellent introduction to quantum mechanics is likely to appeal much more to the mathematician than to the experimental physicist, for, as its title suggests, it deals rather with the fundamental ideas than with the applications of wave-mechanics to special problems. The treatment really assumes that the reader possesses a fairly good knowledge of mathematics, and the book should find a welcome from teachers of mathematical physics.

La spectroscopie appliquée

Par P. Swings. (Bibliothèque scientifique belge.) Pp. 188. (Paris: Hermann et Cie., 1935.) 15 francs.

ALL who are interested in the teaching or practice of spectroscopy will find this well-written and informative little volume of interest. In particular, the common errors which are encountered in connexion with spectroscope adjustments are discussed in some detail. The advantages and disadvantages of the various sources of light are also well considered, and it is clear that the author has made a profound study of the contemporary literature of the subject.

Cereals of Ancient Egypt and Mesopotamia

By Prof. John Percival

THE origin of civilization is intimately connected with man's discovery of the cultivation of the cereal crops, the grain of which has formed the most important part of the diet of civilized people from the earliest times down to the present day.

It requires but little reflection to realize that the lives of the millions of inhabitants of the villages and towns throughout the world to-day are dependent upon the unceasing toil of the farmer; were he to discontinue his efforts, the congested humanity of our great centres of population could not exist very long. It is, indeed, no exaggeration to say that the total loss of the cultivated crops of one, or at most, two seasons all over the world, would wipe out the greater part of the human race, and leave the towns and all they contain silent and derelict; the farmer is truly worthy of more respect and sympathy than he usually gets.

Who were the first farmers, where did they live and what were the crops which they grew, are questions of fascinating interest on which light is being thrown by the patient researches of archæologists. Historic records of man's activities take us back some four or five thousand years, at which time village settlements and towns were already established in Egypt and parts of Mesopotamia. Samples of the kind of grain forming, as now, the chief portion of the diet of the people, have been unearthed, and it is to these that I now refer.

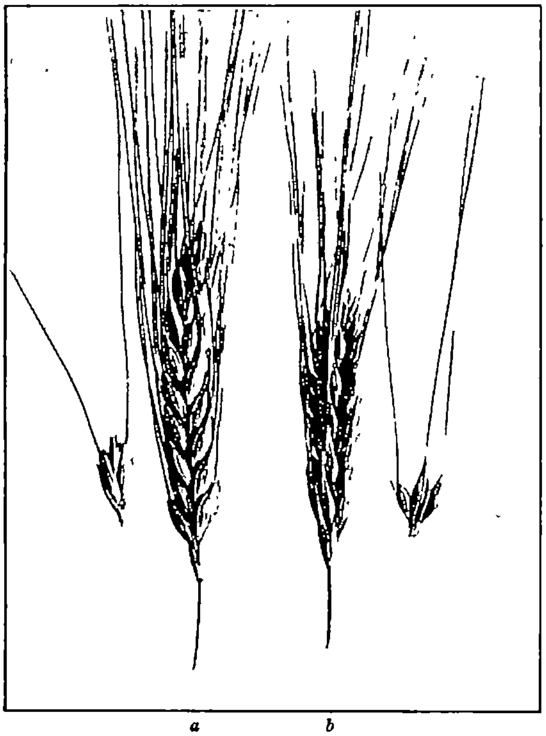

FIG. 1. *a*, Ear of modern Abyssinian Emmer, with spikelet. *b*, Ear of Bere barley, with triplet of single-grained spikelets (about half natural size).

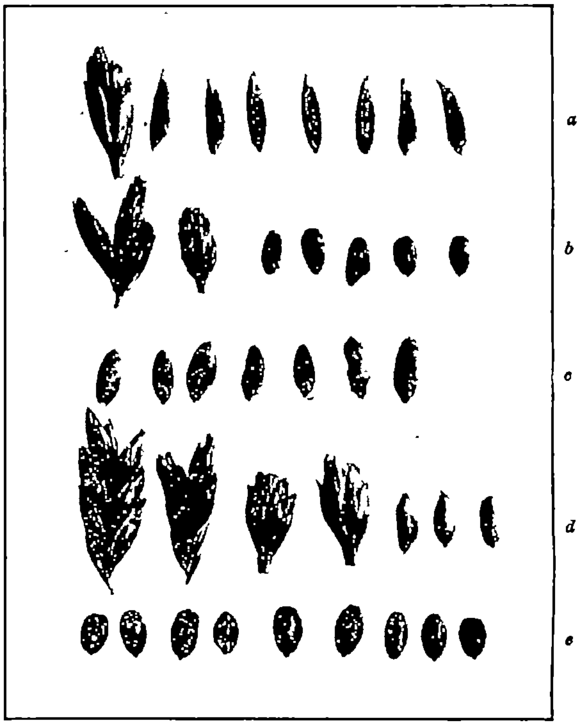

Fig. 2. *a*, Spikelet and grains of Abyssinian Emmer. *b*, Part of ear, spikelet and grains of Badarian Emmer, from Mostagedda (? 5000 B.C.) (Mr. Guy Brunton). *c*, Badarian grains of Emmer from Mostagedda. *d*, Portion of ears, spikelets and grain of pre-dynastic Emmer, from the Fayum desert. *e*, Naked wheat grains from pre-dynastic Fayum site (Miss Caton-Thompson) (all natural size).

From the earliest times in Egypt and in Mesopotamia, two kinds of cereal grains were cultivated, namely, wheat and barley. The wheat which was grown was a kind or race of this cereal known as Emmer (*Triticum dicoccum*). It was a very primitive kind of wheat, with flat ears having long awns or beards, like those of present-day barley (Fig. 1, *a*). Ears of Emmer when thrashed break up into short spikelets (Fig. 1), each of which contains two grains closely invested by the glumes or chaff, so much so that the naked grains for consumption can only be obtained free from the chaff by pounding the spikelets with a long pole

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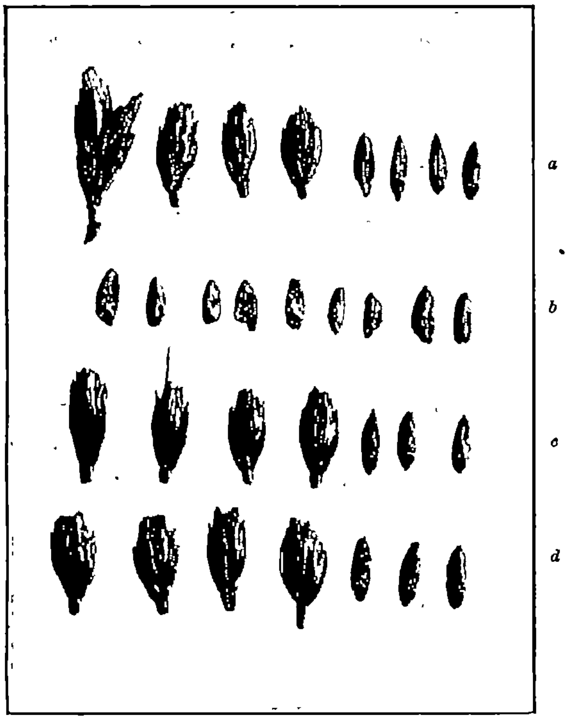

FIG. 3. *a*, Portion of ear, spikelets and grains of Emmer, from tomb of third dynasty, inside enclosure wall of step pyramid of Sakkara (about 3000 B.C.). *b*, Naked Emmer grains from underground gallery magazine, north side of Sakkara pyramid. *c*, Spikelets and grains of Emmer, from tomb of Tutankhamun (about 1400 B.C.). *d*, Spikelets and grains of Emmer from tomb of Eighteenth Dynasty (about 1500 B.C.) (all natural size).

in a kind of wooden mortar. The naked grains are narrow and pointed at each end, much narrower and less plump than the ordinary wheat of our fields to-day.

Emmer is still cultivated for human food in Abyssinia, parts of Russia and India, and in smaller amounts in north-west Persia, Serbia, south-west Germany and the Basque provinces of Spain. It is remarkable that many of the varieties of Emmer still grown are exactly similar in their specific characters to those cultivated by the most ancient Egyptians.

In addition to Emmer (*T. dicoccum*), several other different species of wheat are known with brittle ears which break up readily into short spikelets when thrashed; these are classed together as 'spelt' wheats, 'spelt' being in this case a generic term. Unfortunately, *one* of these has the specific name "Spelt" given to it, being called Spelt or Large Spelt (English), *Spelz* or *Dinkel* (German), *Epeautre* (French); its botanical name is *Triticum Spelta*. This wheat is a comparatively modern kind, quite unknown to the ancient people of Egypt, but Egyptologists in particular have frequently fallen into the error of translating the Egyptian term for Emmer by the word "spelt" and adding to it the name *Triticum Spelta* instead of *T. dicoccum*.

The ears of the other cereal, barley, are differently constructed from those of Emmer. In barley, three single-flowered spikelets grow close together on opposite sides of the axis of the ear; there are thus six longitudinal rows of spikelets. In the so-called two-rowed barley commonly grown in the fields of Great Britain, only the central flower of each triplet produces grain, giving rise to an ear with two opposite rows of grain. In Bere barley (*Hordeum vulgare*) and Six-rowed barley (*H. hexastichon*), all the flowers of the triplet of spikelets are fertile, and an ear with six rows of grain is produced.

All these kinds of barley are grown at the present time, the two latter being most frequently cultivated in Egypt and other countries bordering the Mediterranean. Both Bere and Six-rowed barley were cultivated in ancient Egypt and smaller amounts of the two-rowed form.

Whether the cultivation of Emmer preceded that of barley or vice versa has been the subject of controversy. A wild kind of Emmer grows in Syria, Palestine and regions near the Caucasus, and is generally accompanied by wild barley. Since there is no character in either which would suggest a preference for one of them, it would appear likely that both were selected contemporaneously by the first cultivators, probably

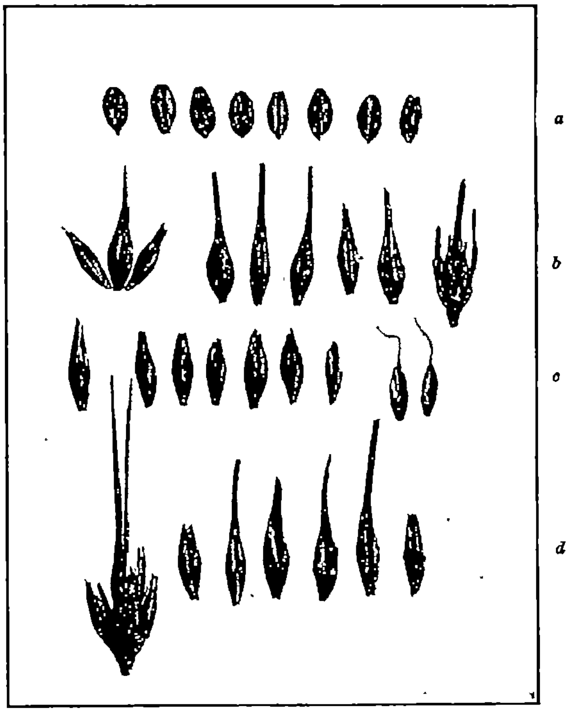

FIG. 4. *a*, Pre-Dynastic carbonized grains of barley, Fayum desert. *b*, Triplet of grains of Bere barley, single grains, and spikelet of two-rowed barley (?) Pre-Dynastic, from the Fayum desert. *c*, Grains of barley, and two 'seeds' of darnel (*Lolium temulentum*), from tomb of Third Dynasty, inside north enclosure of the step pyramid of Sakkara (about 3000 B.C.). *d*, Spikelets of barley of Eleventh Dynasty (Gebelien) (all natural size).

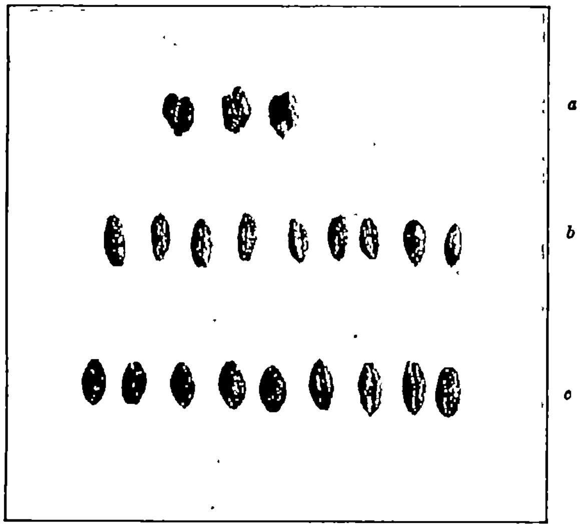

Fig. 5. *a*, Carbonized grains of three spikelets of Emmer, from grain room at Arpachiyah, near Nineveh (about 4000 B.C.). *b*, Carbonized grains of Emmer, and *c*, carbonized grains of barley from the same source (Mr. M. E. L Mallowen, 1933) (all natural size).

thousands of years before the large-scale farmers of the Egyptian dynastic periods. This view is supported by the fact that mixtures of Emmer and barley, and separate samples of the two, have been found dating from the earliest times.

All these ancient grains, whether taken from underground pits, storehouses, tombs or vessels within the latter, are more or less carbonized. Naked grains generally exhibit complete carbonization, becoming changed into charcoal; their appearance suggests the action of fire, and they are often erroneously described as charred or burnt.

The change from the normal to carbonized grain is, however, a natural process which takes place at ordinary temperatures. The carbohydrates cellulose and starch, of which the cereal grains are largely composed, consist of carbon united with the elements of water; under certain obscure conditions, both become slowly dehydrated, leaving behind only the carbon.

The carbonization of complete spikelets is very much less marked than naked grains. The chaff is more resistant to dehydration, and usually appears dark brown in colour. The grains within such spikelets often show little change; the form of the grain, the hairs at its apex, are but slightly altered, and the starch grains in the endosperm retain their shape and reaction to iodine. The proteins of the endosperm are, however, completely decomposed, and the embryo is always disorganized and quite incapable of germination.

For more than a hundred years, samples of wheat and barley have been taken from tombs in Egypt, but only within comparatively recent times have trustworthy records been made of the archæological horizon from which the samples have been derived, and the age of many of the earlier finds cannot now be determined. During the last few years, however, much well-authenticated material has been submitted to me for examination, and it is with this that I deal here.

Among the most ancient specimens of cereal grains hitherto discovered in Egypt are those found by Mr. Guy Brunton at Badari (1923–34) and at Montagadda, Middle Egypt, in 1928. Fragments of ears and spikelets were obtained, together with carbonized grains of Emmer (*T. dicoccum*) and grains of Bere barley (*Hordeum vulgare*) (Figs. 2 and 4). The Badarian folk were growing both these cereals at a date antecedent to the predynastic period, which according to some Egyptologists extended from about 5000 B.C. down to 3400 B.C. when the first of the Egyptian dynasties was established. How much earlier than this these samples were harvested cannot be accurately assessed; some authorities have placed them as early as 10,000 or 15,000 B.C.

Another series of excellent samples belonging to the pre-dynastic period was obtained by Miss Caton-Thompson, in the Fayum desert, northwest of the Birket Qurun lake. A number of small straw-lined granaries or pits was discovered, in several of which were portions of typical ears of Emmer with grains (Fig. 2, *d*), as well as grains of Bere barley (Fig. 4, *b*). In some of the pits were found completely carbonized grains shorter and plumper than those of typical Emmer. Whether these are modified Emmer grains cannot be definitely settled, for the exact determination of the species of cereal grains when carbonized presents great difficulty, since the amount of

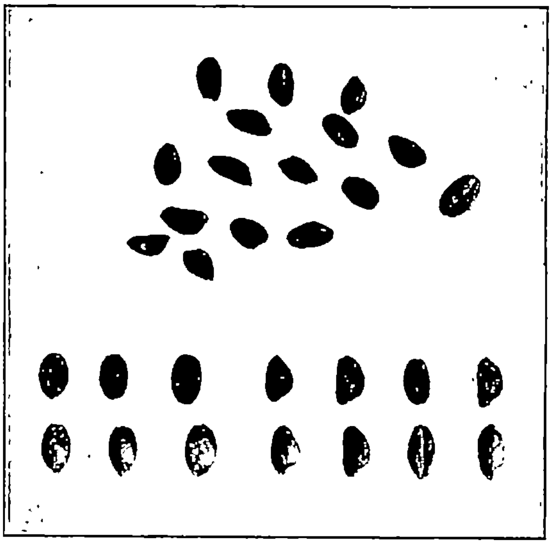

Fig. 6 Upper group random sample of grains of wheat from a vase on the site of a Sumerian house at Jemdet Nasr, near Kish (3500 B.C) (Prof. Langdon) First row of lower group selected carbonized grains from the sample. Second row of lower group. grains of modern Rivet wheat (*Triticum turgidum*) (natural size).

change in the size and form of the grains which appears in some cases to accompany carbonization is not accurately known.

Very numerous examples of grain from Egyptian tombs of later date are available (Fig. 3). These are invariably samples of Emmer and barley, and for several thousand years down to the end of the dynastic period, no other form of wheat than Emmer was cultivated in Egypt.

The dryness of Egypt has greatly contributed to the excellent preservation of all kinds of objects. In Mesopotamia, however, the other great centre of early civilization, the climate and damp soil have led to the destruction of most cereal grains and other plant remains, and very few specimens of grain from this region have been recovered.

From literary evidence, Hrozny concluded that the two chief cereals of ancient Babylonia were Emmer and barley, exactly as in Egypt, Emmer predominating at the earlier dates.

Two samples of great importance have been submitted to me for examination. One of these was found in 1933 by Mr. M. E. L. Mallowen in a granary during excavations of a prehistoric site at Arpachiyah, four miles east of Nineveh. Carbonized grains of barley, and a primitive, small type of Emmer were present (Fig. 5). These are the earliest grains hitherto discovered in Mesopotamia, belonging to a period 4000 B.C. or earlier. The other sample, sent by Prof. S. Langdon, of Oxford, was taken by Mr. Henry Field (U.S.A.) in 1926, from a vase on the site of an ancient Sumerian house at Jemdet Nasr, a few miles north of Kish.

Only grains of wheat were present, and these completely carbonized. They were of large average size, with blunt tips and the prominent dorsal hump characteristic of varieties of Rivet wheat (*Triticum turgidum*) (Fig. 6) which belongs to the Emmer group. I gave an account of the sample in NATURE of February 19, 1927. I consider that these grains represent an advance on the earliest forms of Emmer, resembling some superior types of Emmer now grown in Abyssinia, which are sometimes classed as Rivet wheats.

Mr. O. F. Phillips (U.S.A.) has expressed the opinion that these Kish grains are a kind of Club wheat (*Triticum compactum*), but I unhesitatingly regard this view as erroneous. There is no evidence that any wheat of the bread wheat group to which Club wheat belongs was known in any part of the world for some thousands of years after the date attributed to the Kish sample.

Mr. Henry Field records the discovery of barley grains at Jamdet Nasr, but these I have not seen.

It is hoped that archæologists will look for and carefully preserve all samples of grain which they may unearth in the investigation, paying special heed to fragments of ears and chaff, for these are of importance in the correct determination of the race or species to which they belong.

Biogeography and Ecology of North African Birds and Mammals

THE animal population of the northern parts of the African continent is of exceptional interest to a biologist, both by reason of the great similarity of the conditions in coastal areas to those of southern Europe, and by the striking contrast provided by the Sahara, with its extreme desert regime and highly peculiar fauna. While the fauna of North Africa in its entirety remains still very inadequately explored, our knowledge of at least two groups, birds and mammals, is sufficiently advanced for a comprehensive survey of the fauna. Such a survey is provided in a recent memoir by M. Henri Heim de Balsac*, who has based it not only on all the available literature, but also on personal explorations carried out over many years.

A careful analysis of the mammalian population of the coastal and mountainous Berberian zone reveals the somewhat unexpected fact that its relationship with the European fauna is not so close as is usually assumed. Apart from bats, three quarters of the species composing the Berberian mammalian fauna cannot be considered European, and are mostly Ethiopian in origin. Bats in this respect approach the birds, among which the majority are European; but there is a considerable proportion of unmistakable tropical forms. Since palæontological studies have shown a still lower proportion of European forms in North Africa in the earlier stages of the Quaternary period, it appears impossible to retain the idea of any post-Pliocene connexion of Europe with Africa. On the other hand, an exchange of populations with palæarctic Asia, through Libya and Egypt, must have existed until the middle of the Quaternary (Rissian) period. The Atlantic islands (Azores, Madeira, Canaries) are populated by relics of the Tertiary Mediterranean fauna, and did not play any prominent part in the origin of the Quaternary fauna of Berberia.

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* Biogéographie des Mammifères et des Oiseaux de l'Afrique du Nord. (Supplément xxi au *Bulletin Biologique de France et de Belgique.*) Pp. 447+7 plates. (Paris: Press Universitaires, 1936.) 125 francs.

The northern limit of the Saharan zone depends on humidity, and the isohyet of 200 mm. per annum coincides almost exactly with the limits of the distribution of the desert fauna. The mammalian fauna of the Sahara is almost entirely tropical, mostly Ethiopian, in its origin, and even amongst birds the vast majority are non-palæarctic. It is, therefore, impossible to continue to include Sahara in the Palæarctic region, as is usually done.

A number of urgent problems of desert ecology are discussed in the second part of the memoir, comprising twelve chapters. There is a mass of original information, often leading to deductions which may be unorthodox, but are well supported by first-hand evidence. The distribution of mammals is very little influenced by the absence of water, since all of them are able to do without drinking, being satisfied with the water obtained from food. The same, however, is observed in mammals elsewhere, and cannot be considered as a special physiological adaptation. Among birds, only a few grain-feeding species (Pteroclidæ, etc.) cannot live without drinking, while all those with mixed diet can do so. No special adaptations exist in desert mammals for protection against powerful insolation, since the vast majority of them are nocturnal in their habits, and many pass the day underground. In birds, which are exposed to the sun, no special adaptations in behaviour have been noted.

As regards morphological adaptations to desert environment, some of the classical text-book examples do not withstand serious criticism. Thus, a statistical study of the structure of the feet in desert mammals and birds shows that, contrary to accepted opinion, there is no special dominant type of structure which can be regarded as adaptation to the environment. On the contrary, there is a great variety of structures, and some of them appear to be singularly ill-adapted to the particular habitat. Similarly, the hypertrophy of external ears considered by many authors as a typical feature of desert animals is actually not a general feature. As regards the great development of bullæ tympanicæ observed in the large majority of desert mammals, it appears to be a real response to the environment, but its physiological and biological significance is wholly obscure, and various hypotheses as to its presumed rôle rest on a desire to prove its usefulness to the animal, rather than on facts.

Again, a thorough discussion of the vexed problem of the coloration of desert animals does not permit the author to subscribe to its classical explanation as a protective device developed by selection. Both the hypertrophy of the bullæ tympanicæ in desert mammals, and the dilution of pigments, with the preponderance of phæomelanines and almost complete absence of carotinoids, are regarded by the author as characters which developed in strict dependance on the dryness of the environment, acting on the organism either directly, or indirectly.

Every ecologist and general biologist will find in this memoir, the contents of which are very inadequately expressed by its modest title, a store of original ideas, supported by abundant and fresh data of biogeographical, ecological, anatomical and physiological order.

B. P. UVAROV.

Blackpool Meeting of the British Association

ALL signs point to a full and interesting meeting of the British Association on September 9–16 in its new surroundings. The work of the Association, wide enough in all conscience, has been, of recent years, taking on a still wider character. The man of science is realizing to-day, as he never realized before, that he is, as man of science, a citizen of a great community; that he is a power in that community; and that he can forge weapons of a potency, for good and ill, such as the world has never yet known. The destinies of the future civilizations are in his hands, more than in those of any other class; and it is for him to see that the knowledge which he presents so freely to his fellows is used for weal, and not for ill.

To that end, it is necessary to study, critically and minutely, the effects of the advances of science on the well-being of the community. Most of us are content to indulge in that study, so long as it is a matter of handing out bouquets; but the gifts of man to mankind may be evil as well as good, and it is precisely those possibilities of evil which demand most careful study. The new policy of the Association, of starring in its programme those items which deal with aspects of knowledge the repercussions of which on the welfare of the community are direct and important, marks an important step in the history of the Association; it is to be hoped that it will remain a permanent feature of the programme.

The subject of the presidential address (the impact of science on society), the titles of the sectional presidential addresses, and the principal topics of discussion have already been announced in an article which appeared in NATURE of May 9 (p. 766). To these we may now add the series of public lectures and lectures to children. The series is as follows:

PUBLIC LECTURES.

Lytham St. Annes. Dr. Olaf Bloch: "The Scope of Photography".
Blackpool South. Dr. W. F. Bewley: "Science and the Glass-house Industry".
Preston. Prof. J. L. Myres: "Who were the Greeks?"
Southport. Sir James Jeans: "Some Recent Advances in Astronomy".
Poulton-le-Fylde. Mr. P. A. Francis: "Applications of Science to Poultry Farming".
Fleetwood. Prof. C. M. Yonge: "Common Shore Animals".
Thornton Cleveleys. Dr. D. F. Harris: "Joy in Scientific Discovery".
Preston. Prof. Allan Ferguson: "Splashes and what they Teach".

LECTURES TO SCHOOL CHILDREN.

Brigadier H. S. L. Winterbotham: "How Maps are Made".
Mr. D. Seth Smith: "Favourites of the London Zoo".

Evidently the public lecture, whether to a senior or to a junior audience, is becoming an increasingly important feature of the annual meeting. It is possible that this impressive list of lectures is still incomplete, as applications are still coming in from some of the East Lancashire towns.

The Evening Discourses, to be delivered by Mr. C. C. Paterson and by Capt. F. Kingdon Ward, will deal with "Science and Electric Lighting" and with "Plant-hunting and Exploration in Tibet". These discourses are open to members only.

Some of the sectional excursions and the social events have already been announced. The Mayor and Mayoress of Blackpool (Alderman W. Newman and Miss Newman) invite members to a reception in the Winter Gardens on Thursday, September 10. The headmaster of Rossall School (Mr. H. G. M. Clarke) will entertain four hundred members at a garden party at the School on Tuesday, September 15. The Rotary Club will hold a luncheon on Thursday, September 10, when the president will address the members and their guests. The Official Service will be held at St. John's Parish Church on Sunday, September 13, when the Right Reverend the Lord Bishop of Blackburn will preach the sermon.

Thirty sectional excursions and visits have been arranged, of geological, botanical, antiquarian, engineering and educational interest. Their range in space is as wide as their range in subject. A visit to the Amusement Park stands cheek by jowl with an excursion to the Lake District, and a visit to the open-air swimming bath hard by an excursion to Garstang, Furness Abbey and the Southport Sand Dunes, Stonyhurst and Rossall, Fleetwood Fish Docks and the Fylde Farms. The members of the Association will indeed have enlarged their experiences by the time that the annual meeting draws to its close.

Obituary

Sir Henry Wellcome, F.R.S.

EARLY on the morning of Saturday, July 25, there passed away, at the ripe age of eighty-two years, a unique personality, whose activities ranged from archæological and geographical exploration to the creation of a great manufacturing business, and whose interests included such diverse matters as the collection of ancient manuscripts, the social welfare of native races and the provision of funds for fundamental research in those sciences on which the progress of medicine depends.

Sir Henry Wellcome was born in Wisconsin and, as the son of a frontier missionary, spent his childhood among Dakota Indian tribes. A boy whose earliest experiences included that of organizing the casting of rifle bullets for the defence of a settlement of whites, and of assisting his uncle—a well-known frontier surgeon—in treating the wounded in the Sioux War in Minnesota, was obviously well-equipped for an interesting career. He chose pharmaceutical chemistry as a vocation, and passed a period of study in Chicago and Philadelphia, where he took his diploma. His life-long interest in travel began to show itself at this stage, and he visited most parts of North America and spent some time in South America in the study of cinchona distribution in its native habitat, a subject in which his life-long interest was again manifested in the tercentenary celebration of the discovery of cinchona, which he organized in London in 1930.

Having given full play to the romantic side of his nature in these *Wanderjahre*, Wellcome looked round for a suitable centre for the exercise of his practical bent towards the pharmaceutical side of chemical industry and chose London as his future home, and here in conjunction with the late Mr. S. M. Burroughs he established in 1880 the firm of Messrs. Burroughs, Wellcome and Co. for the manufacture of fine chemicals and pharmaceutical products. The business was a success from the beginning; its products are known all over the world, and in addition to the chief works at Dartford, the firm now carries on operations in New York, Montreal, Sydney, Cape Town, Milan, Shanghai, Bombay and Buenos Ayres and has agencies in most of the world's great commercial centres.

The activities thereby engendered were not enough for Sir Henry Wellcome, and he soon began to use his resources in furtherance of the benevolent and scientific projects he had at heart. He founded at Dartford a club and institute with a park and ground for field sports, and in this and other ways spent large sums in providing technical instruction and means of mental and physical recreation for the staff and work people. In 1894, the Wellcome Physiological Research Laboratories were started, and two years later the Wellcome Chemical Research Laboratories were opened. In 1913 the Wellcome Bureau of Scientific Research was founded with the triple duty of controlling the various research laboratories already in operation, acting as a centre of information on scientific medical matters and to conduct research in biological subjects affecting the progress of medicine. Associated with it are the Entomological Field Laboratories and the Medical Museum, the latter a boon to students and remarkable for the wealth of its pathological material and the ingenuity of its illustrative methods. Sir Henry's latest and most striking gift is the magnificent building of the Wellcome Research Institution, which was described in NATURE of December 5, 1931, p. 974, and in which the organizations referred to above, with the exception of the Physiological and the Entomological Field Laboratories, are now housed.

For the greater part of his life, Sir Henry Wellcome had collected books, manuscripts, pictures and materials of all kinds illustrative of the customs and habits of primitive man and the beginnings and progress of pharmacy, medicine and surgery. These formed the nucleus of the Historical Medical Museum organized in 1913 in premises in Wigmore Street, where it rapidly outgrew the accommodation available. Of all his projects for the near future, the one nearest to the founder's heart was probably to see these cherished treasures displayed in the exhibition galleries designed for them in the new building, and it is a matter of keen regret to his friends that he did not live to see the completion of this scheme. Sir Henry's other interests can only be referred to briefly. For some years he conducted personally archæological explorations in the Upper Nile regions, discovering and excavating several important ancient Ethiopian sites, and since 1932 he has provided funds for the excavations at Tell Duweir (Lachish) of which an account appeared in NATURE of July 18, 1936, p. 135. He gave generously in funds and medical equipment to expeditions for geographical exploration, and his friendship with H. M. Stanley and his deep interest in Africa led among other things to the foundation of the Lady Stanley Maternity Hospital in Uganda, and the establishment in 1900 of Tropical Research Laboratories at the Gordon Memorial College, Khartoum.

In recent years, Sir Henry Wellcome received numerous honours and marks of appreciation of his services to research in medicine and its allied sciences. In 1932 he was elected a fellow of the Royal Society and an honorary fellow of the Royal College of Surgeons. In the same year he was created a knight, and in 1936 he received the Cross of the Officier of the Legion of Honour from the President of the French Republic, and he also had conferred on him, for outstanding services to Spain, the decoration "Comendador de la Orden de la Republica".

By the death of Sir Henry Wellcome, the world loses not only a great, but also an effective giver, for his benefactions were the outcome of a knowledge of the real, but not always obvious, means for the betterment of mankind.

Mr. F. C. Lewis

MR. FRANCIS CHARLES LEWIS was one of five men who unfortunately met their death through an explosion at the Research Department, Woolwich, on July 8. Born at Barry, South Wales, in 1894, he was educated at the Woolwich Polytechnic and Cardiff Municipal Secondary School. He studied at the University College of South Wales and Monmouthshire, Cardiff, graduating B.Sc. (Wales) in 1915. He then joined the staff of Messrs. Nobel's explosives factory at Pembrey, where he later superintended the manufacture of trinitrotoluene. In 1918 he became a member of the Royal Flying Corps, and shortly after the Armistice was appointed technical research chemist by Messrs. British Dyestuffs, Ltd.

In 1921, Mr. Lewis was appointed research chemist on the staff of the Explosives Branch of the Research Department, Woolwich, where his work has been almost entirely concerned with the application of high explosives to the requirements of the fighting services and with improvements in the methods of using these explosives to obtain the highest efficiency. This has included both explosives already in use and new explosives. Research of this type naturally calls for careful precautions in all its stages, and appropriate safeguards are applied to minimize the risks. These precautions have been generally successful, as is shown by the fact that the Explosives Branch has had only one previous fatality due to explosion since it came into existence in 1901.

Mr. Lewis's work has been of great value and his experience of high explosives has greatly assisted in the progress of the work. His loss will be much felt by his colleagues and friends. Mr. Lewis was married in 1920, and leaves a widow and four children.

G. R.

News and Views

Chronology of Early Man and Cultural Associations

IN his recent presidential address to the British Speleological Association (see NATURE of August 1, p. 194) Sir Arthur Keith, when arguing for a parallel evolution in the development of modern races from primitive ancestral forms in their respective continental areas, demonstrated the connexion between the Australian and *Pithecanthropus* of Java, with the aid of mid-Pleistocene Solo man as the connecting link between the early Pleistocene *Pithecanthropus* and the late Pleistocene form of that region, Wadjak man. There would now appear to be a possibility that the chronological position of the undoubtedly archaic form discovered in the gravels of the Solo river at Ngandong, Java, in 1932, may be called in question. In another column of this issue of NATURE (see p. 293) reference is made to a communication from Dr. P. van Stein Callenfels, the distinguished Dutch authority on the archæology of Indonesia, appearing in the current issue of *L'Anthropologie*, in which he points out that the cultural associations of Solo man, harpoons and axes of stag horn, are such as in a European context would denote an antiquity of not more than nine or ten thousand years. While the early dating of Solo man has been generally accepted hitherto, if, as is stated, these artefacts are apparently beyond question contemporary with the human relics, this would appear to demand re-examination of the geological data. If further consideration supports Dr. Callenfels' argument, like the evidence of the Swanscombe skull in relation to the position of Piltdown man (see NATURE, August 1, p. 200), it would suggest that the current phylogenetic scheme, while valid as a logical classification, is an uncertain guide to chronology, and that the evolution and descent of man has been a far more complex process than has been demonstrated hitherto.

Spiritual Healing

AT the Methodist Conference held at Newcastle in July, the report of a Committee on Spiritual Healing was read by the Rev. Leslie D. Weatherhead (*Methodist Recorder*, July 23). He declared it to be an interim report only, and expressed the hope that the Committee would be reappointed. The report is cautious in tone, recognizing that the subject is full of difficulties. The trouble from the scientific point of view is that what appear to be like causes do not necessarily produce like effects. "We pray for one man and he gets better; we pray for another and he does not—and we don't know why in either case." Of course, in healing, the individual factor is the important one, and this makes scientific generalizations almost impossible. The only thing to do, presumably, is to record a large number of cases as accurately as possible, and to extract from them whatever may seem to establish some sort of a regular law of behaviour. Or, as the report puts it: "the work which lies before students of this subject must include research into those conditions under which those energies which sweep through personality may be set free to do their work." The report wisely says: "We felt all along that a method is not less a manifestation of the Divine because it is understood." As for "orthodox" medical science, "We believe no method [of spiritual healing] is to be welcomed which brushes aside as irrelevant the amazing findings of modern medicine and surgery." It is indeed all to the good that religious bodies such as the Methodist Church should interest themselves in the systematic study of the psychological causes of physical health and sickness, and the report of this Committee is for that reason important.

J. C. Loudon and the Waterloo Beeches

REFERRING to the note in NATURE of August 8 (p. 237) in which this excellent story was mentioned, a correspondent points out that there are many variants of it extant. Sir William Fraser's version, which is by far the most detailed, bears all the signs of study of the original sources. It would spoil the story to condense it; let the worthy baronet tell it in his own inimitable, if stilted, fashion.

"The Duke of Wellington . . . received a letter . . . from the eminent landscape designer and great authority on botanical matters, J. C. Loudon. It was . . . to this effect:

" 'My lord Duke: It would gratify me extremely if you would permit me to visit Strathfieldsaye, at any time convenient to your Grace, and to inspect the Waterloo beeches. Your Grace's faithful servant, J. C. Loudon.'

"The Waterloo beeches were trees that had been planted immediately after the battle of Waterloo; as a memorial of the great fight. The Duke read the letter twice, the writing of which was not very clear; and, with his usual promptness and politeness replied as follows; having read the signature as 'C. J. London' instead of 'J. C. Loudon':

" 'My dear Bishop of London, It will always give me great pleasure to see you at Strathfieldsaye. Pray come there whenever it suits your convenience, whether I am at home or not. My servant will receive orders to show you so many pairs of breeches of mine as you wish; but why you should wish to inspect those that I wore at the battle of Waterloo is quite beyond the comprehension of Yours most truly, Wellington.'

"This letter was received, as may be supposed, with great surprise by the Bishop of London. He showed it to the Archbishop of Canterbury, and to other discreet persons: they came to the melancholy conclusion that the great Duke of Wellington had evidently lost his senses. The Bishop of London (Blomfield) declared that he had not written to the Duke for two years; and to receive this extraordinary information puzzled the whole Bench of Bishops."

So far Sir William Fraser, whose account may be regarded as authoritative. Fraser (1826–98, Eton, Christ Church, and 1st Life Guards) worshipped the memory of Wellington with a devotion that almost reached fanaticism; his "Words on Wellington", from which this account is taken, is one of the most remarkable collections of sayings and doings that have ever been recorded concerning one individual—remarkable not only in the variety of its Wellingtoniana, but in the insight which it gives into the character of its compiler. The book is long out of print, and has a certain historical value. The author carried out a first-rate piece of detective work, of which he gives a full account, in his identification of the scene of the Duchess of Richmond's famous ball on the eve of the battle of Waterloo.

Scientific and Industrial Research in Australia

THE Australian Government has announced that the work of the Council for Scientific and Industrial Research is to be extended in the interests of secondary industry generally. Since its establishment in 1926, the Council has deliberately restricted its attention to problems of the primary producing industries, though no such restriction is imposed upon it by the Act under which it is constituted. It has always been assumed that an extension was only a matter of time in view of the contraction of world markets for primary products and the consequent pressure to increase the home market by expanding secondary industries. A recent decision to establish aircraft and motor production in the Commonwealth has intensified a growing demand for an extension of national scientific research, and an influential committee, including leading engineers and industrialists, is now at work preparing a definite scheme of work. Existing institutions will be utilized wherever possible, but it is fully recognized by the Government that considerably increased financial obligations must be carried by it. A first step is to establish an agency for the maintenance of accurate fundamental standards of measurement and for the testing of master gauges for controlling precision manufacture. It is intended that in all developments intimate contact shall be maintained with, and guidance sought from, established British institutions engaged on work of the same type.

Luminous Phenomena on the Sea during a Thunderstorm

THE occurrence, during a tropical thunderstorm between Singapore and Bangkok on the morning of May 21, 1936, of a diffused white light over the surface of the sea, pulsating at regular intervals of about two to the second, so that the ship seemed to be sailing through waves of light and darkness, was referred to by a correspondent in *The Times* of June 26. The phenomenon is said to have continued for about half an hour. Another correspondent referred to a similar phenomenon in the Persian Gulf in March 1908, when waves of light were observed wheeling round the ship. Both these phenomena would appear to have been due not to electrical conditions but to phosphorescence. A description and sketch of a "Phosphorescent Wheel" near Sumatra (with an interval of about one second between the waves of light) is given in the *Marine Observer* of the Meteorological Office of November 1926; waves of light with an interval of half a second were observed on October 27, 1924, at 1 a.m. near Krakatoa Island (*Marine Observer*, October 1925); streaks of luminescence, observed in January 1927 in the Equatorial Atlantic, were practically parallel with the wind, which was south-east, about force 4 (*Marine Observer*, January 1928). These observations indicate that phosphorescence is not uniform over the wave profile, and consequently streaks of light will appear to an observer on board ship to move as the ship moves relative to the waves. Phosphorescence is most readily observed on ripples or on the breaking crests of waves, and while no one has yet worked out in detail the conditions under which the streaks will appear, the period of pulsation, which is reported as 0·5–1 second, is probably equal to the interval of time between the passage of the ship over successive waves.

Lightning and Atmospherics

IT is now generally agreed that the majority, if not all, the atmospherics encountered in radio communication originate in lightning flashes. When the storm is close to the receiver, it is possible to identify the stronger atmospherics with the neighbouring flashes. In a recent communication, Mr. P. F. Fyson, Langherne House, Rushwick, Worcester, claims to have observed that the atmospheric crackle produced on a broadcasting receiver was heard before the lightning flash which caused it was perceived visually. If this difference in the perception of the two effects is real—it obviously needs verification by other observers—it would appear on first consideration that the human eye is rather more sluggish in its operation than the ear; and Mr. Fyson suggests that this may be due to the time required for the chemical change in the retina to affect the optic nerve. An alternative explanation, however, may be found in the fact, which has arisen from recent research on lightning, that an intermittent electrical discharge appears to precede the actual main lightning flash. It is possible that this discharge may be invisible and yet may be capable of producing audible effects on a wireless receiver. These sounds may thus be heard a very short time before the visible flash was observed.

Champollion and Hieroglyphics

In "Science News a Century Ago", in NATURE of August 8 (p. 257), an extract appears from the *Athenæum* describing an obelisk erected to the memory of Champollion, and bearing the inscription "To the memory of F. J. T. Champollion, who first penetrated into the mysteries contained in the writing and monuments of ancient Egypt. . . ." A correspondent has pointed out that, even allowing for the generosity of interpretation of a 'lapidary inscription', Champollion has no claim to the honour of first penetrating into the mysteries of the writing of ancient Egypt. That honour, beyond all question, belongs to our versatile countryman, Thomas Young. In 1819, Young published an article, "Egypt", in the supplement to the "Encyclopædia Britannica", in which he gave a list of *alphabetic and syllabic characters*, an article which has been described by Sir E. A. Wallis Budge as "practically the foundation of the science of Egyptology". In 1821, two years later, Champollion published a treatise in which he shows not the slightest trace of knowledge of anything alphabetic in hieroglyphic or hieratic characters; Champollion's publication of an alphabet dates from 1822. Concerning Champollion's alleged attempt to suppress his unfortunate work of 1821, we need say nothing here; the whole story of the Rosetta Stone and the decipherment of the hieroglyphic characters was discussed some years ago in an article in NATURE (April 30, 1932, p. 638). It is sufficient here to say that the inscription on the tablet to the memory of Young in Westminster Abbey states no more than the bare truth when it describes him as the one who "first penetrated the obscurity which had veiled for ages the Hieroglyphics of Egypt".

Recent Acquisitions at the Science Museum

AMONG the objects recently placed on exhibition in the Science Museum, South Kensington, is a model of the complete lay-out for a 120-ton 10,000 horse-power Mond gas producer plant with ammonia recovery apparatus which has been lent by the Power-Gas Corporation, Ltd. Mr. Edward J. Willis, an American authority on astronomical navigation, has sent from the United States an example of a navigating machine which was invented by him and constructed at a cost of about £300. The machine solves problems in spherical trigonometry connected with navigation. An example of Selling's calculating machine which has long lain neglected in the stores of the Imperial College of Science and Technology has been lent to the Museum for exhibition. The machine was invented fifty years ago and made ingenious use of the 'lazy tongs' mechanism in order to perform multiplication and division. A representative selection of fourteen stone (chert) weights and a plaster cast of a fragment of a linear measure, all found in excavations at Mohenjodaro, Harappa, and elsewhere in northern India—relics of a civilization of c. 3250–2750 B.C., that formed great cities along the Indus valley, contemporaneous with the ancient Egyptian first to fifth dynasties, and the ancient Sumerian kingdoms in Mesopotamia—have been presented by the Archæological Survey of India.

Frontier System in Roman Scotland

A FURTHER effort to settle the question of the number and character of the occupations of the Roman fort of Birrens, near Ecclefechan, Scotland, is being made by excavations now proceeding in charge of Mr. Eric Birley, of the University of Durham. The problem to be solved is whether the occupation of the fort was part of the organization of the Antonine Vallum, as Sir George Macdonald has suggested, or whether it is to be related to Hadrian's Wall, as the Dere Street forts to the east recently have been shown to be by Mr. Ian Richmond's excavations. Two periods of occupation separated by a destruction were demonstrated in 1925 by excavation, but the examination of the stratification was not, nor was it intended to be, exhaustive. Search for further evidence is now being made, and with this object excavations are proceeding at two points down to the subsoil for a thorough examination of the stratification and the pottery. Up to the present, a section in the *retentura* of the fort, it is reported in *The Times* of August 10, has shown that a wooden building and two of stone preceded the two periods, of which evidence was found in excavations made in 1895. The wooden structure is assigned to the latter part of the first century and it is said that traces of Agricola have been found; while the two stone periods which follow are thought to belong to the Antonine occupation. Under the earlier of the two periods previously known, two vessels have been discovered, for which there are parallels from Hadrian's Wall. A second excavation in the *prætentura* has been more fruitful as a source of pottery and other finds, including a large piece of a cut-glass bowl, of which a fragment was found in 1895. Excavation at the west gate has exposed what is described as "the worst Roman masonry so far found in Scotland".

Archæological Finds in Iraq

DR. HENRI FRANKFORT'S assiduity in making known to the public at an early date any points of special interest arising out of the excavations of which he has been in charge, season by season, is worthy of all commendation, especially since he became field director for the Oriental Institute of the University of Chicago at Tell Asmar, the ancient Eshnunna. The important and extensive operations of the Oriental Institute in the field of the Ancient East possibly are not so widely known, outside the circle of specialists, as they deserve. In his report on the results of the past season (*The Times*, August 1), Dr. Frankfort mentions a number of finds of exceptional interest. As is generally known, one of the objects to which he has given special attention at Tell Asmar and on the neighbouring site of Khafaje is the problem of the early relations of Mesopotamia with both the Indus Valley and the Mediterranean. On both these questions he is able to record new and important evidence, in the former instance pointing to a more intimate relation than the purely commercial connexion, which is all that it has been possible to infer from previous finds. In a temple on a new site, Tell Agrab, the expedition has found among a quantity of interesting material some remarkable examples of stone vases with surprising sculptures. Among these is one fragment which shows the sculptured figure of a humped bull standing before a manger and enclosed in the poles of arches which support a roof. Not only is this a common motif at Mohenjo-daro, but also it belongs to a cult as alien to Mesopotamia as is the humped bull itself. Its occurrence at Tell Agrab should point to a more than casual or commercial contact. Similarly a further link with the Mediterranean is afforded by a terra cotta relief from a small shrine at Tell Asmar, in which one of the figures, possessing one eye only, and associated with fire, is identified as a cyclops. It is interesting to note how many of the interesting series of finds recorded this year by Dr. Frankfort, such as the bowls which had contained a live snake, are to be referred to cults, popular or otherwise, upon which at present we have no information.

Systematists and Text-Books

IN a recent issue of the *Nederlandsch Tijdschrift voor Geneeskunde* (80, 15, pp. 1675–1677; 1936), Dr. L. D. Brongersma directs attention to the deplorable results which can arise through a lack of understanding of the principles of systematic zoology and zoological nomenclature. As an example of his thesis, Dr. Brongersma surveys the most recent edition of a standard text-book of vertebrate comparative anatomy. The confusion to the student which must arise through different authors using different names for the same animal can scarcely be avoided until the systematists have set their house in order, but there can be no possible excuse for the use of two or more names for the same creature within a single chapter; yet that has happened on numerous occasions. Perhaps even more inexcusable are errors arising from the careless confounding of similar names of very different animals. Dr. Brongersma finds that *Hemidactylus* (a gecko) appears amongst the Urodeles, due to confusion with *Hemidactylium*, and *Neomeris* (intended for a porpoise, but strictly applicable to a polyzoan) is confused with a tortoise and is discussed as a reptile! Further difficulties are due to faulty transcription and proof-reading, which have produced a crop of apparently new names, such as *Chelonia speciosa* written instead of *Chelonia sp.* and *Gecko vertis* intended as an abbreviation of *Gecko verticillatus*. The evils attendant on nomenclatorial changes can certainly be minimized by closer co-operation between teachers of zoology and systematists and by a better understanding of the difficulties which confront the latter in the search for stability. It is consequently gratifying to learn that, as a result of Dr. Brongersma's article, a list of corrigenda will be published in the next volume of the particular work he has criticized, and this will itself be submitted to competent systematists before publication.

A Fire in the Mersey Tunnel

SOME of those who have driven through the three miles long Mersey Tunnel may have thought that it was unnecessary to place fire alarms at distances of fifty yards apart throughout the tunnel and to take the many other special precautions against fire which are described in guide books. Remembering that it cost eight million pounds to build and that 5,000 vehicles per hour use the tunnel, it was necessary to take every precaution. The first test of the fire alarm installation occurred on July 25, when a lorry carrying cinematograph films from Liverpool to Birkenhead burst into flames inside the tunnel. The driver at once gave the alarm from one of the fire-alarm boxes, and in less than five minutes the Liverpool and Birkenhead fire brigades had put out the fire. An alarm given at any one of the ninety-eight special boxes is received at both the brigade headquarters. At the same time, large neon 'stop' signs on the roof close the tunnel to traffic, and the pay boxes at each entrance are warned by bells and red lights. The 'electromatic' vehicle-actuated traffic signals are automatically interlocked and allow vehicles to leave and prevent them from entering the affected portions of the tunnel. The alarm is also given to the ventilation control room, from which the large electric air fans can be regulated to meet requirements of any situation that may arise.

The Economics of Railway Electrification

THE *Engineer* of July 17, 24 and 31 contains three short articles on main-line electrification abroad, which are devoted to a statistical survey of the financial aspect of electrification. That electric traction has great advantages for suburban traffic and where water-power is plentiful and coal dear is generally admitted, but the fact that only 2¼ per cent of the total railway mileage in the world is electrified will, perhaps, come as a surprise to those who advocate the adoption of electrification on a wide scale in Great Britain. Of all European countries, in only one, Switzerland, does electrified mileage predominate, and in only six out of twenty does it exceed trifling proportions. Commenting on this, the *Engineer* says: "It is impossible to believe that this neglect of electrification is due to the supineness and conservatism of so many nations. When it is observed that the German national railway system is only electrified to less than 4 per cent, those who are firmly convinced that there is no more technically progressive nation in the universe will have to admit that the arguments against electrical operation must have been overpowering." Electric traction is undoubtedly an extremely efficient means of transport, but against this has to be put the very high capital costs involved. The arguments against electrification have also been strengthened by the great improvements recently made in steam locomotives and the introduction of Diesel-electric units.

German Road Progress

ALTHOUGH it is only two years since Munich entertained the seventh International Road Congress, the city is holding another road congress and in addition a large exhibition of road building machinery on September 16–27. The Research Department of the German State Highways Commission and the leading road construction firms are in charge of all the arrangements. In *Roads and Road Construction* of August 1, Dr. Otto Reismann outlines the programme for the Congress. He points out that the present road construction programme in Germany is on so large a scale, and has been pushed forward so rapidly that great improvements in technical matters have ensued in connexion with road and bridge construction. At the Congress these will be discussed by Government, scientific and industrial experts. The road building machinery exhibition will be held in the open on the Munich Fair Ground, and will show the visitors the very rapid progress made in the mechanization of road construction. The quality of the materials used and the design of the machines have been vastly improved. The Congress will not be confined to purely business sessions. The German motor roads are not built merely for transport purposes. An attempt has been made to build them in such a way that they are in harmony with the landscape and the country in which they lie. Included therefore in the Congress programme are excursions and journeys of inspection over specially constructed motor roads and over the German Alpine highways. At the same time as the Congress there will be an art exhibition on roads as seen by modern art. This is an attempt to demonstrate the strong impression modern art has received from the inspiration of the new roads. It is anticipated that the first 600 miles of the new motor roads (*autobahn*) will be thrown open to traffic in the coming autumn. In two years time, thoroughfares will be completed between Hamburg and Karlsruhe, Stettin and Munich, Ruhr and Karlsruhe, and Stuttgart to Salzburg via Munich.

Crops and Livestock in England and Wales

THE Ministry of Agriculture and Fisheries has recently issued the first part of its publication, "Agricultural Statistics, 1934", entitled "Acreage and Production of Crops and Number of Livestock in England and Wales" (London: H.M. Stationery Office, 1*s*. 6*d*. net), a report which summarizes the annual returns from all holdings exceeding one acre. An outstanding feature is the arrest of the continuous change from arable to grass that has been going on since the Great War, the area under permanent grass showing a reduction on the previous year, whereas the total area under corn has expanded during the same period. As regards roots, the acreage under sugar beet reached a new record figure; that under fodder roots and potatoes, on the other hand, showed a decline. Yields were generally high, being above the average for all corn crops, potatoes, mangolds, hops and several kinds of fruit, though appreciably below normal for hay, turnips and swedes. The numbers of cattle, dairy cows, pigs and poultry have risen since 1933, whereas those for sheep and horses have declined, and as might be expected the output of meat and livestock products, eggs and milk have all shown considerable increases, while the wool clip was substantially reduced. An interesting feature of the report lies in the attainment of many record figures, the yield of wheat and apples being attributable no doubt to the favourable season, and the output of dairy and poultry products to the increase in numbers of cows and birds maintained. Records in area, total production and yield per acre were also reached in the case of sugar beet, while the area under oats, turnips and swedes fell to the lowest figure yet attained, reflecting the changes that are taking place in farming practice.

Mining and Fuel Research at Sheffield

WE have received from the University of Sheffield a report on the research work done in the Departments of Mining and Fuel Technology during the year 1934–35. The former includes numerous subjects, such as mine ventilation, mine lighting, research on trailing cables, accuracy of mine surveys (in which we miss, however, any reference to the very valuable work done by the Institution of Mine Surveyors), subsidence resulting from mining operations, gas testing, movement of firedamp, fireproofing of mine timber, whilst in the Department of Fuel Technology the composition and decomposition and analysis of coal have been carefully studied. The formation of coke, the combustion of coke and the testing of coke have also received attention. A perusal of this pamphlet cannot fail to be of interest to colliery managers.

Symbols for Heat and Thermodynamics

AN attempt will be made to relieve the present chaotic situation with regard to symbols for equations in thermodynamics at an international conference which has been called by the American Society of Mechanical Engineers, to be held in New York on September 14–15, 1936. The Conference has been arranged for this time so that some of the delegates to the World Power Conference to be held the week previous in Washington, D.C., may also act as representatives at the Symbols Conference. American usage in regard to such symbols has become fairly well standardized; but other lists have been issued by various European bodies. The Conference will endeavour to compromise the differences in the several lists.

Fifty Years of West Ham

THE jubilee of the incorporation of the borough of West Ham has been the occasion for the publication of a volume illustrated by maps, photographs and old prints on the history and past and present activities of the borough ("Fifty Years a Borough". Edited by D. McDougall. West Ham County Borough Council 1936). The chief scientific interest in this municipal enterprise is the full account of the growth of the borough from Anglo-Saxon times and its relationship to the Lea and other rivers which were important influences in deciding direction of growth. The chapters on the local government and social services are also of considerable interest.

Sterilization Operations in the United States

ACCORDING to a Science Service bulletin, steady increase in sterilization operations performed on insane and feeble-minded patients in the United States is reported by the Human Betterment Foundation, Pasadena. A total of 23,092 such operations had been officially performed up to January 1, 1936. This does not include operations of this nature privately performed, but is limited to those performed under State laws in the institutions of the twenty-eight States now having sterilization laws in force.

Announcements

PROF. J. BASIL BUXTON, professor of animal pathology in the University of Cambridge, and director of the Institute of Animal Pathology and of the University Field Laboratories, Cambridge, has been appointed acting principal and acting dean of the Royal Veterinary College from September 25, and to succeed Sir Frederick Hobday as principal and dean on the retirement of Sir Frederick after the opening of the main block of the new college buildings.

AT a recent meeting of the North East Coast Institution of Engineers and Shipbuilders the following awards were made: *Institution Gold Medals* (Engineering), to Eng. Comdr. C. J. Hawkes and G. F. Hardy, for a paper entitled "Friction of Piston Rings"; (Shipbuilding), to R. C. Thompson, for a paper entitled "Modernizing the Motor Vessels 'Silverpine' and 'Silverlarch' and Increasing Their Service Speed"; *M. C. James Medal*, to W. C. S. Wigley, for a paper entitled, "The Theory of the Bulbous Bow and Its Practical Application"; *Institution Scholarship*, to Anthony Gilchrist; *Thomas Fenwick Reed Medal*, to Dr. Will Pratt.

THE second International Congress of the International Association for Testing Materials will be held in London on April 19–24, 1937, under the presidency of Sir William Bragg. The Congress will be open to anyone on payment of membership fee. The subjects selected for discussion will be classed into the following groups: A, Metals; B, Inorganic Materials; C, Organic Materials; D, Subjects of General Importance. Further information can be obtained from the honorary secretary, Mr. K. Headlam-Morley, 28 Victoria Street, London, S.W.1.

DR. MAX BODENSTEIN, professor of physical chemistry at Berlin, has been awarded the Bunsen Medal by the German Bunsen Society for applied physical chemistry, and Dr. Max Le Blanc, professor of physical chemistry at Leipzig, has been elected an honorary member of the Society.

DR. DONALD D. VAN SLYKE, a member of the Rockefeller Institute of Medical Research, has been awarded the Charles Mickle fellowship of the University of Toronto for his work on blood analysis, respiratory and renal reactions, diabetes and nephritis.

A MINISTRY of Health has recently been formed in Belgium under the direction of M. Emil Vandervelde, the well-known Socialist leader.

THE twenty-fifth Congress of the German Physiological Society will be held at Giessen and Bad Nauheim on August 30–September 2 in conjunction with the German Pharmacological Society. Further information can be obtained from Prof. Dr. Burker, Physiologisches Institut, Giessen.

THE twenty-third French Congress of Hygiene will be held at the Institut Pasteur, Paris, on October 20–22, under the presidency of Prof. Leclainche. Further information can be obtained from the general secretary, Dr. R. Dujarric de la Rivière, Institut Pasteur, 28 rue du Docteur Roux, Paris, 15^e.

FOUR committees (medical, engineering, economic and legal, and administrative) have been appointed in the United States, consisting of health experts, representatives of employers, workers, insurance companies, Government, technical societies and engineers, to attempt to devise a method for putting an end to silicosis.

EIGHTY-SIX cities in the United States with an estimated population of 37 millions reported 8,799 deaths from motor accidents in 1935 as compared with 9,060 deaths in 1934. Forty-eight of the cities showed a decrease in the total number of fatalities; thirty-six showed increases and two cities reported the same number of deaths in 1935 as in 1934.

THE fifteenth Annual Clinical and Scientific Session of the American Congress of Physical Therapy will be held at the Waldorf-Astoria Hotel, New York, on September 7–11. The programme will include symposia on short-wave diathermy, hydrotherapy, exercise, electro-resection, fever therapy, treatment of vascular diseases, the educational aspects of physical therapy, the relationship of physical technicians to physicians and hospital departments, and technical and scientific exhibits. Further information can be obtained from Dr. Norman E. Titus, 730 Fifth Avenue, New York.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

Two assistant experimental officers (Grade *D*) (physics or engineering) in a War Department at Woolwich—The Superintendent, Experimental Signals Establishment, Woolwich Common, S.E.18 (August 18).

A scientific officer (physics or engineering) in a Government establishment of the War Department—The Secretary, Royal Engineer Board, Regent's Park Barracks, Albany Street, N.W.1 (August 26).

A chemist in the Department of War Department Chemist—The Under-Secretary of State (C.5), War Office, S.W.1 (September 7).

An assistant keeper in the Science Museum, South Kensington, S.W.7—The Director (September 7).

An Elder professor of anatomy and histology in the University of Adelaide—The Secretary, Universities Bureau of the British Empire, 88a Gower Street, W.C.1 (September 20).

A temporary lecturer in zoology in the University of Cape Town—Prof. T. A. Stephenson (October 5).

A lecturer in civil engineering and building in the Portsmouth Municipal College—The Registrar.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 292.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Some Observations on the *C* Regions of the Ionosphere

RECENT observations at Calcutta[1,2], at Morgantown (U.S.A.)[3] and Orfordness (England)[4] have established beyond doubt the existence of ionized layers much below the Kennelly-Heaviside *E* layer. Not infrequently these layers act as good reflectors of radio waves. The topmost of these layers (sometimes called the *D* layer) is situated at an average equivalent height of 55 km. The next one lies between 20 km. and 35 km., and the lowest ones appear to be situated within the tropospheric region between heights of 5 km. and 15 km. (It has recently been suggested by Mitra[5] that since the designation *D* is usually applied to the non-deviating absorbing 'tail' of the *E* region, the new regions be called *C* regions. It would perhaps be convenient to call them, starting from the top, C_1, C_2, and C_3 regions.)

Since data regarding the properties of these regions —particularly of the lower ones—are still lacking, we have recently carried out a series of 24-hour observations, at intervals of one hour and a half, using a frequency range of 1–15 mc./sec. The results of our observations are summarized below.

(1) Echoes from C_1 (55 km.) are much more frequent and are of greater strength than those from C_2 and C_3. C_2-echoes (25–30 km.) are also strong and are more frequent than C_3-echoes; the latter are weak and are observed on rare occasions. C_1, *E*- and *F*-echoes of moderate strength have been observed on several occasions to occur side by side.

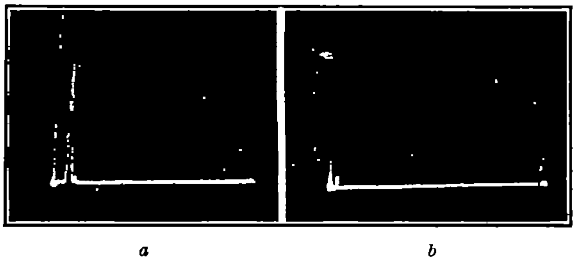
a *b*

FIG. 1. Echoes from. (*a*), C_1 region (55 km), (*b*), C_2 region (20 km.).

(2) Echoes recorded during day-time are invariably weaker than those recorded during the night. The intensities of C_1- and C_2-echoes have occasionally been found at night to be comparable with those of fairly strong *E*- and *F*-echoes.

Fig. 1*a* shows a C_1-echo (55 km.) with 3 mc./sec. frequency as received at midnight of June 5. Fig. 1*b* shows a C_2-echo (20 km.) with a frequency of 2·18 mc./sec. recorded at 1900 hours on June 12. A closer examination will reveal the presence in Fig. 1*b* of another very low height echo (8 km.) and traces of single and double reflections from the *E* region.

(3) Echoes have been observed at all times of the day and night; but they seem to be more frequent during the afternoon and are usually too weak to be detected at about midday.

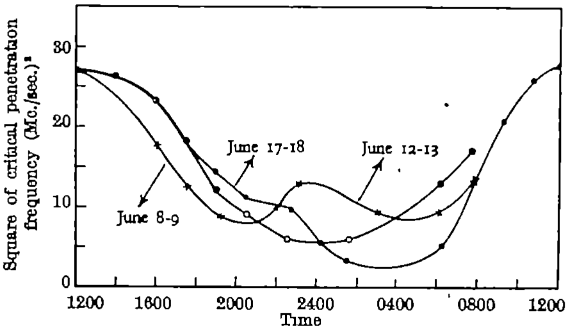

FIG. 2. Hourly variation of the square of the critical penetration frequency (noon to noon) of the C_1 region (55 km.) on three typical days.

(4) Curves in Fig. 2 represent hourly variation of the square of the penetration frequency (f^2) for the C_1 region for three selected days and are typical of those usually obtained in the course of our observations. It is evident that the ionization in general attains its daily maximum at about noon, and tends to a minimum during the small hours of the morning. There are also at times abnormal variations which appear to be more pronounced at night. The general nature of the hourly variation, however, leads one to conclude that the ionization is of solar origin.

(5) The critical penetration frequencies of the C_2 and C_3 regions have been obtained occasionally. But the occurrence of these echoes, particularly those from C_3, is not frequent enough to enable one to study the hourly variation of ionization of the corresponding regions. It may, however, be mentioned that the average values of the penetration frequencies are of the same order as those for the C_1 region.

The observations described here were carried out at the suggestion of Prof. S. K. Mitra.

H. RAKSHIT.
J. N. BHAR.
Wireless Laboratory,
University College of Science,
Calcutta.
June 22.

[1] S. K. Mitra and P. Syam, NATURE, **135**, 953 (1935).
[2] S. K. Mitra and J. N. Bhar, *Science and Culture*, 1, 782 (1936).
[3] R. O. Colwell and A. W. Friend, NATURE, **137**, 782 (1936).
[4] R. A. Watson Watt, L. H. Bainbridge Bell, A. F. Wilkins and E. G. Bowen, NATURE, **137**, 866 (1936).
[5] S. K. Mitra, NATURE, **137**, 867 (1936).

IN connexion with the above observations of Dr. Rakshit and Mr. Bhar on the *C* regions, I would like to point out that it is not justifiable to take the hourly variation of f^2 as proportional to the variation of the ionization density (N) in these low regions of the ionosphere. The collisional frequency (ν) is high at such levels, and in the C_1 region it is perhaps comparable with $2\pi f$. Conditions favourable for reflection (or penetration) may be brought about either by an increase (or decrease) of N or by a decrease (or increase) of ν. It is quite conceivable that the atmospheric density and, along with it, ν, varies from hour to hour at such levels, and the abnormalities observed in Fig. 2 may have been caused either by a variation of N or by a variation of ν or by both occurring simultaneously.

S. K. MITRA.

London.
July 5.

Existence of a Surface Wave in Radio Propagation

IN the mathematical development of the problem of radio propagation over plane earth, Sommerfeld[1] expressed his solution in the form of three terms, one of which he identified with the surface wave of Zenneck[2]. Curves calculated from Sommerfeld's formula have been given by Rolf[3]. Weyl[4], approaching the problem in a different manner, obtained a solution which did not explicitly contain this term. A formula given by Norton[5] gives values agreeing with Weyl. It appears that Weyl was of the opinion that his result was numerically equivalent to that of Sommerfeld. The purpose of this letter is to point out that this is not true, that the evaluation of Sommerfeld's formula by Rolf differs from the formulæ of Weyl and Norton by exactly the 'surface wave' component, and to give the results of a recent experiment showing the Weyl–Norton values to be the correct ones, which raises a question as to whether surface waves do or do not physically exist.

Previously available experimental data that might be used to decide which expression is correct have, unfortunately, been obtained under conditions for which Sommerfeld and Weyl do not differ greatly. For ultra-short wave propagation over deep fresh-water, however, their results differ enormously. To make a test under these crucial conditions, an experiment on the propagation of 2-metre waves has been conducted over Seneca Lake, New York State. The variation of the field with distance was found to agree well with Weyl. At a distance of about 1·8 km., where Sommerfeld's formula gives values about 1,000 times that of Weyl, the field was studied as a function of antenna height and polarization. Whereas Sommerfeld's expression for the surface wave gives values decreasing with height, the measured field actually increased. At the greater heights, the field was independent of polarization, as it should be if there were no surface wave. Since there is no uncertainty in the correct formula to use for horizontal polarization, this comparison showed that the field at the earth's surface was about 0·001 of the value predicted by Sommerfeld. It seems evident that a revision of the Sommerfeld–Rolf curves is required for propagation over all types of ground for which the dielectric constant cannot be neglected.

CHAS. R. BURROWS.

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Deal, New Jersey.
July 14.

[1] A. Sommerfeld, *Ann. Phys.*, 4, **28**, 665 (1909); *Jahrb. drahtl. t.u.t.*, 4, 157 (1911).

[2] J. Zenneck, *Ann Phys.*, 4, **23**, 846 (1907).

[3] B. Rolf, *Proc. Inst. Rad. Eng.*, **18**, 391 (1930).

[4] H. Weyl, *Ann. Phys.*, 4, 60, 481 (1919).

[5] K. A. Norton, NATURE, **135**, 954 (1935).

Specific Ionization of Cosmic Radiation

AFTER Danforth and Ramsay's recent publication[1] I think it would be of interest to give here briefly the results of similar work, carried out last year, the conclusions of which have been proposed as a thesis at the University of Brussels (April 29, 1936) but cannot be published *in extenso* in a periodical before December next.

The problem is to measure the specific ionization of a penetrating radiation (cosmic radiation, fast electrons, etc.) by the comparison of the efficiency of a Geiger-Muller counter (single impulse or coincidence) corresponding to different internal pressures.

This method was indicated by Tuwim[2] in 1931, and by us[3] in 1933. The integration necessary for the determination of the mean length of the internal path was resolved by Tuwim and Kolhorster[4] (1933) in a particular case; unfortunately, that case was not very convenient for the precise determination of specific ionization.

I have solved that integration graphically and numerically with sufficient approximation (error less than one per cent) in the general case of two identical counters, parallel, connected for counting coincidences.

This calculation shows that the approximate formula used by Danforth and Ramsay, and by me in 1933, was definitely different from the true one (more than five per cent discrepancy). I had also shown experimentally that a single pair of ions gives a discharge of the counter with a probability of 0·999; the corrections due to showers, accidental coincidences, recovery time, latent time, barometric effect, etc., have been discussed and taken into account.

The counters used had an over-voltage range of the order of 1,000 volts, a reproducibility better than 0·5 per cent during many months, and a residual frequency of impulses that may be neglected.

The following results were found: Total cosmic radiation:

Specific primary ionization:	
Hydrogen	5·96 ± 0·07 cm.$^{-1}$ (0°–760 mm.)
Helium	5·96 ± 0·15 ,,
Argon	29·40 ± 2·0 ,,
Specific total ionization:	
Argon	71·40 ± 2·0 ,,

Absolute intensity of cosmic radiation (number of rays crossing per second a sphere of 1 cm.^{2} of cross-section):

Brussels (reduced to sea-level) (760 mm.):

$$0{\cdot}0266 \pm 0{\cdot}0003 \text{ cm.}^{-2} \text{ sec.}^{-1}.$$

The concordance between the experimental results and the calculated curve (mean error, 0·9 per cent, equal to the calculated most probable error due to uncertainty of readings) indicates a remarkable homogeneity of specific ionization of the different components of cosmic radiation (primary and secondary).

MAX G. E. COSYNS.

Physical Laboratory,
"Fondation Médicale Reine Elisabeth",
Brussels. July 21.

[1] *Phys. Rev.*, **49**, 854 (June 1936).

[2] *Berl. Ber.*, 830 (1931).

[3] Cosyns et de Bruyn, *Bull. Ac. Belg.*, **20**, 371 (1934).

[4] Tuwim und Kolhorster, *Z. Phys.*, **78**, 130 (1931).

Diffraction of Light by Ultra-Sonic Waves

IN a recent paper, R. Lucas[1] has described an experiment designed to test the relative merits of a theory, proposed by C. V. Raman and N. S. Nagendra Nath, of the scattering of light by high-frequency sound waves and that due to himself and P. Biquard. The two theories differ in that, while Raman and Nath assume only a change in phase of normally incident light as it progresses through the sound field, Lucas and Biquard's theory takes account of changes in both amplitude and phase. Lucas's experiment appears to prove by indirect methods that the theory of Raman and Nath is true only for sound fields of thicknesses of the order of 4 mm. or less. R. Bär[2] has also reported on an experiment which indicates that while the Raman-Nath theory predicts a type of intensity distribution which agrees qualitatively with the observed patterns at frequencies of 1·5 and 7·5 megacycles, there are several discrepancies which indicate that the fundamental assumption of these authors is incorrect. The portion of their theory dealing with oblique incidence apparently gives results which are not in accord with the observations, particularly at the higher frequency. Furthermore, Bar has obtained 'photographs' of the actual ultra-sonic grating by the insertion of a photographic plate in an appropriate position in the light beam behind the stationary sound field. With no lens system of any type to focus the light rays, a series of quite sharp fringes appears on the plate, indicating the presence of some changes in light amplitude as well as in phase.

I have recently completed some experiments, which are to be published shortly in the *Canadian Journal of Research*, in which the distribution of light energy among the various diffraction orders has been measured as a function of ultra-sonic intensity at a number of frequencies in the region of 5 megacycles per second. Using light of wave-length 589 mμ, path lengths of about 2·5 cm. and ultra-sonic intensities ranging from zero to about 0·2 watts per cm.^{2}, it is found that the envelopes of the diffraction patterns as predicted by the Raman–Nath theory are in excellent agreement with the observations for light scattered in both progressive and standing wave fields, the intensities of positive and negative orders from zero to five being measured.

In view of this close agreement, it appears somewhat strange that further experimental evidence should indicate the fundamental assumption of Raman and Nath to be in error. The explanation may possibly be found in the deviations of a practical sound field from the ideal case postulated by these authors, who for simplicity assume the sound field to consist of a rectangular prism of plane waves, the sound intensity over any plane normal to the direction of motion of the waves being constant at any instant. A light ray incident normally on such a field would suffer retardations in phase only. In the practical case, however, the sound field does not fulfil these conditions, particularly at the edges. It is probable that a light ray incident in a direction normal to the axis of the field may suffer some refraction on entering the sound field. Once bent, the ray will be traversing layers of varying refractive index and will suffer some changes in amplitude. Eventually, the various rays may come to a series of foci, thus producing the fringes observed by Bär. In such a field the Raman–Nath theory for oblique incidence might also fail, as noted by Bär.

The fact that the discrepancies between theory and observation are less at the lower frequencies tends to support the above hypothesis since, as the sound wave-length is increased, the probability of a light ray entering the field under the conditions postulated by Raman and Nath is considerably greater. In the case of normal incidence, it is quite conceivable that small changes in amplitude, coupled with the normal changes in phase, give rise to an emergent light wave surface which approximates very closely to that which would be produced if changes in phase alone had occurred. That this is the case appears to be substantiated by the very close agreement between the predicted intensities in the various orders and those measured quantitatively by me and observed qualitatively by Bär.

Until a theory is developed which takes complete account of the nature of a practical sound field, it would hence appear that the theory of Raman and Nath, though based on an assumption which is somewhat erroneous in the practical case, describes most accurately the nature of the diffraction effects observed.

F. H. SANDERS.

National Research Laboratories,
Ottawa.
July 11.

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[1] R. Lucas, *C.R.*, **202**, 1165 (March 30, 1936).
[2] R. Bär, *Helv. Phys. Acta*, **9**, 265 (1936).

Absorption Spectrum of Heavy Methane (CH$_3$D) in the Photographic Infra-Red

WE have recently prepared 40 litres of mono-deuteromethane and examined its absorption spectrum in the photographic infra-red from 12,000 A. to 6000 A. under the high dispersion of a grating spectrograph. Examination of our plates reveals complete absence of even the strongest lines of ordinary methane ; absence of the heavier methanes was shown by density determinations carried out on a specially fractionated sample.

The spectrum includes a region of intense absorption extending from 8350 cm.$^{-1}$ to 9000 cm.$^{-1}$ with a particularly strong and broad maximum at 8617 cm.$^{-1}$. The structure here is complex, but if anything simpler than with ordinary methane, although no obvious regularities stand out. Of particular interest is the occurrence at 9065 cm.$^{-1}$ of a band with a simple structure of regularly spaced lines (approximate spacing 7·5 cm.$^{-1}$) and with what may be a Q branch at 9021 cm.$^{-1}$. In the case of methane[1], a similar band is found at 9047 cm.$^{-1}$ with a spacing of 10·5 cm.$^{-1}$, and apparently similar bands are also shown by methyl halides[2] round about 9025 cm.$^{-1}$. The region from 9600 cm.$^{-1}$ to 10,200 cm.$^{-1}$ is occupied by some ten fainter bands. Then from 10,960 cm.$^{-1}$ to 11,220 cm.$^{-1}$ come four bands, that at 11,220 cm.$^{-1}$ being relatively strong and very similar in appearance to the methane band of the same frequency.

A detailed discussion of this spectrum will shortly be published elsewhere.

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H. A. JAHN.

Davy Faraday Laboratory,
Royal Institution,
London, W.1.
July 22.

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[1] W. H. J. Childs, *Proc. Roy. Soc.*, A, **153**, 555 (1936).
[2] H. Verleger, *Z. Phys.*, **98**, 342 (1936).

The Cepheid Variables and Black-Body Radiation

IN dealing with the problem of determining the concurrent variations in radius and temperature in the Cepheid variables, in order, for example, to construct the Milne diagram[1] for the variability, two possible alternative points of view may be considered, each being inconsistent with the other.

(1) The radial velocities, determined from the displacement of the absorption lines in the spectrum, can be taken to represent unchanged the radial motion of the photosphere. In this case the pulsation theory in its present form has to be abandoned, and it is further necessary to assume that the Cepheid radiation deviates very markedly from that of a black body. These are the postulates favoured by Getting[2], who has in this way prepared Milne diagrams for a number of Cepheids.

(2) We may assume the radiation to approximate closely to that of a black body, and consider the radial velocities to give a measure of the motion of the atmospheric layers only. The radius of the photosphere at any phase must then be considered as completely unknown; the temperature and radius can, however, be determined by the application of the Planck radiation formula, from magnitude determinations in light of two different wave-lengths.

At the present stage of our knowledge, it appears doubtful, however, whether we can assume, a priori, that the velocity of the atmospheric layers reflects the motion of the photosphere. It is known that the radial velocity curve differs for lines at different levels in the atmosphere, both with regard to phase and to amplitude. It is difficult to decide which level is to be taken as representing the motion of the photosphere.

Further, we are at present unable to give a satisfactory picture of the chromosphere in a static star. It follows therefore that the problem of the pulsations of an extended atmosphere in which the photospheric temperature and surface gravity are both undergoing considerable variations is very far from solution; in fact, until some attempt has been made to predict the behaviour of such an atmosphere, it appears advisable not to use the radial velocities to determine the motion of the stellar body.

If (1) fails, we are forced to investigate the possibility that the Cepheids radiate as black bodies. A recent investigation by Kox[3], with this object, has led to the conclusion that this is definitely not the case. Kox has, however, made the initial assumption that the radial velocities give the stellar motion, which is inconsistent with the possibility of black-body radiation, so that his conclusion is not unexpected, and must be regarded as invalid. If, in conformity with (2) above, we assume the radius at any phase to be completely unknown, Kox's observations of the amplitude of light variation in two regions of different wave-length enable us to calculate maximum and minimum temperatures and radii, but are incapable of providing a test of the agreement of the stellar radiation with that demanded by the Planck formula.

It is obvious, however, that if the amplitude of light variation could be determined in three or more wave-lengths, the maximum and minimum temperatures and radii could be calculated from the results of any two such determinations. If the Planck formula is satisfied, the remaining observations should all be consistent with these results.

Kox gives material for δ Cephei from other investigations which enable us to test this conclusion. It is found that if all observed amplitudes are corrected by the same term, depending on the maximum and minimum radii, determined from two observations, the temperature range ΔT required to produce the corrected variation in light is 1,810°. The probable error of a single ΔT is 30°, which would be produced by an error of approximately 0·015 mag. in the observed amplitude, and can, therefore, be explained entirely by errors of observation.

On the present data, the conclusion therefore is that the light variation in the Cepheids is consistent with the joint assumptions:

(*a*) The stars radiate to a close approximation as black bodies.

(*b*) The photospheric radius is considerably greater at minimum light than at maximum, that is, the radial velocities are not to be regarded as reflecting unchanged the motion of the photosphere.

A. E. H. BLEKSLEY.

University of Witwatersrand,
Johannesburg.
June 26.

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[1] E. A. Milne, *Mon. Not. Roy. Ast. Soc.*, **94**, 418 (1934).
[2] Getting, ibid., **95**, 139 (1934).
[3] Kox, *Astr. Nach.*, **256**, 21 (1935).

Thermal Conductivity of Deuterium

IN the course of an experimental investigation of thermal conduction in deuterium-hydrogen mixtures, recently completed, determinations of the absolute value of the thermal conductivity of deuterium have been made. The method used in these determinations was the hot wire method as developed by Gregory and Archer[1,2].

The deuterium was prepared from deuterium oxide of guaranteed 99·95 per cent concentration, supplied by Imperial Chemical Industries, Ltd., and two independent methods of preparation were adopted:

(1) The vapour of the deuterium oxide was passed over pure magnesium, heated by means of an electric furnace to about 500° C. in a quartz tube, after very careful and prolonged de-gassing of the magnesium. In this instance, the value of the thermal conductivity of deuterium at 0° C. obtained from the measurements was

$$0{\cdot}000308_2 \text{ cal. cm.}^{-1}\text{ sec.}^{-1}\text{ deg.}^{-1}\text{ C.}$$

(2) The deuterium was prepared by decomposition of the oxide by metallic sodium, the sodium having been previously boiled *in vacuo* to remove all traces of air and other impurities. In this case, the value of the thermal conductivity of deuterium at 0° C. found was

$$0{\cdot}000307_8 \text{ cal. cm.}^{-1}\text{ sec.}^{-1}\text{ deg.}^{-1}\text{ C.}$$

In both cases, the observations were checked by repetition of the preparations, using different samples of the deuterium oxide. Also, the same apparatus was used to determine the thermal conductivity of pure hydrogen, prepared by the magnesium method from pure water. The value at 0° C. was found to be

$$0{\cdot}000418_2 \text{ cal. cm.}^{-1}\text{ sec.}^{-1}\text{ deg.}^{-1}\text{ C.}$$

The accuracy of all the results is estimated to be of the order of 0·25 per cent.

It is of interest to note that the value for deuterium obtained by calculation[3] from the experimental value for hydrogen is

$$0{\cdot}000295_7 \text{ cal. cm.}^{-1}\text{ sec.}^{-1}\text{ deg.}^{-1}\text{ C.,}$$

while the actual measurements of Kannuluik[4] gave

$$0{\cdot}000329_4 \text{ cal. cm.}^{-1} \text{ sec.}^{-1} \text{ deg.}^{-1} \text{ C.}$$

A detailed account of the investigations will be published elsewhere in the near future.

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July 22.

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[1] Gregory and Archer, *Proc. Roy. Soc.*, A, **110**, 91 (1926).
[2] Gregory and Archer, *Phil. Mag.* (7), **15**, 301 (1933).
[3] "Ortho-, Para- and Heavy Hydrogen", Farkas A., p. 148.
[4] Kannuluik, NATURE, **137**, 741 (1936).

Effects of Hypertonic Media on the Contractile Vacuoles of Protozoa

IT has long been suspected that the contractile vacuoles of Protozoa maintain the internal osmotic pressure of the organism above that of the external medium, and it has been argued that, if this is correct, the rate of vacuolar output should be reduced when the external osmotic pressure is raised. This has been found to be true for various Ciliata, and recent work has made it necessary to examine evidence of this nature more critically.

In Peritrich Ciliates[1] and in *Paramecium*[2], it has been found that if the external osmotic pressure is raised sufficiently the body shrinks, but that the contractile vacuole may continue to eject water, although at a reduced rate, even after this shrinkage. Kamada[2] has argued from his results with *Paramecium* that since the body has shrunk, the internal osmotic pressure is no longer above the external osmotic pressure, and hence that no more water can be entering through the body surface, and therefore in turn that the water ejected by the contractile vacuole must be of internal and metabolic origin. This argument is open to criticism.

According to the osmotic control theory, the contractile vacuole acts as a pump which, by utilizing energy, ejects water and retains the salts of the organism. There is no reason whatsoever why the contractile vacuole should stop as soon as the external osmotic pressure is raised so as to equal or exceed the (original) internal osmotic pressure of the organism. Its continuance would lead to a raising of the internal osmotic pressure by a shrinkage of the body until a new and steady value was attained above that of the new external medium. One might, however, expect a decrease in rate of output owing to the increased energy required to separate water from a more concentrated internal solution. Only if the external osmotic pressure were raised very considerably above the original internal osmotic pressure of the organism would one necessarily expect the contractile vacuole to stop completely.

After an increase in the osmotic pressure of the external medium, in the process of reaching a new steady state (1) the body will shrink, and the internal osmotic pressure will therefore be raised, with the result that (2) the rate of vacuolar output will (probably) decrease, and (3) the rate of entry of water by osmosis through the body surface will increase (even from zero or from a negative value). The body volume will become constant when it has decreased to such a value that the rates of loss (2) and gain (3) of water are equal. There is no reason for expecting a linear relationship between rate of vacuolar output and external osmotic pressure. The rate of vacuolar output will be dependent on unknown internal factors such as the water content or salt concentration of the tissues. This theory is in good accordance with the data which are available for Ciliata.

The situation is more complicated for *Amœba*, and the evidence is more conflicting, although a similar explanation may be applicable. Adolph[3] found that the contractile vacuole of *Amœba proteus* maintained its rate of output undiminished when the organism was subjected to pure solutions of sodium chloride or other salts up to $M/20$ in concentration (that is, of osmotic pressure equal to about one-tenth of that of sea water). But Zuelzer[4] found that fresh-water amœbæ lost their contractile vacuoles when transferred to sea water, and Hogue[5] found that marine amœbæ developed contractile vacuoles when cultured on an agar medium made up with fresh-water.

It seems therefore probable that Adolph did not use strong enough solutions, and in any event pure sodium chloride is scarcely a suitable medium for the purpose. It may be stated in conclusion that the situation as regards amœbæ is still unsettled, but that the evidence so far available is not inconsistent with the osmotic control theory of the contractile vacuole.

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[1] Kitching, J. A., *J. Exp Biol.*, **11**, 364 (1934).
[2] Kamada, T., *J. Sci. Tokyo Imp. Univ.*, **4**, 49 (1935).
[3] Adolph, E. F., *J. Exp. Zool.*, **44**, 355 (1926).
[4] Zuelzer, M., *Archiv EntwickMech* , **29**, 632 (1910).
[5] Hogue, M J., *J. Elisha Mitchel Sci. Soc.*, **39**, 49 (1923).

Colloid Osmotic Pressure of the Body Fluids of Freshwater Animals

THE fact that the colloid osmotic pressures exerted by the body fluids of marine animals arrange themselves in the order of their phylogenetic development[1], suggested that there exists a definite relationship between the general organization of an animal and the colloid osmotic pressure of its body fluids. The results of the measurements undertaken with the hæmolymphs of some terrestrial invertebrates confirmed this hypothesis; the values obtained[2] were indeed practically the same as those of the body fluids of the corresponding marine animals. I concluded from these observations that neither sea water nor air as surrounding media have any marked influence on the above-mentioned relation.

It was interesting to see whether this relationship is modified by life in fresh-water. I have therefore measured the colloid osmotic pressures of the body fluids of some freshwater animals and compared the results with the data previously found for the corresponding marine groups. The animals used were one species of lamellibranch Molluscs (*Anodonta cellensis*), two species of gasteropod Molluscs (*Limnœa stagnalis*, *L. auricularis*), one decapod Crustacean (*Astacus fluviatilis*), and three teleostean fishes[3] (*Cyprinus carpio*, *Esox lussius*, *Anguilla vulgaris*). The following table gives the average values of each of these groups (except the values obtained with the serum of the eel, which will be discussed below) and, for comparison, the average values of the corresponding marine animals :

	Marine animals (cm. H_2O)	Freshwater animals (cm. H_2O)
Lamellibranch molluscs	1·1	0·8
Gasteropod molluscs	1·5	1·2
Decapod crustaceans	3·6	3·1
Teleostean fishes	19·0	11·9

The table shows that the colloid osmotic pressures of the body fluids of freshwater animals arrange themselves, as well as those of the marine animals, in the order of phylogenetic development. The parallelism between the two series of figures is striking. There is, however, a marked difference between the marine animals and those living in fresh-water: the values for the freshwater animals are 20–35 per cent lower than those given by the body fluids of the marine animals. This difference does not conflict with the hypothesis of a relation between the general organization of an animal and the colloid osmotic pressure of its body fluids, but even strengthens it. The freshwater fauna being considered as a regressive branch of the aquatic fauna in general, this regression expresses itself by a diminution of the colloid osmotic pressure of the body fluids of these animals.

There is one exception from this rule: the eel's serum exerts a colloid osmotic pressure varying from 19·9 to 27·2 cm. H_2O. This exception, however, does not in the least weaken the hypothesis; though passing a great part of its life in fresh-water, the eel must essentially be considered as a marine fish. The colloid osmotic pressure of its serum has indeed the same value as that of one of the most active marine Teleosteans, that is, *Labrax lupus*.

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July 21.

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[1] P. Meyer, NATURE, **136**, 757 (1935); *Compt. rend. Soc. Biol.*, **120**, 303, 305 (1935); *J. Physiol.*, **34**, 5 (1936).

[2] P. Meyer, NATURE, **137**, 401 (1936); *Compt. rend. Soc. Biol.*, **120**, 1004, 1005 (1935); *J. Physiol.*, **34**, 448 (1936).

[3] A. Keys and R. M. Hill (*J. Exper. Biol.*, 11, 28; 1934) had already measured the colloid osmotic pressure of the serum of three freshwater teleosteans (*Tinca vulgaris*, *Esox lussius* and *Anguilla vulgaris*). The figures reported by these authors agree with the values recorded in this note.

Metabolism of Cartilage

In reply to the letter of Dickens and Weil-Malherbe[1], a previous communication[2] on this subject was based, except where rabbit cartilage was specified, on more than one hundred experiments with cartilage from the carpo-metacarpal joints of the adult horse, to whose metabolism that of human cartilage is very similar.

As regards the rabbit, hyaline cartilage from the femur has an anaerobic glycolysis of 1·0 for the first few hours, falling to an average of 0·6 over the 24 hours: the figures cited previously refer to meniscus (fibrocartilage) over a period of 24 hours in an experiment lasting fourteen days. A comparable figure is that for the first hour, 0·6.

Respiration measurements have not yet been made on rabbit material, but it is perhaps of interest:

(1) That the well vascularized epiphyseal cartilage of the fœtal rabbit has an anaerobic glycolysis ten times as high as the adult, or, per cell, twice as high.

(2) That a human enchondroma showed a glycolysis thirty times that of normal cartilage and an oxygen uptake of 0·34.

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July 25.

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[1] Dickens and Weil-Malherbe, NATURE, 138, 125 (1936).

[2] Bywaters, NATURE, 138, 30 (1936).

Intermediate Metabolism of Carbohydrates

We have found some new chemical reactions in living cells which represent steps in the breakdown of carbohydrates. Pyruvic acid, if added to animal tissues, disappears rapidly not only in the presence, but also in the absence of oxygen. In the presence of oxygen the end-products of the pyruvic acid metabolism are known to be carbon dioxide and water. We find that the primary steps of the oxidation proceed in the absence of molecular oxygen, and as products of the anaerobic oxidation the following substances were identified: (1) acetic acid, (2) carbon dioxide, (3) succinic acid.

The reductive equivalent for the oxidation of pyruvic acid is the conversion of another fraction of pyruvic acid into lactic acid or the homologous reduction of another ketonic acid. The quantitative data suggest that pyruvic acid is metabolized by the following intermolecular oxido-reductions: The first step is a dismutation of pyruvic acid according to the reaction:

(1) 2 pyruvic acid + water → acetic acid + carbon dioxide + lactic acid.

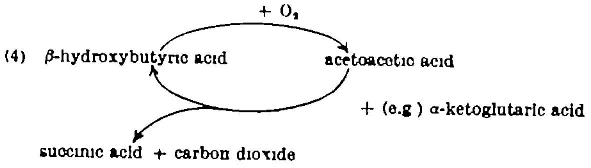
The evidence for the occurrence of this reaction in the tissues which metabolize carbohydrates is conclusive. The subsequent reactions which lead to the formation of succinic acid may be tentatively formulated in the following way:

(2) acetic acid + pyruvic acid + 'ketonic acid' → α-ketoglutaric acid + 'hydroxy acid'.

(3) α-ketoglutaric acid + 'ketonic acid' + water → succinic acid + carbon dioxide + 'hydroxy acid'.

According to (2) α-ketoglutaric acid is formed by the oxidative condensation of pyruvic and acetic acids, a ketonic acid acting as hydrogen acceptor. According to (3), α-ketoglutaric acid is oxidatively decarboxylated by dismutation. Reaction (3) is analogous to (1).

The experiments suggest that different 'ketonic acids', such as pyruvic acid, acetoacetic acid, oxalacetic acid[1], or their homologues may be concerned in reactions (2) and (3), and may possibly take the place of pyruvic acid in (1). It seems that acetoacetic acid reacts preferentially in (3), and it is therefore of great interest that we find in tissues which metabolize carbohydrates a specific system which catalyzes the oxidation of β-hydroxybutyric to acetoacetic acid by molecular oxygen[2]; β-hydroxybutyric acid may thus act as a carrier for molecular oxygen according to the scheme (4).


+ O_2
(4) β-hydroxybutyric acid
acetoacetic acid
+ (e.g.) α-ketoglutaric acid
succinic acid + carbon dioxide

As is indicated in (4), α-ketoglutaric acid is not directly oxidized by molecular oxygen, but through the intermediation of another ketonic acid. It has long been known that there are links between carbohydrate breakdown and 'ketone bodies', and it is now possible to describe this link, or at least one of the links, in chemical terms.

The oxidative formation of succinic acid from pyruvic acid has been discussed by previous workers.

The new feature is the demonstration that this oxidation is brought about by anærobic oxido-reductions. The reactions described seem to occur in all animal tissues which metabolize carbohydrates. They occur also in bacteria. Reaction (1), for example, is quantitatively realized in gonococci.

The work of Peters[3] and the findings of Simola[4] suggest that vitamin B_1 is a co-enzyme for dismutations of the type of the reactions (1) and (3). Experiments on tissues of vitamin B_1 deficient rats and chickens show that such is the case.

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July 9.

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[1] See also A. Szent-Györgyi, *Z. physiol. Chem*, **236**, 1 (1935)
[2] See also M. Jowett and J. H. Quastel, *Biochem. J.*, **25**, 2181 (1935).
[3] R. A. Peters, *Lancet*, May 23, 1936.
[4] P. E. Simola, *Suomen Kem.*, 9, B, 4 (1936).

Length of Saccharide Chains in Glycogens from Different Sources

EMPLOYING Haworth's 'end-group assay' method, it has already been shown that rabbit liver glycogen formed under normal conditions has a chemical molecule built up of a chain of 12 glucose units[1,2]. Fish (Gadidae) liver glycogen also conforms to this structure[2].

Haworth afterwards recorded that glycogen (source not mentioned) may also exist derived from 18 units[3].

I have now examined, by the above method, the glycogens (*a*) laid down in the liver after oral administration of galactose to fasted rabbits; and (*b*) from the whole tissue of *Mytilus edulis*. In each instance the mean number of glucose units in the chemical molecule of the polysaccharide has been found to be 18.

This fact was revealed only following examination of the cleavage products of the methylated glycogen in question. No apparently significant differences from 12 unit glycogen could be demonstrated by examination of the purified polysaccharides themselves with respect to $[\alpha]_D$, reducing power, rate of hydrolysis, or properties of the acetylated or methylated derivatives.

These investigations will be fully reported through the usual channels.

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[1] Haworth and Percival, *J. Chem. Soc*, 2277 (1932).
[2] Bell, NATURE, **136**, 184 (1935); *Biochem. J.*, **29**, 2031 (1935).
[3] Haworth, Pres. Add. to Chem. Sec of Brit. Ass., p. 41 (1935).

Inhibitory Effect of Phloridzin and Phloretin on Kidney Phosphatase

THE inhibitory effect of phloridzin on phosphatase action[1] is well pronounced only when rather high concentrations (about *m*/50–*m*/100) of the poison are used. The phloridzin concentrations which are able to prevent any reabsorption of glucose in the kidney are definitely lower[2] (about 0·5–1 mgm. per gm. kidney). Phloridzin is hydrolyzed by *N* hydrochloric acid at 100° into glucose and phloretin.

The present communication shows that the inhibitory effect of phloretin on kidney phosphatase is about three to four times as high as that of phloridzin. In alkali at 100° the phloridzin is hydrolyzed into phloroglucin-glucoside and phloretin acid. Here also an increase in the poisonous action (about twice) is observed. Phloroglucin has no poisonous action on phosphatase; pure phloroglucin-glucoside has not been tested. However, phloroglucin-glucoside inactivates the reabsorption of glucose in the kidney[3].

Exp. 24/6. Kidney phosphatase; veronal buffer *p*H 8·5; temp. 38° C.; incubation, 60 min.

Substrate: glycerophosphate	Ester hydrolysis (mgm. P)	Per cent inhibition
Normal sample	0·350	
Phloridzin *m*/370	0 292	15
Phloretin *m*/370	0 152	57

In this connexion, it is of interest that liver and kidney contain great amounts of β-glycosidases; phloridzin-glycosidase has been found in horse kidney[4].

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July 10.

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[1] Lundsgaard, *Biochem Z.*, **264**, 209 (1933).
[2] Lundsgaard, *Skand. Arch. Physiol.*, **72**, 265 (1935).
[3] Lambrechts, *Compt. rend. Soc. biol.*, **121**, 870 (1936).
[4] Hoffmann, *Biochem. Z.*, **285**, 429 (1936).

Steady Performance of Geiger-Müller Counters

DUE to rapid discharges that take place in a counter, a considerable amount of gas may easily be liberated, or in some cases even adsorbed, causing fluctuations of pressures in the counters. After working for some time, the voltage initially found to be suitable may no longer be so, and may lie beyond the limits within which the counts are independent of variations of applied voltage. This is more likely to occur with low-pressure counters than with high-pressure ones, since the working range of voltage diminishes with diminution of pressure. Herein lies the cause of unsteadiness.

One way of remedying this unsteadiness is to increase the pressure in the counter; but this necessitates the use of very high voltages to the counter. Two other ways are open. By the use of suitably high resistances between the counter and the battery, the tendency for a heavy arcing discharge to be initiated by the condenser discharge can be checked. Another way is to use a big reservoir in connexion with the counter volume. The large volume makes changes of pressure negligible.

We have found that counters in which no counting range could be detected easily gave such ranges on the insertion of a ten-litre volume. This arrangement was tested for pressures from 5 mm. up to 10 cm. with counters of different dimensions, air being used in all cases. Tinned copper wire of about 0·3 mm. diameter was used for the central electrode. The tinning was done not for any special reason, it being the usual 5 amp. fuse wire. The material of the outer electrode is brass, in thin sheet and enclosed in a sealed glass tube.

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Vibrational Frequencies of Molecules

IN a recent letter to NATURE[1], I submitted evidence that the ground state vibrational frequency of a molecule AB was the mean of the frequencies of the molecules A_2 and B_2 provided that A and B belong to the same group of the Periodic Table. I was then unaware of the work of Dr. C. H. Douglas Clark[2], who had previously arrived at the same conclusion. To account for certain deviations from this rule, he adds the further condition that the frequencies of A_2 and B_2 must not be too dissimilar in magnitude.

If the motion of a diatomic molecule AB be considered simple harmonic, the vibrational frequency ω is given by the expression:

$$\omega = \frac{1}{2\pi}\sqrt{\frac{M_A + M_B}{M_A \cdot M_B}\cdot K},$$

where M_A and M_B are the atomic weights of A and B respectively and K is the force constant. It is reasonable to assume in the first instance that for such molecules as A_2, B_2 and AB, the force constant K will have the same value. A simple calculation then shows that the above relation between the vibrational frequencies follows if the masses M_A and M_B are of the same order. Consequently the frequencies of A_2 and B_2 should also be of the same order, thus accounting for Clark's second condition.

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[1] H. G. Howell, NATURE, 138, 36 (1936).

[2] C. H. Douglas Clark, *Trans. Faraday Soc.*, 31, 1017 (1935).

Asymmetry in Metallic Zinc and Cadmium

IN the issue of NATURE of February 22, Dr. G. W. Brindley reports on discrepancies in the X-ray scattering factors of zinc and cadmium. The observed values do not lie on a smooth curve. Of the two possible interpretations of this phenomenon, namely (*a*) the asymmetry of the atom or (*b*) the asymmetry in the lattice vibrations, Dr. Brindley gives preference to the latter, since the deviations are too large to be explained by (*a*)[1].

Nevertheless, I wish to say that the possibility of an appreciable variation from a spherical shape of the zinc and cadmium atoms is not altogether out of the question. This opinion is based on the two following observations:

(1) Nineteen of the twenty-one elements having the close-packed hexagonal structure[2] show a ratio c/a between $1\cdot578_5$ (Os) and $1\cdot64$ (Ni). This implies variations of only $-3\cdot3$ per cent and $+0\cdot43$ per cent respectively from the value $1\cdot633$, which corresponds to the case of close-packed spheres. Cadmium and zinc, however, show values of $1\cdot885_9$ and $1\cdot856_2$ ($1\cdot884_3$ resp. at 415°), these ratios being 15½ per cent higher. This difference seems to be too large to be explained by thermal oscillations, should this be taken as the reason for the deviations in the case of the other metals.

(2) The following calculation seems to be of still greater weight. In pursuance of the hypothesis that cadmium and zinc atoms are rotational ellipsoids[3], the question arises, what would be the shape of the ellipse forming the cross-section, that is, what would be its numerical eccentricity. The answer is given by the following calculation for cadmium (p = major, q = minor axis):

$$\frac{p}{q} = \frac{1}{\sqrt{1-\varepsilon^2}} = \frac{(c/a)_{\text{ellipse}}}{(c/a)_{\text{sphere}}} = \frac{1\cdot885_9}{1\cdot6333},$$

and hence $\varepsilon = 0\cdot5002$; that is, equal to 1/2 as precisely as possible[4]. It is difficult to believe that this is a mere chance, especially in view of the considerations mentioned under (1). (There is no intermediate value between $1\cdot64$ and $1\cdot856_2$).

The foci of this ellipse are situated at the centre of each half of its major axis. It is therefore possible to put a sphere in each half of the rotational ellipsoid, their centres coinciding with the foci and their surfaces touching the vertices and the centre of the ellipsoid. Such a rotational ellipsoid, being a 'quasi double-sphere', can be regarded as a body very nearly related to the sphere as to its degree of symmetry.

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[1] See also the paper by C. Zener, *Phys. Rev.*, 49, 122 (1936).

[2] See M. C. Neuburger, "Gitterkonstanten 1936", *Z. Krist.*, 93, 1 (1936).

[3] This view has been mentioned by various writers: Hull, Ewald, Hume-Rothery. See also Canfield, *Phys. Rev.*, 35, 530 (1930)

[4] For zinc at room-temperature with $1\ 856_2$, one gets $\varepsilon = 0\ 475_5$ and at 415° with $1\cdot884_3$, $\varepsilon = 0\cdot4989$.

THROUGH the kindness of the Editor, I have been allowed to see Prof. Herrmann's letter prior to its publication. I entirely agree that the X-ray results do not exclude the possibility that the *outermost* electrons of the atoms in metallic zinc and cadmium may depart from having spherical symmetry; one would not expect the completed inner electron shells to have appreciable asymmetry. The possibility of the outermost electrons being asymmetrical, however, is not to be regarded as an *alternative* explanation of the experimental results, but as something *additional* to the explanation already given in terms of asymmetrical lattice vibrations. The contributions of the outermost electrons to the scattering factors of zinc and cadmium at all angles for which measurements can be made are so small that one could scarcely hope to measure an asymmetry in their distribution by means of X-rays. On the other hand, any asymmetry in the lattice vibrations will affect the entire atom, and at large scattering angles, measurable effects may be expected if the asymmetry is sufficiently great, and this appears to be so for zinc and cadmium.

With regard to point (1) raised by Prof. Herrmann, it is difficult to see whether this indicates an asymmetry of the atoms or of the lattice vibrations, without going into the matter much more fully. If, however, the unusually high c/a values of zinc and cadmium are associated with strongly asymmetrical lattice vibrations, then one might expect that a 'normal' metal, such as magnesium with $c/a = 1\cdot624$, would not show strongly asymmetrical vibrations. I have recently carried out an X-ray investigation of magnesium similar to the previous experiments on zinc and cadmium, and the results so far obtained suggest that in magnesium the lattice vibrations are very much more nearly isotropic than in zinc and cadmium. These results appear to be consistent with the fact that, whereas in zinc and cadmium the thermal expansion coefficients perpendicular and parallel to the principal axis are very different, in magnesium they are almost the same[1].

With regard to Prof. Herrmann's second point[2], that the eccentricity of the ellipsoidal space occupied by an atom in zinc or cadmium is almost exactly 1/2, and that into this space one can place two spheres in contact with their centres at the foci, it is difficult to see what *physical* significance this *geometrical* result can have; if one regards the atom as occupying alternately the two foci, the situation is equivalent to a larger vibration along the *c*-axis than normal to it.

Finally, it may be mentioned that since my letter appeared in NATURE, the results for zinc have been discussed in the *Philosophical Magazine*[2], and a preliminary account of the cadmium results has appeared in the *Proceedings of the Leeds Philosophical Society*[3].

G. W. BRINDLEY.

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University, Leeds.
July 13.

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[1] See, for example, a recent paper by E. Goens and E. Schmid, *Phys. Z.*, **37**, 385 (1936).

[2] *Phil. Mag.*, **21**, 790 (April 1936).

[3] *Proc. Leeds Phil. Soc.*, **3**, 200 (April 1936).

Oxide Layer on a Polished Surface

I CAN confirm S. Dobinski's results[1] for copper by my own experiments on polished aluminium[2]. I used a different method, namely, observations of changes in the initial solution potential when polished under paraffin, benzene, water. The conclusion I came to in my paper was that wet "polishing resulted in the formation of an oxide film in close contact with the metal and similar to that formed by heating in air". This seems further evidence that many observations on the so-called 'amorphous' layer may really have been observations on the properties of the oxide.

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[1] NATURE, **138**, 31, July 4, 1936.

[2] "The Influence of Boundary Films on Corrosive Action", *Proc. Roy. Soc.*, A, **115**, 368 (1927).

Inhibitive Effect of Vitamin C on Toxin Production by *C. diphtheria*

KING and Menten (1935) have reported that guinea-pigs having a high vitamin C storage are less sensitive to diphtheria toxin than are those having a low vitamin C storage. This observation may be important in relation to the pathogenesis of diphtheria infection. We, therefore, tried to ascertain the effect of vitamin C on toxin production by *C. diphtheria in vitro*.

Experiments have been conducted on the influence of vitamin C in the culture media on the toxicity of culture filtrates of a toxin-producing strain of *C. diphtheria*. A sterile solution of vitamin C was added to the culture medium in concentrations ranging from 0·05 to 0·125 per cent. The flasks containing vitamin as well as corresponding controls were inoculated with *C. diphtheria*, incubated 48 hours at 30° C., and the toxicity of the filtrates tested by intracutaneous injection in guinea pigs.

Vitamin C added to culture media rapidly disappears on incubation at 30° or 37° C. However, if immediately after the vitamin is added the medium is inoculated with *C. diphtheria*, the vitamin disappears more slowly. But most significant is the fact that even small residual amounts of the vitamin (20–40 mgm. per cent) are sufficient to inhibit toxin production.

A series of experiments under a variety of conditions has clearly established the fact that vitamin C added in small amounts to a suitable medium inhibits toxin production. The same strain of *C. diphtheria* produces a potent toxin in the flask without vitamin C, and little or no toxin in the one containing the same medium plus the addition of 0·05 per cent ascorbic acid.

It is suggested that the varying toxic character of a diphtheritic injection may depend as much on the tissue saturation with vitamin C as on the toxigenic properties of the infecting strain. It is also possible that the mildness of diphtheritic infection in subtropical and tropical countries is in some way related to the quantitative differences in the concentration of this vitamin. These questions are being investigated.

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Induced Chiasma Formation in Somatic Cells by a Carcinogenic Hydrocarbon

EXPERIMENTS are being done on the effects of methylcholanthrene on mouse fibroblasts cultivated *in vitro*. The tissue is grown by the hanging drop method in a medium containing approximately 0·005 mgm. of the hydrocarbon per c.c. and is subcultivated every 48 hours. After three days' growth, the cultures when fixed in Navashin's fluid and stained with iodine-gentian-violet are found to contain a high percentage of abnormal mitotic figures of various types.

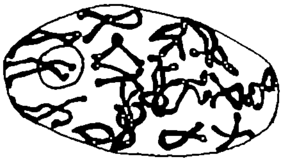

FIG. 1.

Of particular cytological interest is the induction of chromosome pairing and chiasma formation in somatic cells. This condition was observed in several tetraploid cells at various stages from early prophase until anaphase. This disturbance may take the form of a precocity of the prophase in relation to the chromosome splitting, which may also be the underlying mechanism of the induction of chromosome pairing. This suggestion is supported by the abnormal degree of contraction which is observed in the chromosomes both in the cells which show chiasma formation and in the other abnormal cells. The chiasma frequency observed is 1–3 per chromosome as in normal meiosis. A typical prophase cell of this type is shown in the accompanying drawing (Fig. 1) in which some chromosomes have been omitted for clarity.

E. MARIE HEARNE.
(Canadian Federation of University
Women's Scholar.)

Strangeways Research Laboratory,
Cambridge.
July 16.

Isotopes and Molecular Asymmetry

QUITE recently[1], attempts have been made to resolve into their optically active components, molecules of the type $C.H.D.R_1.R_2$, with very slight success, if any at all. In 1922[2], I suggested that if this type of asymmetry associated with isotopes was responsible for very slight rotation or none at all, a molecule of the type $C.x.y.R_1.R_2$. should be investigated, x and y being atoms or groups of similar electronic configuration. In view of the resemblance (which some physicists consider is a real one) between the electronic configuration of the methyl radical and the fluorine atom, the molecule of α-fluor-propionic acid might be a fit subject for investigation. This substance may have no optical activity, if the recent results are correct. I am not aware that asymmetric molecules containing CH_3 and F as dissimilar groups have ever been subjected to optical resolution.

T. IREDALE.

University,
Sydney.
July 18.

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[1] Erlenmeyer and Gartner, *Helv. Chim. Acta*, 19, 145, 331 (1936); Coppock and Partridge, NATURE, 137, 907 (1936).

[2] NATURE, 109, 779 (1922).

Points from Foregoing Letters

GRAPHS showing the hourly variations in the (square of the) critical penetration frequency (f^2) of radio waves for the C_1 ionizing region of the atmosphere, located at a height of 55 km., are given by Dr. H. Rakshit and J. N. Bhar. Prof. Mitra, commenting on one of their remarks, points out that the critical penetrating frequency cannot be taken as a measure of the density of ionization since it depends upon both ionization density and upon collisional frequency, which vary independently.

An experiment conducted by Chas. R. Burrows on the propagation of ultra-short radio waves over freshwater shows that a revision of the Sommerfeld–Rolf curves is required in those cases where the dielectric constant is taken into account.

Max G. E. Cosyns has measured specific ionization of cosmic rays in hydrogen, helium and argon by comparing the efficiency of Geiger-Müller counters for different internal pressures. The results are given for argon, helium and hydrogen. The absolute intensity of cosmic radiation at Brussels has been found to be 0·0266 per second per sq. cm.

Forty litres of methane with a single substituted deuterium atom have been made by Drs. W. H. J. Childs and H. A. Jahn, in order to obtain its absorption spectrum in the photographic infra-red. Preliminary results are given and the spectrum compared with that of ordinary methane.

From data obtained by Kox on the amplitude of light variation of three separate wave-lengths in different regions of a pulsating star (δ Cephei), and assuming that Planck's formula for 'black body' radiation holds in such cases, A. E. H. Bleksley concludes that the light variations in cepheid variables is consistent with the view that the radius of their photosphere (layer from which comes most of the light that reaches us directly, that is, without absorption and re-emission) is considerably greater at minimum than at maximum luminosity.

In discussing the osmotic function of the contractile vacuoles of Protozoa, Dr. J. A. Kitching points out that while one might expect the rate of vacuolar output to decrease after the external osmotic pressure has been raised above the original internal osmotic pressure of the organism, one would not necessarily expect the contractile vacuole to stop completely. Changes of body volume, and hence of internal osmotic pressure, must also be taken into account.

According to Dr. P. Meyer, the colloid osmotic pressures of the body fluids of freshwater animals are in the order of phylogenetic development, but 20–35 per cent lower than those exerted by the body fluids of the corresponding marine animals. Regarding the freshwater fauna as a regressive branch of the aquatic fauna in general, this is not necessarily contrary to the hypothesis of a relation between the general organization of an animal and the colloid osmotic pressure of its body fluids.

Dr. H. A. Krebs describes chemical changes which pyruvic acid undergoes in living cells. These reactions are intermediate steps in the biological breakdown of carbohydrates; they shed light on the relations between the metabolism of carbohydrates and of ketone bodies, and on the physiological function of vitamin B_1.

D. J. Bell states that glycogen obtained from the whole tissue of the edible mussel, and also from the liver of fasted rabbits (after oral administration of galactose) consists of 18 glucose units, while the glycogen obtained from the liver of rabbits under normal conditions, or that from fish liver, consists of 12 glucose units. No significant difference in the properties of the two glycogens has been observed.

The action of the phosphatase enzyme of the kidney (which splits phosphoric acid esters) is found by Dr. H. Kalckar to be much more strongly inhibited by phloretin than by its glucoside, phloridzin, a bitter principle in the bark of apple and other trees.

It has been found that the vibrational frequency of a molecule AB is the mean of the frequencies of the molecules A_2 and B_2 when A and B belong to the same Periodic Group and where the frequencies of A and B are not too dissimilar. Dr. H. G. Howell points out that this result follows if the force constant is considered to be the same for molecules within a given group.

Prof. K. Herrmann prefers to ascribe certain discrepancies in the X-ray scattering factors of zinc and of cadmium to the asymmetry of the atoms rather than to lattice vibrations, and gives reasons for his preference. Dr. G. W. Brindley, in reply, maintains his opinion that the lattice vibrations are responsible for the asymmetry and considers that, while the outermost electrons of the zinc and cadmium atoms may depart from spherical symmetry, the inner complete electron shells are not likely to do so.

Research Items

Cultural Associations of Solo Man

DR. P. VAN STEIN CALLENFELS has directed attention (*L'Anthropologie*, 46, 3–4) to the character of certain of the artefacts associated with the skulls of Solo man, when these were found in the alluvial gravels of the River Solo at Ngandong, Java, which apparently are of later date than the gravels of Trinil, from which *Pithecanthropus* was derived. The artefacts were scattered over an adjacent area of about fifty metres. They consisted of worked stones of an indeterminate character, and a number of implements of bone and staghorn (chiefly *Cervus Lydekkeri*) with a quantity of bones, for the most part broken. Their contemporaneity with Ngandong man, it would seem, cannot be questioned. They are now in the Bandoeng Geological Museum of Batavia. A flat harpoon with bilateral barbs would be sufficient alone to justify a comparison with the late Azilian harpoons of Scotland, while certain rare forms of Maglemosian harpoon would also serve for comparison. Even more surprising, however, is the association at Ngandong of these archaic skulls with axes of staghorn, of which analogies can be found only in the Mesolithic. The most ancient reindeer horn axes known have been found in northern Europe and belong to the civilization of Lyngby, the first stage of Childe's Forest Culture. At Ngandong the stem of the horn forms the handle and one of the tines forms the blade of the axe. The Lyngby culture belongs to the pre-Boreal post-glacial, and is a little later than Azilian, say 7000–8000 B.C. While all reserve must be shown in comparing two cultures so far removed from one another as that of Ngandong in Java and the Lyngby culture of northern Europe, in estimating the age of Solo man at Ngandong, the associations of artefacts of similar type in Europe must not be forgotten.

Tibetan Blood Groups

PROF. R. RUGGLES GATES, in studying blood-groups of American Indians, has been led to seek an Asiatic people of similar physiognomy, who might be sufficiently high in the O blood-group to have been ancestral to the Indians. One such people, whose blood-groups are wholly unknown, are the Tibetans. Material was obtained through Capt. David Tennant, I.M.S., stationed at Gyantse, Tibet, and the results of its examination are recorded by Prof. Ruggles Gates in *Man* of July. The results, both unexpected and unusual, are as follows: O, 28, 14·9 per cent; A, 88, 47·1 per cent; B, 26, 13·9 per cent; AB, 45, 24·1 per cent; total, 187. By applying the formula $\sqrt{N} = \sqrt{(A+O)} + \sqrt{(B+O)} - \sqrt{O}$, it is evident that the results do not depart significantly from expectation in a homogeneous or well-mixed population. Of the numerous blood-grouping results listed by Steffan, only one has a higher percentage of AB—a series from South Hungary. Some of the Ainu show 25 per cent AB, while the Japanese usually run about 10–15 per cent and some Russian communities have about 15–20 per cent AB. It is evident that these results, the first to be published from Tibet, show that the Tibetans are at the opposite pole from the Americans. No record from any other race shows such a low percentage of O. Another peculiar feature is that AB is nearly double the frequency of B. The percentage of A appears to be the highest recorded for Central Asiatic peoples, being definitely higher than the Chinese, and much higher than the Hindoos. A higher percentage of A is found only in peripheral peoples, such as the Lapps, Bushmen or Australian aborigines. The Tibetans are then well saturated with the blood-groups, and the result is such as might be expected from a people originally very high in A meeting a people, such as the Chinese, with a high proportion (c. 35 per cent) of B.

Reindeer Grazing

IN relation to the pastoral possibilities of the North-West Territories of Canada, some conclusions drawn by Mr. E. Porsild, who has spent several years in charge of experimental herds of reindeer, are contained in an article in the *Geographical Journal* of July. Apart from lake areas and rocky ground that exclude large areas, the ubiquity of insect pests, notably the mosquito, seems to be the limiting factor. Except in the arctic archipelago and along the sea-coast of the mainland, flies and mosquitoes occur throughout the North-West Territories in such enormous numbers during the short summer that "neither the reindeer nor the hardiest of herders can endure their movements". The only escape from these pests is to move the herds to the sea-coast in June and July. There are no hills of sufficient height to be clear of mosquitoes. However, all the Canadian Eskimo tribes without exception live on the coast, and are thus potential reindeer herders. Mr. Porsild considers that among the areas suitable for reindeer grazing, the best is on the west coast of Hudson Bay. An area east of the Mackenzie delta will support great herds, and is now in use. So far, the introduced Alaskan reindeer seem to be doing well.

German Copepods

DR. OTTO PESTA has completed his account of the copepods of Germany and adjacent seas ("Die Tierwelt Deutschlands und der angrenzenden Meeresteile nach ihren Merkmalen und nach ihrer Lebensweise". By Prof. Dr. Friedrich Dahl and others. Teil 29. Krebstiere oder Crustacea. 1: Ruderfüsser oder Copepoda (4, Monstrilloida; 5, Notodelphyoida; 6, Caligoida; 7, Lernaeoida). Jena: Gustav Fischer. 6 gold marks). This is a specially interesting and important part of the section dealing with the Copepoda as it contains the parasitic and semi-parasitic forms. Of the Monstrillidæ, which are planktonic in the adult state and the larvæ of which inhabit polychætes (or, exceptionally, a mollusc), there are four species recorded here, and of the Notodelphyoida, which are commensals or true parasites in echinoderms, ascidians or *Cephalodiscus*, there are three species recorded. All the rest belong to the Caligoida and Lernæoida, both groups represented by numerous species. This is a most useful summary, and is well up to the standard of the former parts, the whole being an indispensable reference book for all working in these regions.

Porcine Trypanosomiasis

HOARE has shown by an exhaustive study (*Trans. Roy. Soc. Trop. Medicine and Hygiene*, 29, No. 6; 1936) that *T. simiæ* is the trypanosome responsible for acute trypanosomiasis of the pig—an animal little subject to infection by the pathenogenic trypanosomes of other domestic animals. Contrary to what was originally thought, it is a polymorphic form, which no doubt accounts for the list of aliases under which it has masqueraded. The intermediate host is the tsetse fly, *Glossina morsitans*, and possibly other species, and the reservoir host is the wart-hog. The etiology and epidemiology of the parasite are discussed.

Varietal Difference in the Potato

THE text of a lecture on "Recent Developments in Connection with the Potato", recently delivered by Dr. T. P. McIntosh before the Royal Caledonian Society, appears in the *Gardeners' Chronicle* of June 6, 13, and 20. Much work relating to the place of origin of the potato was reviewed, and some recent work in Russia suggests that the Peru-Bolivian plateau and south Chile were the two original centres. Dr. McIntosh dealt with his own work on the observation of varietal differences in potatoes, and their detection by chemical means. A test with dilute caustic potash causes the petals, or the flesh of the tuber of some varieties, to turn a vivid canary-yellow. Oxidase tests may also be applied to the tuber for the detection of certain varieties, and the variety Golden Wonder gives an electric-blue fluorescence with ultra-violet light, where other kinds appear red-purple. Characters of tuber sprouts may also be used for diagnostic purposes, and some very interesting colour correlations are set forth. Various experiments on potato breeding are described, and modern work on virus diseases, blight, and other subjects, is reviewed.

Spray Covering on Apples

A SHORT paper by Messrs. Kermit Groves and James Marshall (*J. Agric. Res.*, 51, No. 12, 1139–1142, Dec. 1935) directs attention to the fact that spray fluids applied to fruit crops are often deposited very unevenly upon the developing fruits. They show that more than a third of the total wash received by an apple fruit may collect round the depressions at the calyx and stem ends, and recommendations for estimating spray covering are set forth involving a degree of accuracy which, however, scarcely seems justified in a problem of this calibre.

Vapour Pressure of Deuterium Water

IT is known that the vapour pressure of deuterium water is smaller than that of ordinary water and that the difference becomes smaller as the temperature is raised. F. T. Miles and A. W. C. Menzies (*J. Amer. Chem. Soc.*, 58, 1067; 1936) have determined the pressures for deuterium water at temperatures from 20° to 230° C. by a differential tensimetric method. The results could be reproduced only by a five-constant equation: $\log r = -16{\cdot}998671 + 268{\cdot}8426/T + 7{\cdot}4971604 \log T - 9{\cdot}761107 \times 10^{-3} \times T + 4{\cdot}4288 \times 10^{-6} \times T^2$, where $r = p_{D_2O}/p_{H_2O}$. The normal boiling point of D_2O is calculated as 101·40° ± 0·016°. The temperature at which the vapour pressure of the two varieties of water is identical is calculated as 224·3°, which may be within 0·5° of the truth. Values for the excess of the latent heat of evaporation of D_2O over that for H_2O are calculated. They vary from 300 gm.cal. per mol. at 40° C. to 115 at 220° C. The value at 70° agrees with that found by Lewis and Macdonald for measurements between 20° and 90°.

Exchange Reactions with Isotopes

E. OGAWA (*Bull. Chem. Soc. Japan*, 11, 367, 425, 428; 1936) has described some experiments on the interchange of hydrogen and deuterium in urea, glutamic acid and asparagine and also in carbohydrates, and on the isotopic separation of oxygen, chlorine, bromine and nitrogen by chemical methods. In a further communication to the Editor, he claims to have achieved a separation of nitrogen isotopes by the following method. One kgm. of ammonium chloride (Sample *A*) in 3 litres of water was converted into ammonia (assumed to be NH_3OH_2) by the weighed amount of caustic soda. The ammonia was distilled off and the ammonium chloride was decreased to 47·5 gm. (Sample *B*). This was again decreased to 1·34 gm. (Sample *C*). By interaction with silver nitrate the atomic weights of nitrogen in the samples were determined as 14·002 (*A*), 14·023 (*B*) and 14·105 (*C*). Samples *B* and *C* would then contain 1·61 and 10·5 per cent, respectively, of N^{15} and the separation coefficients would be 5·0 and 3·1. The method depends on a theory of the author according to which the element is richer in heavier isotope when it is in the more positively polarized state. The interchange reaction is $N^{14}H_4{}^{+}Cl^{-} + N^{15}H_3OH_2 = N^{15}H_4{}^{+}Cl^{-} + N^{14}H_3OH_2$.

Plaster of Paris

IT has generally been assumed that plaster of Paris is the hemihydrate of calcium sulphate, $CaSO_4, \frac{1}{2}H_2O$, which on setting takes up water to form gypsum, $CaSO_4, 2H_2O$. Some recent investigations on various lines have been held to show that the water in gypsum is lost on dehydration without any intermediate formation of a lower hydrate, and thus it necessarily follows that plaster of Paris is not a definite hydrate but contains water bound in the state found in zeolites. H. B. Weiser, W. O. Milligan and W. C. Ekholm (*J. Amer. Chem. Soc.*, 58, 1261; 1936) have now published results of X-ray diffraction studies which seem to show that the hemihydrate and dehydrated hemihydrate have not identical structures, as has been asserted. The X-radiograms of the two substances are similar, showing that the structures are similar, but the existence of definite characteristic differences between the two patterns indicates that the water molecules in the hemihydrate occupy fixed positions in the lattice. The results support the view that the hemihydrate is a definite chemical individual, and that the process of dehydration is not zeolitic in character. The isobaric dehydration curves of gypsum also show a very definite break at the composition of the hemihydrate, although both this and anhydrous calcium sulphate adsorb water. The failure of some previous investigators to notice the difference in the X-ray patterns may be due to the use of too small cameras, molybdenum radiation, and failure to use a reference material for standardizing the films. There can be no doubt, the present authors state, that significant differences exist between the X-radiograms of the hemihydrate and its dehydration product when use is made of a relatively large camera, copper radiation, and a standardizing material, and when special care is taken to avoid rehydration of the dehydrated hemihydrate.

Second International Congress for Microbiology

THE week of July 27–August 1 saw more than a thousand microbiologists from all over the world united in conference at University College under the presidency of Dr. J. C. G. Ledingham, director of the Lister Institute. Six years have elapsed since the first Congress in Paris, the original triennial plan having fallen through for reasons which, in view of the world-wide political and economic unrest, may readily be imagined. Much new and important work was therefore ripe for discussion, and the scientific programme had to be divided into no less than eight sections, devoted each to a special subject.

Section 1, under the presidency of Prof. E. Gotschlich, formerly of Heidelberg and now of Ankara, Turkey, dealt with the general biology of micro-organisms. Selective bacteriostasis (the inhibitory action of such substances as dyestuffs and the products of their own metabolism on the growth of bacteria and fungi) and the preservation of micro-organisms in suspended animation, so to speak, by drying in the frozen state were two of the subjects most actively discussed. Their importance is both theoretical and practical: the latter subject especially, interesting in itself in its implications as regards resting states in more highly organized living creatures, has become practically valuable, since it has been realized how subject to variation the unicellular microbe is during culture in the laboratory, particularly variation by loss of such original properties as virulence.

Section 2, devoted to the viruses and virus diseases in animals and plants, under the presidency of Prof. Doerr, of Basle, had perhaps the greatest body of observations to consider, nearly all new since 1930. The five days of discussion, on the general characteristics of viruses, on the modes of transmission and paths of infection in virus diseases, on the evidence concerning the agency of viruses in the ætiology of new growths and on the mechanism of immunity in virus infection, with its practical applications, might alone have furnished material for a congress. Besides the plant diseases in which 'virus' was first discovered, the common cold and influenza, foot-and-mouth disease of cattle, psittacosis, hydrophobia, yellow fever and malignant tumours were all considered in the light of their experimental production by filtrates from which all but 'ultra-microscopic' life had been removed. Astonishing progress was reported in measuring particles of living matter possessing such pathogenic properties, particles not much greater in size than the molecules of comparatively simple chemical compounds, in purifying them and in studying their behaviour in the body fluids of infected and immune subjects: it is gratifying to note how much of it lies to the credit of British research work.

As Bordet put it, in his address as past president to the general assembly of the Congress, "il n'est point de problème plus passionnant, puisqu'il comporte l'étude de la vie dans ces mystérieuses profondeurs où les dimensions deviennent tellement petites que parfois l'on se demande si l'on est encore en presence d'êtres vivants et si les phénomènes qu'on observe ne sont pas dûs à des principes chimiques doués de propriétés imprévues." Yet these particles have been rendered visible and, as 'elementary bodies', have been collected in suspensions of which a dilution of a millionth or more may still produce disease, and multiply indefinitely. Whether they can so multiply apart from the living tissue is yet unsettled: it seems rather that their reproduction is inseparable from the living cell and may indeed be actually a derangement of the cell's own life process.

Section 3, on bacteria and fungi in relation to disease in man, animals and plants, under the joint presidency of Dr. E. J. Butler of the Agricultural Research Council and Prof. H. Zinsser of Harvard, seemed almost staid and commonplace after such adventures in the unknown. Its subjects of highest interest, perhaps, were (1) the general one, on the significance of serological and cultural types of the pathogenic bacteria and fungi in relation to epidemic, epizootic and epiphytotic outbreaks of disease, and (2) the special discussion on the pathogenic streptococci which appear to cause more varied and widespread human misery and death than any other bacterial species.

Section 4, on economic bacteriology, under the presidency of Prof. R. E. Buchanan of Iowa, U.S.A., had to be divided into three subsections: (*a*) dairy, (*b*) water, including sewage and industrial fermentations, and (*c*) soil microbiology. Each of these had its own specialists conferring on its particular problems, but joining with the other subsections for discussion of a subject of general interest, the metabolism of yeast.

In Section 5, on medical, veterinary and agricultural zoology, with Prof. E. Brumpt of Paris as its president, the most active discussion was that on typhus fever and the rickettsias, with chemotherapy of protozoal infections as a close second. The author of "Rats, Lice and History", Prof. Zinsser, appropriately opened the discussion on the former. The similarities and differences, clinical and serological, in the great 'typhus group' of fevers have all been defined in quite recent years; the biology of the infecting microbes, the rickettsias, is, moreover, of particular interest in relation to life-cycles in bacteria, a fascinating field scarcely yet open to exploration.

Section 6, on serology and immunochemistry, was to have been presided over by the arch-priest of the doctrine of antigenic specificity, Prof. Landsteiner of the Rockefeller Institute. Unfortunately prevented, he was replaced by Dr. P. Hartley of the National Institute at Hampstead, himself a serologist of distinction. The study of antigenic structure—and especially of the structure of the new synthetic antigens, the subject of a joint discussion with Section 7—as the new tool for investigating the architecture of living matter, took almost the whole week of the section's time, though it found a day for the significance of allergy in disease, both as a general hypothesis in pathology and as an explanation of such special cases as the cotton-dust asthma, recently elucidated by Prausnitz in Manchester.

Section 7, on microbiological chemistry, had, naturally, Sir Arthur Harden as its president, and a particularly long and varied list of contributions, ranging over growth factors in bacterial culture to the influence of substrate on the chemical potentialities of the cell.

Section 8, on specific immunization in the control of human and animal diseases, was presided over by the veteran Prof. W. H. Park of New York. Its programme was the longest of all, since its subject is the immediate practical concern of health officers in every country, all of them anxious to compare notes and to learn new methods in the prophylaxis of disease. Whooping cough, pneumonia, cerebrospinal fever and the streptococcal infections already mentioned were the chief human diseases in which progress was reported in protective and curative immunology, while in veterinary practice the various anærobic infections, especially, had victories to relate since 1930.

So much for the set discussions: perhaps even more valuable, since they dealt with speculations too young and tender for the rough handling of public debate, were the private conversations during the afternoons free from open sessions. How many of these there were, one can judge only from observation of numerous groups of well-known workers with their heads together in eager talk. Such intercourse may well be the most fertile of all the Congress activities.

A full programme of 'scientific visits' had been arranged for the Congress members and most of the well-known institutes for microbiological research in and near London were 'at home' to visitors on at least one day during the week. The Ladies' Committee had, in addition, organized general excursions for sight-seeing round London which proved extremely popular. The Universities of both Oxford and Cambridge invited and entertained with generous hospitality large parties of Congress visitors.

The Congress closed on August 1 with a plenary session at which resolutions for the alteration of the name and statutes of the original International Society for Microbiology were adopted. Future triennial congresses are no longer only one of the activities of a society, in the sense of a body of society members, unlimited in number, but of a new 'Association of Microbiologists', limited in function mainly to congress organization and in number to one delegate from each participating country. Under the new constitution, the United States invited microbiologists to a congress in 1939 to be held in August on the Atlantic seaboard, and this invitation was accepted by the plenary session with acclamation.

Fruit Supplies in 1935

UNDER the above title, the Imperial Economic Committee has issued a comprehensive supplement to its weekly fruit intelligence notes (London: H.M. Stationery Office, June 1936. 2*s.* 6*d.* net). It will surprise most citizens of the United Kingdom to know that only 79 lb. of fruit per head of the population was eaten in 1935, as against an average of 96 lb. in 1934. Imports of raw fruit, however, exceeded those of any previous year, and made a total of 1,480,000 tons. It is gratifying from an Imperial point of view that 53 per cent of this quantity came from Empire countries overseas, and the amount from this source was greater than the total imports from all sources in the years immediately preceding the Great War.

Home supplies show a rather disturbing variation from year to year, though the acreage under fruit crops does not fluctuate greatly. This is shown in the accompanying table, compiled from information on pages 12 and 14 of the volume, and relating to the orchards and small fruit in England and Wales:

Year	Acreage	Yield, in cwt.
1929	313,295	11,098,000
1930	313,188	10,116,000
1931	306,801	5,871,000
1932	306,839	5,896,000
1933	309,553	9,445,000
1934	315,890	16,217,000
1935	321,963	4,387,000

If the yearly amount of home-produced fruit could be made more or less stable, the consumer would have the benefit of an increased, healthy diet of fruit, whilst the home producer and the importer would find a more uniform and workable market. The reason why the average consumption of fruit was 17 lb. more in 1934 than in 1935 seems to be that there was more than 3½ times the quantity from home sources in the former year than in the latter. Imports could not account for the increased consumption, for 27,069,000 cwt. of fruit came into the country in 1934, and only a slightly larger amount, 29,593,000 cwt., in 1935. Damage by frost may possibly explain the extremely low yield of 1935, though it was not wholly responsible for the small quantities produced in 1931 and 1932. It remains a potent factor, however, as a cause of fluctuating yield, and is beginning to receive the scientific study it deserves.* The so-called "biennial habit" of fruiting, where a year of high yield is followed by a lean season, is not obvious in the returns set forth above. Could not the growers and scientific workers of the country turn their attention to this rather obvious gap in the development of scientific distribution and controlled cropping?

"Fruit Supplies" gives very extensive analyses of the imports of fresh fruit, vegetables, flowers and bulbs into the United Kingdom, and reviews the output of various sources of supply. A useful feature is the statistics of imports into other countries, and the survey should be welcomed by all who are interested in watching the development of Empire resources.

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* For example: B. O. Mulligan, "The May Frosts at Wisley", *J. Roy. Hort. Soc.*, **60**, 10 (Oct. 1935); A. N. Rawes, "An Orchard-heating Experiment", ibid., **60**, 11 (Nov. 1935); J. Grainger and A. L. Allen, "The Internal Temperature of Fruit tree Buds", *Ann. App. Biol.*, **23**, 1 (Feb. 1936); T. N. Hoblyn, "Spring Frosts at East Malling 1915–35", Ann. Rep. East Malling Research Station for 1935 (May 1936).

The Hammond Organ

By Sir James Barrett, K.B.E., C.B., C.M.G.

A GENEROUS but anonymous donor has just presented a Hammond organ to the University of Melbourne; and as I am interested in music, especially orchestral music, I am glad to testify to the excellent results obtained from it. The instrument itself is about the size of a small harmonium; it has two manuals and a pedal register, and a foot lever for producing variation in volume. When used fully, the volume of tone is very great, but the musical beauty of the instrument lies even more in the solo stops or arrangements. The clarionet stop produces something superior to any clarionet I have heard, and the volume of tone can be altered at pleasure. The oboe and violin equivalents are very satisfactory.

By combining the various overtones it is obvious that any instrument can be imitated and even improved. The only adverse criticism I have heard is that when the instrument is used fortissimo it is apt to produce a somewhat raucous tone, but that is a matter for the organist to rectify. As the instrument costs about £800, it seems unlikely that many expensive pipe organs will be built in future; and I have no doubt that the Hammond organ represents the commencement of a new development in music.

The following account of the mechanism was kindly furnished me by the professor of physics in the University of Western Australia, Dr. A. D. Ross:

"A synchronous motor rotates at constant speed a shaft provided with sixty-one iron disks, each fitted with a series of projections like teeth. The speed of rotation and the number of projections is such that for any disk the number of projections passing a given point per second is equal to the frequency of the note represented by the disk. When a key of the keyboard is depressed, a magnet is brought close up to the circumference of the associated disk. The passage of the projections of the iron disk causes periodic fluctuations in the magnetic field of the magnet, and consequent induced current in a coil wound on the pole piece of the magnet. The electromotive force for this current varies harmonically, so that the current when supplied to a loud speaker gives a sine-wave movement to the speaker diaphragm and therefore a pure tone. (Unfortunately the material of the diaphragm has its own natural harmonics which are introduced to a slight extent into the tone, and this is one of the chief practical defects in the instrument.)

"When the key middle C of the keyboard is depressed, not only is a magnet brought up to the disk corresponding to frequency 256, but other magnets to the disks for 512, 768, 1024, etc. (the overtones). Each gives alternating electromotive forces with the above-mentioned periodicities, and resultant currents. These currents all pass through separate variable resistances, controlled by the draw-stops (each of which can be moved in or out in eight stages) and so one can utilize the series of electromotive forces corresponding to frequencies 256, 768, etc., in any desired degree of intensity. When the electromotive forces, so adjusted, are applied to a circuit, a current flows with fluctuations corresponding to all the effects superposed. This is amplified and transmitted to the loud speakers, which must produce a sound which has the same fluctuations and is the combination tone with the several harmonics present in the arranged proportions.

"The sounds given out by orchestral instruments have been investigated by recording the air pressure fluctuations in each wave. These waves are then analysed by Fourier analysis, either mathematically or experimentally, and the harmonics present are found and their relative intensities. (The problem is identical with that of tidal analysis.)

"The Hammond organ can undoubtedly produce a wealth of tone shades different from those of any known instruments. I found it most interesting when experimenting with it to alter a tone in a series of steps (each of which was in itself practically imperceptible) from that of a clarinet to that of the flute or oboe."

Industrial Use of Electric Batteries

ELECTRICAL engineers have recently been considering the relative merits of vehicles driven by electric batteries and of those driven by petrol. Considerable difference of opinion exists on this point, and so the paper by Dr. Strohe, of Cologne, a translation of which appears in *World Power* of June, is of value as he gives the results of practical tests on the two classes of vehicle.

Dr. Strohe summarizes the relative performances of an electric and a petrol vehicle as follows. Electric vehicles have a life of twenty years and their maintenance costs are five per cent. Petrol vehicles have a life of ten years and their maintenance costs are ten per cent. The 'fuel' costs of the latter are about four times greater than that of the former. The capital cost of the large electric vehicle is now lower than that of a petrol vehicle of similar loading capacity, and in addition the oil required is less and the tires last longer. The economic advantages, therefore, are in favour of the electric vehicle. The results show that the daily performance of an electric commercial vehicle after several years' use lies between 18 and 24 miles, and it can double this distance on one battery charge. Electrical vehicles are now available with speeds up to twenty miles per hour; but the radius can be extended by increasing the size of the battery. Increasing the size of the batteries is only advantageous when the batteries are in full-time use. Otherwise the heavier batteries mean additional non-paying load.

When the huge alternating current network of the Grid supply was completed, many thought that there would be little further use for storage batteries in connexion with lighting supply. Having practically obtained standardization, it is most unlikely that Great Britain will ever drift back into the large variety of voltages and systems of supply which existed before the advent of the Grid. There have been a few breakdowns and blackouts since the early years of its working, but their number is diminishing. In *Electrical Industries* of May 6, E. C. McKinnon raises the interesting point whether their number is not a secondary consideration to the question of the possibility of their ever occurring at all. The national supply is now so great that to consider emergency duplicates or alternatives for all of it is impracticable, but there are many sections of the community which might be imperilled in the absence of light and power. Statistics show that the list of installations where an alternative supply has been provided so as to be available in the remote possibility of the cutting off of the main supply by storm, riot, enemy's action, etc., is rapidly mounting. Engineers who have been studying the question of emergency plant recognize that there must be no appreciable time lost after a breakdown in putting it into commission.

It has been customary in the past to regard the average working life of a battery of the stationary type to be something over ten years. But this assumes that the battery has been working during this period. A battery that is only used for standby purposes has a much longer life. It is unlikely that any system of telephone supply would be run solely from the public mains. There is always a storage battery in reserve and so continuity of supply is assured. Proprietors of cinemas are compelled by law to instal a lighting supply secondary to the main supply.

The use of the storage battery as the nucleus for the alternative supply is now firmly established. In several hospitals the storage battery is introduced as a means of assuring constant illumination. The chances of interruption of the public supply are very small, but the outlay required to ensure an unfailing brilliant illumination by a storage battery with automatic control is not a serious item and might possibly save the life of a patient. In stores and public buildings the object of installing automatic emergency lighting devices is to prevent panic amongst those present and the prevention of pilfering should there be a breakdown of the main supply.

In central electric stations and electricity works standby batteries are much used to help carry over the peak loads and so delay the inevitable purchase of more generating plant. A large standby battery in a London supply station was kept fully charged by allowing a 'trickle' of current to flow continuously through it. When recently subjected to the annual examination it was found, for all intents and purposes, to be equal to new after nine years' running.

Turf Nurseries

THE experimental planting work carried out by Sir John Stirling Maxwell at Corrour in Inverness-shire over a long period of years has attained an almost, if not complete, world fame. It was a study of the Belgian system of turf planting which gave Sir John his first successes at Corrour. Since then he has inaugurated what may be considered a sound technique in afforestation work in this type of country.

Sir John has now applied the wide experience gained to the nursery. In the *Scottish Forestry Journal*, 50, Pt. 1 (Edinburgh, March 1936), he describes his method in an article entitled "Turf Nurseries". It is obvious, says the author, that the method has a restricted application; it can only be practised where peat beds are available. The method was suggested by the ease with which it was found possible to move trees planted on upturned turfs for several years after planting. The method is described as follows by the author:

"An area of peat is selected free from roots and boulders. Nothing is more suitable than the *Molinia* flats which are found on nearly all Scots moors. Turfs are lifted and turned over in continuous rows, leaving a space between the trenches from which they are taken just wide enough to carry the line of upturned turfs. These nurseries are best prepared in the autumn and planted in the spring, but this is not essential. The plants are inserted in the centre of each turf, a plug being cut out by a circular spade. A dressing of manure mixed with sand or gravel is applied to the roots of each plant. The plug is broken up and used to fill up the hole. Well-grown 2-year seedlings are the best plants for the purpose. As regards species, we have hitherto only used Sitka and Norway spruce and *Contorta* pine, but Japanese larch, which grows well on certain types of peat, should be equally suitable. As regards the size of nurseries, the ideal arrangement would be to have each nursery just large enough to plant an acre so that no plants would have to be carried more than thirty yards. In practice we have generally found it more convenient to make the nurseries rather larger, since the number of suitable sites is limited. After two years' growth in the nursery the plants are ready to move. They are carried on hand barrows, six or eight turfs to a barrow. Enough plants are left in position to make the nursery part of the wood. For Sitka we leave every fifth plant in every other row. For Norway every fourth plant. The remainder are set out at whatever distance is desired. If the heather is long a space has to be cut or pulled for each turf. Sometimes on very steep slopes it is necessary to make a nick to prevent the turf sliding downhill. The setting out is usually done as soon as the second year's growth is complete. It may be asked why the turfs are not cut where required and placed at once in their permanent positions. The answer is that there is great economy in concentrating all the preparatory work in one spot. Also the turfs are heavy to handle when first cut, whereas after two years' exposure they become much lighter."

Sir John states that the advantage of the system is that the plants receive no check at any stage in their growth; that the method can be used with success on ground where planting in pits or notching would result in prolonged check; and finally, where draining is required, it does not make up for the lack of it. The author discusses the types of countryside on which he thinks the method is applicable. He says that the turf nurseries require little shelter. Nurseries placed on exposed salients at 1,600 ft. in Scotland have produced plants which "would do credit to any lowland nursery". As regards manures, the old Belgian recipe of one part of slag to seven of sand has given the best results.

Sir John is modest, and thinks the scope of the method is limited. This is by no means so certain. There are parts of the Empire, by no means restricted to peat lands, where it is possible that this type of nursery rearing of plants might be applicable both with success and cheapness.

Educational Topics and Events

CAMBRIDGE.—Applications for a John Lucas Walker studentship in pathology are invited and should be sent before September 30 to Prof. H. R. Dean at the Department of Pathology, to whom requests for further information regarding the studentship may be addressed. This studentship will be tenable for such period and will be of such annual value not exceeding £200 as the professor of pathology with the approval of the Managers may determine.

The Board of Management of the Frank Edward Elmore Fund will shortly proceed to the award of not more than three or four studentships for research. The studentships are open to male graduates of any University in any country who were born at any place within the British Empire other than Scotland. The students first appointed will work in the Department of Medicine under the direction of the regius professor of physic. The commencing salary will be £300 a year.

At Clare College, Prof. R. S. Hutton, Goldsmiths' professor of metallurgy, has been elected into a professorial fellowship.

At Emmanuel College, the external studentship offered to graduates of other universities intending to commence residence as research students in October next has been awarded to C. O. Hutton of Otago University, New Zealand, for research in geology.

SCIENTIFIC research is made self-propagating by the peculiar methods in use by the Wisconsin Alumni Research Foundation. As explained in "A Decade of Service" recording achievements of the first ten years, 1925–35, of the Foundation's existence, this trust started with no invested capital but only a patent application belonging to one of the University professors, Dr. Harry Steenbock. The application, then pending before the United States Patent Office, related to the use of ultra-violet rays to enrich the vitamin D content of foods and medicinal products. A corporation was formed to exploit this patent and any others that might be similarly acquired from members of the University. In ten years the earnings of the Steenbock patent alone have enriched the University by nearly 700,000 dollars and provided an endowment worth more than 125,000 dollars a year for the future needs of research.

Science News a Century Ago

Use of Coal in American Steam-boats

ACCORDING to Admiral Preble, up to the year 1834, steam-boats in the United States burnt wood only. On August 18, 1836, *The Times* published a note from the *New York Evening Star* about the steam-boat *Novelty*, which said that "recent successful experiments of driving this boat, of the largest class, with anthracite coal, against the tide and a strong current at 16 miles an hour has caused much remark in the city, as an astonishing fact of great importance on the subject of fuel which may lead to revolutions in steam navigation. Dr. Knott, the distinguished president of Union College, is the proprietor of the *Novelty*, which he constructed, we believe, with machinery after his own ingenious invention. The fact of the practicability of using anthracite being now ascertained so as to produce as great a degree of heat as pine-wood, will no longer compel steam-boat proprietors to import their wood at exorbitant prices from the remote forests of Maine and the shores of the Chesapeake. Nearby, and almost at our doors, we have the anthracite coal mines of Pennsylvania, of every possible variety, in exhaustless quantities. The successful navigation of the Atlantic from America to Europe is made certain. Wood is now selling at the Hudson, at five or six dollars a cord. The cost, in fact, of pine-wood is about double that of anthracite."

Progress of Ballooning

IN 1836, balloon ascents were very frequent, and considerable sums were paid by passengers desiring to make an aerial voyage. The subject was one of great public interest, and on August 18, 1836, *The Times* in an article on "Aerostation" gave a chronological account of some of the landmarks in ballooning. In this article it said on September 19, 1736, J. Montgolfier sent up a balloon in Paris, filled in eleven minutes with the smoke of burnt straw and wool. Montgolfier then made a balloon of spherical form 45 feet in diameter and 75 feet high in which Pilatre de Rozier ascended, he having the honour of being the first aeronaut. On December 1, 1783, a balloon filled with hydrogen gas took up aeronauts in the persons of MM. Charles and Robert. In 1784 Madame Thible ascended at Lyons before the King of Sweden. She was the first aeronaute. On June 18, 1786, Mr. Festin ascended from Paris, and remained a whole night in the sky. On November 25, 1783, the first ascent in England was made by Count Zambecarri, from the Woolwich Artillery ground. He descended at Petworth. On September 21, 1784, the Chevalier Lunardi made the first ascent from London. On January 7, 1785, Mr. Blanchard and Dr. Jeffries, an American physician, ascended at Dover and descended near Calais. After referring to the use of balloons in military operations, the article concluded with the observation that balloons have not justified the expectations they raised.

Death of Edward Turner Bennett

ON August 21, 1836, Edward Turner Bennett, secretary of the Zoological Society, died at the early age of thirty-nine years. Born at Hackney on January 6, 1797, he was trained as a surgeon, and practised for several years near Portman Square. He devoted himself with the greatest ardour to the study of zoology. He took an active part in forming an entomological society and the Zoological Society. Of the latter he was at first vice-secretary, and from 1831 until his death the secretary. He contributed many papers to the *Transactions of the Zoological Society* and published "The Tower Menagerie" (1829) and the "Gardens and Menagerie of the Zoological Society" (1831). He also prepared an edition of White's "Natural History of Selborne", with numerous notes, which was published after his death. "From the affability of his manners and general scientific and literary attainments," said one writer, "he was highly respected by a numerous circle of friends."

The British Association at Bristol

THE sixth meeting of the British Association took place at Bristol during the week August 22–27, 1836. The proceedings were fully dealt with in the *Athenæum*, which published several double numbers. On Thursday, August 18, the correspondent of the journal wrote : "There is every fair prospect that the meeting will rival that in Dublin, both in the number and the high scientific character of its members. . . . Upwards of 600 new members were enrolled up to Wednesday evening. . . . As far as can be at present foreseen, Geology and Mechanical Science are likely to be the most important Sections. Reports are current that the Rev. Mr. M'Gawley's discovery of the possibility of deriving a motive power from electromagnetism . . . has received a new and important extension which may make sad havoc with steam and railway speculation—but on this subject your readers will soon be able to judge for themselves". Writing again on August 20, the correspondent said that the General Committee had received a letter from the Marquis of Landsdowne expressing his regret that he would not be able to take the chair owing to the illness of his son, and the committee had therefore elected the Marquis of Northampton as vice-president. "It was gratifying," he added, "to observe that all traces of the temporary estrangement of Sir David Brewster from his colleagues on the Council had disappeared".

Societies and Academies

Dublin

Royal Irish Academy, June 22.

C. F. HUMPHRIES and W. E. FROST : The Chironomid fauna of the mosses of the River Liffey. Quantitative samples of mosses were taken from the River Liffey (Ireland) from two contrasting stations ; one where the water was acid and one where it was alkaline. The species of Chironomid larvæ found in the mosses were identified ; the Orthocladiariæ constitute more than ninety per cent of the fauna at both places. The larval Chironomidæ are equally abundant in the acid and alkaline waters, and show only minor qualitative differences. Some notes on the seasonal distribution are given. Four new types are described and figured.

ARTHUR HOLMES : New analyses of Tertiary igneous rocks (Antrim and Staffa). Pending the publication of certain investigations by Dr. F. Allison and the author, it was thought desirable to make available four new analyses of rocks, made in the course of that work. Three of these are from Co. Antrim, namely, rhyolite, Tardree Mountain ; olivine-dolerite, Portrush Sill ; and basalt, Giant's Causeway. The fourth is the olivine-basalt of Fingal's Cave, Staffa.

JOSEPH ALGAR : The synthesis of diflavonols. Diflavonols may be synthesized by treating dihydroxy-dichalkones, such as dibenzylidene-diacetoresorcinol, with aqueous alcoholic sodium hydroxide and hydrogen peroxide. In this manner the following have been prepared, with satisfactory yields :—diflavonol ; 4′.4″-dimethoxy-diflavonol ; 3′.4′-3″.4″-tetramethoxy-diflavonol ; 3′.4′-3″.4″-dimethylene-dioxy-diflavonol. Since dihydroxy-dichalkones are readily obtained from diacetoresorcinol and the suitable aldehyde, the reaction affords a convenient general method for the synthesis of diflavonols.

Brussels

Royal Academy (*Bull. Classe Sci.*, No. 4, 1936).

G. CESÀRO and J. MÉLON : On cryolite. Refractive index, birefringence perpendicular to various faces and crystalline forms.

J. E. VERSCHAFFELT : The thermo-mechanics of the surface layer. (1) Generalities. (2) The adsorption formula. (3) Mixed phases.

E. DE WILDEMAN and E. VERLEYEN : The budding of the epiphylous tissues in some monocotyledons.

M. DEHALU : Bernstein's theory relating to the hereditary probabilities of blood groups.

L. GODEAUX : Some involutions belonging to the generalized Humbert surface.

P. GÉRARD : The homology between the sense organs of the lateral system and those of the vestibular system in the teleosteans.

P. L. CATTALA : Photo-electric recording of the time of passage of stars. Preliminary theoretical study : variation of the luminous flux through a reticule at the passage of a stellar image.

R. CORDIER : The cutaneous sense organs of *Protopterus*.

G. VAN LERBERGHE and P. GLANSDORFF : Contribution to the thermodynamics of open systems.

E. ANGLADE : Flecnodal surfaces of a ruled surface.

L. DERWIDUÉ : Linear congruence of conics.

B. GAMBIER : Study of the cubic surfaces which can possess Eckardt points.

J. L. DESTOUCHES : Role of the notion of stability in physics.

L. MARTIN : Problems of the limits relative to certain systems of partial differential equations.

G. SOKOLOFF : Singular trajectories in the problem of three bodies which attract each other proportionally to their masses and to a function of the distance (2).

M. LECAT : Remark on the note entitled : "The logical foundations of the theory of probabilities", by S. Avsitidysky.

JEANNE HENRY-CORNET : Study of the absorption spectrum of bilirubin.

Cracow

Polish Academy of Science and Letters, May 4.

G. GIRAUD : A property of certain generalized logarithmic potentials.

J. WEYSSENHOFF and A. BIELECKI : Quaternions, rotations in space of four dimensions, and the formula of Cayley.

M. MIESOWICZ : The influence of the magnetic field on the viscosity of liquids in the nematic phase. A magnetic field produces a marked increase in the viscosity of *p*-azoxyanisol and *p*-azoxyphenetol in the nematic phase.

B. Kamienski and J. Inglot : (1) The dielectric potential and surface tension of cholic acid solutions with different concentrations of hydrogen ions. (2) The influence of the hydrogen ion concentration on the dielectric potential of a solution of potassium chloride.

K. Smolenski and W. Kozlowski : The rotatory power of alkaline solutions of saccharose.

Mlle. R. Ludwiczak and J. Suszko : Alloquinidine, a carbinol base derived from quinidine.

J. Suszko and M. Wdowicki : Naphthalylmalonic ether and peri-naphthindandiono-carboxylic acid.

K. Konior : The profile of the Dziedzice Pleistocene.

M. Ksiazkiewicz : The structure of the Lanckorona zone.

M. Mereminski : The development of the embryo-sac in *Begonia incana*. Contribution to the embryology of the genus *Begonia*.

S. Mikulski : The influence of alternating temperatures on the development of the eggs of batrachians : *Bufo americanus* and *Ambystoma tigrinum*.

J. Zacwilichowski : Researches on the innervation and the sensorial organs of the wings of *Isopteryx tripunctata*.

T. Garbowski : The repetition of instinctive acts generally done once only. Remarks on some experiments on Dicranura and Cerura approaching the chrysalis stage.

June 8.

G. Giraud : A generalization of logarithmic potentials of a double layer.

A. Jagielski : The dielectric polarization of the liquid chloronitrobenzenes.

S. Dobinski and J. Wesolowski : The density of liquid selenium. The density of selenium between 228° C. and 345° C. is a linear function of the temperature, and shows no sudden variations corresponding to those found by Pélabon in the electrical conductivity of this substance.

A. Ziemecki and K. Narkiewicz-Jodko : The continuity of the variation of the cosmic radiation in the upper layers of the troposphere. The results of G. A. Suchstorff were not confirmed, and the authors regard it as unlikely that radioactive bodies are present in the higher regions of the atmosphere.

M. Kamienski : Study of the motion of the Wolf I comet.

F. Kepinski : The movement of the periodic comet Kopff (1906 *e*).

K. Smolenski and S. Porejko : The *p*H of solutions of lime in water and in solutions of saccharose.

L. Marchlewski and Mlle. R. Grünbaum : Absorption of ultra-violet radiation by gossypol.

W. Goslawski : The influence of the hydrogen ion concentration on the dielectric potential and surface tension of solutions of cinchonine and cinchonidine.

J. Szaflarski : Remarks on the thermal properties, transparency and colour of the lakes of the south-west part of the High-Tatra massif.

Mlle. J. Dyakowska : The interglacial period at Poniemunie near Grodno.

T. Litynski : The estimation of nucleic phosphorus in the seeds of the bean, *Vicia Faba minor*.

Mme. W. Zablocka : The mycorrhiza in the genus *Viola*.

K. Rouppert : The leaf of *Philodendron squamiferum*.

J. Marolski and St. Smreczynski : The Coleoptera of the Pleistocene of Leki Dolne, near Pilzno.

F. Rogozinski and Zb. Glowczynski : The behaviour of some liposoluble colouring matters in the animal organism.

Moscow

Academy of Sciences (*C.R.*, 1, No. 8, 1936.)

A. Markov : Some theorems on the Abelian entities.

A. Danilevski and M. Krein : The bilinear developments of symmetrical nuclei, positive in Mercer's sense.

D. Morduchaj-Boltovskoj : The impossibility of expressing modular functions in a finite form by elementary ones.

I. Bessonov : The Brownian movement of a linear grid.

I. N. Nazarov : Splitting and isomerization of olefines indicating a tertiary radical.

M. P. Volarovich, D. M. Tolstoj and L. I. Korchemkin : A study of the viscosity of molten lavas from Mount Alaghez.

M. Neuhaus : Frequency of occurrence of spontaneous lethals in mature and immature germ cells of *Drosophila melanogaster*.

Tokyo

Imperial Academy, May 12 (*Proc.*, 5, 109–146).

H. Hombu : Theory of affinor transformations.

T. Tannaka : Existence of a Galois field with a given *p* group.

T. Nakayama : The algebras over a field with a prime number characteristic (2).

H. Kimura : (1) Provisional result of the work of the International Latitude Service in the North Parallel + 39° 8′ during the year 1935. (2) Preliminary result of the observations made at Adelaide International Latitude Station during the year 1935. (3) Preliminary result of the observations made at La Plata International Latitude Station during the period 1934.64–1935.97.

Y. Hagihara : The speed of corpuscles ejected from stellar atmospheres. The speed of ejection of an atom from a star is calculated by a quantum theoretical method which gives Milne's result as a particular case.

T. Araki and M. Kurihara : The relation between the intensity of the emission lines and the displacement towards the violet of the absorption lines in the spectrum of *P* Cygni. An empirical formula is derived from published results.

S. Nishikawa, S. Nakagawa and I. Sumoto : Slowing down of neutrons by thin layers of paraffin.

S. Akabori and T. Kaneko : A perfume containing sulphur derived from soya.

F. Homma : A method of delineating a curve representing the variation of chemical composition in a zoned plagioclase.

K. Tanaka : Remarkable glaciated rocks found in the high mountains of the central upland of Japan.

S. Endô and H. Okutsu : *Glyptostrobus* cone from the *Liriodendron* bed near Sendai.

H. Yabe and M. Eguchi : *Eohydnophora*, a new genus of Cretaceous corals.

T. Sugiura : A list of chromosome numbers in angiosperms (2).

Official Publications Received

Great Britain and Ireland

Forestry Commission. Sixteenth Annual Report of the Forestry Commissioners for the Year ending September 30th, 1935. Pp 45. (London: H.M. Stationery Office.) 1*s*. net. [167

The National Physical Laboratory. Physical Constants of Pure Metals. Pp. 27 (London: H.M. Stationery Office.) 6*d*. net. [187

University of Bristol The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1935 Pp 250. (Bristol. The University.) [187

The Hannah Dairy Research Institute. Annual Report for the Year ending 31st March 1936. Pp. 20. (Ayr: Hannah Dairy Research Institute.) [207

Technical College, Bradford. Diploma and Special Day Courses, Session 1936–1937 Pp. 257+22 plates. (Bradford Technical College) [217

The Scientific Proceedings of the Royal Dublin Society. Vol 21 (N.S.), No 35 Report of the Irish Radium Committee for the Year 1935; including Reports by Oliver Chance and Oswald J Murphy. Pp 317–332. (Dublin · Hodges, Figgis and Co., London Williams and Norgate, Ltd.) 1*s*. [227

Bedfordshire 'Vermin' Payments: concerning the Destruction of 'Vermin' by Parish Officials during the XVI–XIX Centuries, with Extracts from their Accounts. By J. Steele Elliott Pp 82+2 plates (Luton: Public Museum.) 4*s*. [227

Technical Publications of the International Tin Research and Development Council. Series A, No. 42: Opacifiers in Wet and Dry Enamels. By Dr. L. Stuckert. Pp. 31. (London: International Tin Research and Development Council.) Free. [227

Medical Research Council. Sixteenth Annual Report of the Industrial Health Research Board to 30th June 1936. Pp. ii+84 (London: H M. Stationery Office) 9*d*. net [237

The English Golf Union Year Book, 1936. (Published for the English Golf Union.) Pp xviii+176+48 (Northwood: Rawlinsons Library.) 2*s*. 6*d*. [277

Armstrong College, Newcastle upon Tyne · Standing Committee for Research. Report, Session 1934–1935. Pp 40. (Newcastle: Armstrong College.) [287

Home Office. Report of the Advisory Committee on the Scientific Investigation of Crime. Pp. 10. (London. H.M. Stationery Office.) 2*d* net. [287

International Polar Year, 1932–33: British Expedition to Fort Rae. Some General Characteristics of Aurora at Fort Rae, N.W. Canada, 1932–33. Pp. 6. (London · International Polar Year, c/o Royal Society.) [297

Other Countries

U S Department of the Interior: Geological Survey. Bulletin 847–C · The Richey–Lambert Coal Field, Richland and Dawson Counties, Montana. By Frank S. Parker. Pp. iv+121–174+plates 22–27. 35 cents. Bulletin 855: Geology and Mineral Resources of the Bellefonte Quadrangle, Pennsylvania By Charles Butts and Elwood S. Moore. Pp. vi+111+12 plates. 50 cents. Bulletin 865 Geology of the Monument Valley–Navajo Mountain Region, San Juan County, Utah. By Arthur A. Baker. Pp. vi+106+17 plates 60 cents. Professional Paper 183: Correlation of the Jurassic Formations of parts of Utah, Arizona, New Mexico and Colorado. By A A. Baker, C H Dane and J. B. Reeside, Jr. Pp. v+66+26 plates 50 cents Professional Paper 185–H: The Flora of the New Albany Shale Part 1. *Ditchnia kentuckiensis*, a New Representative of the Calamopityæ. By Charles B. Read (Shorter Contributions to General Geology, 1934–35) Pp. ii+149–161+plates 30–33. 5 cents. Water-Supply Paper 677: Ground Water in South-Central Tennessee By Charles V. Theis. Pp. v+182+7 plates. 50 cents. Water-Supply Paper 679–A: The Thiem Method for determining Permeability of Water-Bearing Materials and its Application to the Determination of Specific Yield; Results of Investigations in the Platte River Valley, Nebraska. By Leland K. Wenzel (Contributions to the Hydrology of the United States, 1935.) Pp. iv+57+6 plates. 10 cents. Water-Supply Paper 680. Droughts of 1930–34. By John C. Hoyt. Pp. vii+106+1 plate. 20 cents. Water-Supply Paper 760: Surface Water Supply of the United States, 1934. Part 5: Hudson Bay and Upper Mississippi River Basins. Pp. viii+250. 30 cents. Water-Supply Paper 761: Surface Water Supply of the United States, 1934. Part 6: Missouri River Basin. Pp. ix+340. 45 cents. Water-Supply Paper 764: Surface Water Supply of the United States, 1934. Part 9: Colorado River Basin. Pp. vi+151. 20 cents. Water-Supply Paper 773–E The New York State Flood of July 1935. By Hollister Johnson. (Contributions to the Hydrology of the United States, 1936:) Pp. iv+233–268+plates 22–38 15 cents. (Washington, D.C.: Government Printing Office.) [157

The Tea Research Institute of Ceylon. Bulletin No. 13 · Annual Report for the Year 1935. Pp. 85. (Talawakelle. Tea Research Institute of Ceylon.) [167

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Research and Teaching in Universities

ONE of the most impressive passages in the recent report of the University Grants Committee is that in which attention is directed to the opportunity of service before the universities to-day in training the right type of leader, competent to think strenuously about great issues of right and wrong, liberty and government, and to bring to the grave problems of to-day minds richly informed and unsleeping in the exercise of critical intelligence, and imaginatively alive to the human issues underlying the decisions they are called upon to make. In an age when appeals to mass hysteria often appear to be more successful than appeals to reason, it is of the utmost importance that a university training should enhance a man's equipment not only as a skilled worker but also as a member of society and a human being.

The desirability of closer contact between the universities and the life of the community was also emphasized in speeches at the banquet on June 29 in connexion with the centenary celebrations of the University of London. Prof. L. Cazamian, of the University of Paris, referred to the function of the university in developing the unselfish love of peace, and a creative instinct of fair play to all the nations. The slow victory of a ripe spirit of justice over the promptings of blood, life and force is a subject for noble pride that something of the will to power of past ages might be sacrificed to a new hope and a new faith.

In a speech on the same occasion, Sir James Barrett directed attention to the value of a university as a place where a problem could be discussed without being overlaid by political and financial considerations. A university, however, cannot speak in the collective sense, and if a professor speaks individually he is apt to be criticized if his notions do not agree with those of some of his hearers. Sir James Barrett suggested that the function of universities as a whole to meet the crying need of a world in constant travail is the production of men with balanced minds, organized intelligence and common sense.

This plea that the universities should no longer be regarded as unco-ordinated centres of specialized knowledge, but should come into closer contact with social problems and give an enlightened lead to the community independently of political parties, has frequently been advocated in different ways during recent years. Essentially it involves two separate questions. The first is the impartial study of social and economic questions, as has been carried out in recent years by the Research Section of the Department of Economics and Commerce at the University of Manchester under the leadership of Mr. John Jewkes. The second is the training of leaders for the community who possess the vision and personality to compel action along the lines indicated as a result of such investigations.

In regard to the first, Sir James Barrett suggested that some system of interlinked university research throughout the world, on the lines of that developed internally in the Commonwealth of Australia under the Council of Scientific and Industrial Research, is required. Without an educated public, however, it is almost impossible to ensure that the results of such investigations are fully utilized for the advantage of the community.

The problem is thus one of education and teaching as well as research or investigation, and the question of the right relation between teaching and research in the universities is one of the most important of those raised by the recent report of the University Grants Committee. It has since been discussed in a valuable article by Dr. R. Coulborn in the *Nineteenth Century*, and reference was made to the same problem by the Prime Minister in opening the fifth Congress of Universities of the British Empire at Cambridge on July 14.

Unquestionably one of our first needs is the re-orientation of research at the universities, and the institution of research in the biological sciences and the humanities, so that we may be in a better position to deal with the many social problems with which the unparalleled and disproportioned development of the physical sciences has confronted us. In such work the prime need is for creative research, and Dr. Coulborn does well to remind us that much research work can be, and is, undertaken without any preceding act of creation. In fact, the patience, dexterity and precision demanded in so much research to-day tend to blunt the enthusiasm, imagination or vision of the investigator. He tends to become a machine, and cannot easily escape some warping of his mind or loss of humanity.

These effects of specialization cause the research worker to lose interest in teaching, and it is for this reason rather than to free the investigator from other distractions, as Mr. Baldwin suggests, that some reconsideration of the close connexion between research and teaching which at present exists in the universities is desirable. Undoubtedly it is true that the investigator of genius, the man with really creative ability, should be free from other claims on his time so far as possible. It is equally true that he is likely to be lacking in the patience which research demands, and will require a number of other workers to carry out the detailed work along the lines his genius suggests. It may also be true that his creative ability will be combined with a capacity for inspiring enthusiasm in others and thus for some measure of teaching, which is the fundamental reason for believing that the university teacher should himself be engaged in original work in his subject.

Such men, however, will always be the exceptions, and Dr. Coulborn's warning as to the damaging effects of research in university education cannot be lightly disregarded. He considers that the numbing influence of research on character destroys the teacher's ability to interest and inspire, while undergraduate studies are also usually planned on a basis of progressive narrowing down towards research minutiæ instead of being such as to offer the student the deepest understanding of his subject. If we accept the view urged by Mr. C. H. A. Wilson, vice-chancellor of the University of Cambridge at the recent Universities Congress, that the universities are national and imperial institutions, and that it is their duty to train against a background of pure scholarship men and women who are fitted to take a lead, or at any rate a creditable part, in the conduct of social, commercial and political administration, the question of the quality of the teaching given acquires primary importance.

The evidence cited by Dr. Coulborn suggests that our present practice of linking teaching and research is inefficient even from the point of view of research, and that much superior results would be obtained if the functions of research and teaching were entirely separated and made full-time occupations. Not only is it probable that teaching would be more effective and inspiring and more adapted to the social needs of the student if such a division were effected, but also it would be easier in the transition to secure a re-orientation and direction of academic research in the fields in which it is most demanded by the needs of the community. Moreover, a check would be given to that untoward tendency for undergraduate training to approximate to a soul-destroying professional training instead of the training in scholarship, in strength of character, and in potentialities of good citizenship, which it should be the glory of a university to give as a preliminary foundation of professional training.

There need be no fear that such a separation of functions would lead to any debasement of research. On the contrary, it is more likely to enhance its repute if the conduct of research is a full-time activity of investigators appointed for the purpose rather than the part-time activity of a lecturer or an aspirant for a higher degree. The prestige of research could only be enhanced by being placed on a footing which would enable its real leaders and men of genius to direct and inspire the large army of patient investigators whose co-operation is so essential in any advance to-day.

One of the most important consequences of such a separation of functions would equally be the encouragement which could be given to the really great teacher with a genuine talent for exposition and inspiring others. Such teachers, though teaching may be their whole occupation, will never fail of that constant refreshment at the fountain heads of knowledge which is essential if their teaching is to retain its freshness and vitality. The present interrelation of research and teaching, in fact, has few more untoward consequences than the way in which it tends to diminish the prestige or status of such expositors who, whether within the walls of a university or in the nation at large, are one of the greatest needs to-day. Only through the work of sincere, able and fearless expositors can we hope that either the alumni of our universities will awake to the vastness of their opportunities of leadership and constructive service in the world to-day, or humanity at large realize how great are the benefits which the acceptance of such leadership could confer upon them. The separation of teaching from research in such ways as these may well advance the dignity of both, and enable the universities to make an ever-growing contribution to our national and imperial well-being. This service will be rendered alike through the provision of exact and impartial knowledge and analysis of the factors concerned in many of our grave social or economic problems to-day, and in the training and inspiring of those who can bring to bear upon them constructive criticism, moral courage, a wide vision and a keen sense of human values.

Native Agriculture in Africa and its Relationship to Population

The Improvement of Native Agriculture in relation to Population and Public Health

By Sir A. Daniel Hall. (University of London: Heath Clark Lectures, 1935, delivered at the London School of Hygiene and Tropical Medicine.) Pp. vii+104. (London: Oxford University Press, 1936.) 10*s*. 6*d*. net.

IN this book, Sir Daniel Hall deals with some of the many problems which have arisen from the impact of modern civilization on the native tribes of Africa. The increase in the human population and in the number of cattle which followed the stoppage of war and the reduction in epidemic disease has led to a dangerous condition—"The eminent consequences are disease due to inadequate diet, tribal unrest and the spread of the desert".

Primitive native agriculture is carried on by the method of 'shifting cultivation'. A piece of bush or forest is burned, and the ashes scattered. On this virgin soil crops are grown for one or two years, by which time the land is overrun by weeds. It is easier to burn another area than clear the weeds and fertilize the soil, so a further area of primitive jungle or forest is burned. So long as the population was small, Nature could repair the damage at leisure. But the population has increased to such an extent that regeneration no longer keeps pace with destruction. Apart from the increase in the population, the process of destruction is increasing owing to the growing of cotton and other products by the native for sale.

To the destruction of the land by the natives there is added the destruction by domestic animals. The increase in the number of cattle, sheep and goats has upset the balance between the grazing animal and the pasture. The pasture gets eaten down to the very roots, and even the roots are destroyed by the goats. On the slopes, the tropical rain washes away the top fertile soil, no longer bound by the mat of vegetation. There results an area completely denuded of vegetation. In this way the desert is steadily spreading. This is a problem which is not confined to East Africa. Soil erosion due to over-stocking has become a most serious problem in various parts of the world.

Unfortunately, the native will not sell his cattle. The wealth and prestige of the family and the tribe depend upon the number of cattle, and the possession of cattle is interwoven with the social and religious structure of native life. Cattle, sheep and goats are, to the African native, even more important than money is to the modern European. Immense numbers are kept quite independently of their value for food or any useful purpose, except the maintenance of wealth and prestige. It will be exceedingly difficult to demonetize cattle in East Africa.

Associated with the problem of the growing population with decreased fertility of soil, is the widespread occurrence of malnutrition. Inadequate diet is one "if not the chief source of disease among African natives". If the health of the native is to be improved, the improvement must begin with better food.

After reviewing the present conditions and showing how they have arisen, the author in the final chapter suggests what should be done to prevent "famine and the spread of desert" replacing war and pestilence, as a means of reducing the population. The essentials of a new system are: "(1) the replacement of shifting cultivation by a fixed agriculture which will maintain continuous production from a smaller area, leading to a more balanced dietary; (2) the elimination of excessive live stock and the utilization of the remainder to provide food; (3) the prevention of soil erosion and the reconditioning of the devastated areas".

Sir Daniel Hall has brought to bear on this problem of East Africa his great fund of biological scientific knowledge, and his long administrative experience. The results of his study given in this book are an interesting illustration of the value of approaching political and economic problems from the point of view of the man of science, who is accustomed to dealing with ascertained facts rather than preconceived political ideas.

This book should be read not only by those who are interested in the great problem of the native races of Africa, but also by those interested in the application of science to present-day world-wide problems of economics.

J. B. Orr.

Concentrated Solutions

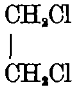
Les solutions concentrées: théorie et applications aux mélanges binaires de composés organiques. Par Prof. Jean Timmermann. Pp. vi + 646. (Paris: Masson et Cie, 1936.) n.p.

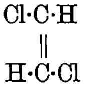
Fifty years ago, important advances were made when Arrhenius and van't Hoff made their classical studies on the conductivity and osmotic pressure of aqueous solutions; but the rules which they established were valid only for dilute solutions, and in most cases were rigidly true only at dilutions at the extreme end of the range, where the percentage of the solute is only a very minute fraction of the whole. Prof. Timmermann's book, on the other hand, is concerned with those solutions in which the two components are present in comparable quantities. Its scope is indicated by the exclusion of all systems for which there are no data between 10 and 90 gm. per cent, or only one datum between 10–20 per cent or 80–90 per cent. A sub-title also restricts the book to "theory, and applications to *binary* mixtures of *organic* compounds".

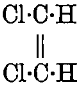
Even with this limitation, the data occupy a volume of 600 pages, which is illustrated by a series of 540 figures, many of which include more than one property in the same figure. The book is, however, by no means a mere dictionary, since it begins very happily with a fascinating account of the admixture of compounds the molecules of which are mirror images of one another. Seven diagrams show the freezing points of mixtures of *d*- and *l*-forms of various optically active compounds, some of which (for example, methyl tartrate and butyl phthalate) form a crystalline racemate with a higher melting point than either of the active components, whilst others (for example, phenylglycollic acid) form a less stable racemate of lower melting point. In other cases again, the *d*- and *l*-forms are isomorphous, and yield 'solid solutions' in all proportions, as in the remarkable case of *d*- and *l*-camphoroxime, or within narrower limits of miscibility. The difficult question of the existence or persistence of racemic compounds in the liquid state is answered in the affirmative in certain instances by a study of the experimental data now cited.

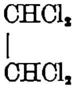
The second chapter of the book extends this study to mixtures of *isomers* which are not mirror images of one another, but differ either in configuration (stereoisomers) or in constitution, and of *polymers* which differ also in molecular weight. In this series of mixtures a clear distinction is drawn between (*a*) *static isomers* (or polymers) where, in spite of their identity of composition, each component is a stable well-defined compound, yielding true solutions when mixed, such as propionaldehyde and acetone, or acetylene and benzene; (*b*) *dynamic isomers* (or polymers) which behave as static isomers in the absence of a catalyst, or in presence of a negative catalyst, but undergo reversible change in presence of a positive catalyst, such as acetaldehyde and paraldehyde in presence of sulphuric acid; (*c*) *tautomers*, to which more than one molecular structure can be assigned, but which are too mobile to be separated into two constituents, such as (i) 1:2 and 1:6 dichlorobenzene, or (ii) stereoisomers which are interconvertible by free rotation about a single bond. Examples which are cited of the group of interconvertible isomers include (i) the dichloroacetylenes studied by Chavanne (and seven other pairs of olefines) which are interconvertible when pure, but can be stabilized by the addition of alcohol, (ii) ten pairs of interconvertible stereoisomers, including two pairs of oximes and the classical examples of fumaric and maleic acids, (iii) acetaldehyde and paraldehyde, (iv) ammonium sulphocyanide and thiourea, studied in very full detail by Werner in Dublin.

In the third chapter of the book, the compounds which are mixed need not be identical in composition, provided that they are sufficiently similar to form isomorphous mixtures. In this field the author (following Bruni) has himself done important work. Thus, in spite of free rotation in the liquid state, ethylene dichloride (I) evidently takes up preferentially a *trans*-configuration, since it forms mixed crystals with the *trans*-form II of dichloroethylene, but a eutectic with the *cis*-form III of this compound, the configurations of which are fixed by the presence of a double bond.

I.  $\begin{array}{c}CH_2Cl\\ |\\ CH_2Cl\end{array}$

II.  $\begin{array}{c}Cl{\cdot}C{\cdot}H\\ \|\\ H{\cdot}C{\cdot}Cl\end{array}$

III.  $\begin{array}{c}Cl{\cdot}C{\cdot}H\\ \|\\ Cl{\cdot}C{\cdot}H\end{array}$

IV.  $\begin{array}{c}CHCl_2\\ |\\ CHCl_2\end{array}$

On the other hand, he has discovered, *inter alia*, that ethylene dichloride (I) forms an equimolecular compound with the symmetrical form of the tetrachloro-compound, IV. The formation of equimolecular aggregates of this type is attributed to the preferential packing of complementary molecules of I and IV, in just the same way that an equimolecular mixture of *d*- and *l*-tartaric acids forms a more stable aggregate than either type of molecule separately. In order to recall this analogy, the equimolecular mixtures are described as "racemoids".

The fourth chapter of the book deals with mixtures of substances of similar type, for example, homologous hydrocarbons, alcohols, esters and amines, substitution products such as $C_2H_4Cl_2$ and $C_2H_2Cl_4$ or *di*- and *tri*-nitrotoluene, and mixtures of compounds with unequal numbers of aromatic rings, such as the binary mixtures formed by benzene, naphthalene and anthracene.

In the preceding systems, which form Part 1 of the book, analogy of structure between the components often produces simple relations in the physical properties of the mixtures, although this is very far from being universally true. Part 2, on the other hand, deals with components of different chemical types, and Part 3 with systems in which one of the components includes a hydroxyl group. The relationships are now more complicated, and long tables are given of mixtures which are 'azeotropic', because they form mixtures of minimum (or more rarely, maximum) boiling point. (The introduction of the term by Wade and Merrimann in 1911 is cited on p. 159.) Shorter lists are also given of pairs of substances which yield two liquid layers at temperatures below the 'critical solution temperature'. Even in these more complicated sections, however, the book never reverts to the status of a mere catalogue, since the reader will find various special subjects, such as the influence of solvents on optical rotatory power, or the behaviour of systems containing anisotropic liquids, adequately discussed, with diagrams and references to the original literature.

The bibliography at the end of the book covers 26 pages, papers published in the same year being given a serial letter, for example, 1914 *b*, which (with the date) suffices to define the reference. The mixtures are indexed in the sequence of formulæ used in Richter's "Lexicon", beginning with methane, CH_4, and ending with tristearine, $C_{57}H_{110}O_6$, the component with the simpler formula in Richter's sequence being chosen for the primary entry in the index. The second component of the mixture is then indexed in the same sequence under the first component. Since the formula of each component is accompanied by the name of the compound in question, isomers are always grouped together but are clearly distinguished from one another.

The book as a whole is a monument to the patience and skill of the author, who has rendered a real service to his colleagues by undertaking so formidable a task for their benefit. T. M. L.

A New 'Oxford Atlas'

The Oxford Advanced Atlas
By John Bartholomew. Fifth edition. Pp. iv+96+32. (London: Oxford University Press, 1936.) 10*s*. 6*d*. net.

THE outstanding feature of the new "Oxford Advanced Atlas" is a larger page with larger maps. This has allowed of the introduction of double-page maps of the Iberian Peninsula and the Balkan States. With their inclusion, the atlas now shows the whole of Western, Central, and Mediterranean Europe on the 1 : 3,000,000 scale. There are also new double-page maps of the U.S.S.R., South-West Asia, the Malay Archipelago, the Laurentic Basin, Central and East Africa, and South Africa.

The atlas is thoroughly up-to-date. The "Sarre" of previous editions has become the "Saar", with the former northern and eastern frontier lines deleted. The new and highly significant railway links between Polish Silesia and Gdynia are shown, and British coal exporters as well as Danzig shippers are likely to be affected by them. The map of the Soviet Union is especially useful, since it emphasizes the essential unity of the European and Asiatic territories of Russia, and their relationship to the marginal lands of Mongolia and Manchukuo. Moreover, it is now possible to locate much-advertised names like Gorki, Dnieprostroy, and Magnitogorsk.

Mercator's projection has been banished from the atlas, except in an illustration on the pages devoted to map projections in general, and the atlas now lacks a serviceable map of world shipping routes. The world political and population maps are drawn on a new equal-area projection termed the Re-Centred Sinusoidal. This shows the land areas true to scale with a minimum of distortion. There is also a valuable map on the morphology of Europe, embodying a more precise classification of the relief features (on the basis of structure) than has hitherto obtained.

In the case of the British Isles, what are described as "the rather elementary county-coloured maps of the earlier editions" have been omitted. One result is that the atlas lacks a satisfactory map of the counties of the British Isles, which seems a pity in view of our strongly developed territorial sense. Another result is that many places found in previous editions do not occur in the present one. To give a test case—the fourth edition marks nineteen places in Hampshire and the Isle of Wight which do not occur in the present edition. It would be ungracious, however, to labour this deficiency in view of the full measure provided elsewhere in this beautifully produced atlas. The claim of the publishers that it should prove "well-nigh indispensable to all who wish to take an intelligent interest in the world they live in" is justified. It definitely supersedes previous editions.

Fish and Fishing

(1) Letters to a Salmon Fisher's Sons

By A. H. Chaytor. Fourth edition. Pp. xxviii + 316 + 8 plates. (London: John Murray, 1936.) 9*s*. net.

(2) Sea Trout and Trout

By W. J. M. Menzies. Pp. 230 + 16 plates. (London: Edward Arnold and Co., 1936.) 10*s*. 6*d*. net.

(3) Trout Heresy

By P. B. M. Allan. Pp. 206. (London: Philip Allan and Co., Ltd., 1936.) 8*s*. 6*d*. net.

(1) SINCE the publication of the third edition of this well-known book, the author has died. It is, as its title suggests, in the form of a series of letters from an ardent salmon fisher to his sons. Presented in this way the information is simply, although adequately, set forth, and it is possible that the author's legal training has a great deal to do with the clarity with which he makes his points. It is evidently the result of long experience, and written in a manner that can be read by the beginner and more experienced angler with equal profit and enjoyment. The present edition is prefaced with a short sketch of the author by Mr. A. Drewett Chaytor, one of the sons for whom the letters were originally written.

(2) Mr. Menzies, the author of "Sea Trout and Trout" is particularly well qualified for his task. As inspector of salmon (including trout) fisheries for Scotland, he has access to the literature of the many researches that have been conducted in this field. During the past fifteen years a great deal has been done in various countries, but particularly in Scotland, to extend our knowledge of the life-history and habits of the trout, and in this work the author has taken a prominent part. In addition, he is an enthusiastic fisherman with an exceptionally wide knowledge of all the Scottish waters. Thus in telling his story he is able to utilize the most recent information to illustrate those points in which the ordinary naturalist and the angler are interested, and he has achieved considerable success.

The modern view is that sea-trout and trout are simply the migratory and non-migratory races of the same species. After some general chapters the book passes on to the life-history of the two races, from the spawning in the redd, through the smolt, whitling and kelt to the old fish again, and the various problems connected with each of them are succinctly dealt with. Such problems include the determination of age from the scales, the food, the results of marking experiments and the seasonal movements. The concluding chapters treat of diseases, abnormalities, parasites, homing instinct and the making and preserving of a sea-trout fishery.

The book is furnished with an index and a short but useful bibliography; it is well illustrated and printed. The straightforward manner in which it is written should give it a wide appeal.

(3) This volume approaches the problem of fishing from yet another point of view, for the first treats of the art of catching fish, the second of the science of their lives and the third of the psychology of the fish and, by inference, that of the fisherman. The author examines the physical

and more particularly the mental equipment of the trout, its senses and their modes of action. This is done in the light of comparative psychology to a considerable extent, but also in the light of a great deal of actual observation by the author and other experienced anglers.

Certain writers tend to endow the trout with almost superhuman attributes, an attitude explained thus: "The rest of the truth is that be we never so skilful, boast we half a century of experience, we can catch trout but little more easily —if at all—than when we were striplings. There *must* be something in it—quite obviously trout are extremely cunning fish." A quotation from such a eulogy serves as an excellent Aunt Sally to be knocked down by the author with considerable gusto. What are the parts played by instinct and intelligence in this cunning? Can the fish profit by experience? Why do they rise? To what extent are they capable of distinguishing flies or other bait? Why are there often two types of trout in the same water? These and other problems that have been pondered by fishermen since first a fly was cast or a minnow spun, are treated in an engaging manner which never becomes tedious or didactic, although the opinions put forward are well documented by footnotes. The pure dry-fly man comes in for some delightful gibes, but they are always kindly and never sneering. It is just the book for the fisherman to take with him on his trip, for he will find in it much food for thought and new side-lights on old problems.

Review of Biochemistry

Handbuch der Biochemie des Menschen und der Tiere

Herausgegeben von Prof. Dr. Carl Oppenheimer. Zweite Auflage. Ergänzungswerk, Band 3. Pp. xxiv+1162. (Jena: Gustav Fischer, 1936.) 84 gold marks.

IN previous reviews of this Brobdingnagian offspring (see NATURE, 133, 595; 1934; and 135, 287; 1935) we have already commented on its dimensions and the deducible dimensions of its parent. In this third volume of the "Erganzungswerk" to the second edition of the "Handbuch" we have 1,136 pages of text and 25 pages of index, giving a total almost identical with that of the first volume; this was, however, published in two half-volumes of about 600 pages each, and there is no clue to the reason for the production of this monster between a single pair of covers.

This third volume is supplementary to vols. 7–9 (Parts 8–10) of the main volume. It covers metabolism under special conditions, including the processes of birds, cold-blooded animals, and invertebrates; metabolism under physiological conditions, including growth, pregnancy, heavy labour, hunger and under-nutrition, variations of climate, and radiation; metabolism under the influence of secretions and of endocrine disturbances; metabolism under various pathological conditions, including fevers, nervous disturbances and deficiency diseases; and the metabolism of the female generative system. These various sections constitute the supplementary material to Part 8 of the main volume.

The supplementary material to Part 9 is concerned chiefly with the metabolism of particular organs and tissues, including tumour tissue, and with the metabolism of the various essential food constituents, water, minerals, carbohydrates, proteins, creatine and creatinine, nucleides, fats and lipoids. Part 10 is supplemented by a survey of all those subjects that are comprised under the general phrase "Regulation of Function"—including both non-specific (for example, nervous) and specific regulation, as by vitamins and hormones. The section here on the biochemistry of the sexual hormones is, incidentally, described in a note as itself supplementing Dr. Butenandt's contribution to the first supplementary volume, published in 1933—a clear demonstration of the exceptionally rapid progress now being made in the field. Separate sections in the supplement to Part 10 are devoted to the physiology of the various endocrine organs. Finally, there is a useful addendum on the sterols, bile acids, and inositol.

As in the previous supplementary volumes, the names of many of the contributors are biochemical household words. Avon, Krüger, Lehmann, Pincussen, Felix, Fürth, Grafe are among the professorial contributors, supported by a number of *Privat-Dozenten* to a total of some twenty. This volume completes the task of supplementing the "Handbuch's" second edition. It maintains the authoritative character of the other two volumes and constitutes with them a quite indispensable whole.

Words almost fail one at the scope and completeness of the "Handbuch" and the supplementary volumes. If a reviewer may be permitted to repeat himself, it can once more be stated that "these volumes are of the kind that fill the user with awe-inspired gratitude and the reviewer with awe-inspired terror". A. L. BACHARACH.

A Pilgrim's Quest for the Divine

By Lord Conway of Allington. Pp. 255. (London: Frederick Muller, Ltd., 1936.) 10*s.* 6*d.* net.

LORD CONWAY's book reminds one of a philosophical romance such as "Rasselas", or even "John Inglesant". Much of it is in dialogue, and the scene passes from place to place—Switzerland, Italy, the Andes, Spitsbergen. The writer has been a pilgrim in the physical as well as in the spiritual sense. This is not a systematic treatise; but readers can go on with interest, and take the ideas as they come—they are always suggestive and often ingenious. Not that it is a casual book, for it has been rewritten four times, the author tells us, and he is working out his point of view all the while.

The problem with which the book is largely concerned is that of time and its relation to eternity, especially in the light of the theory that time is a fourth dimension of space. Lord Conway asks whether this conception may not "involve an entire revolution in our ideas about both the present and a possible so-called future life". His theory is that we are living and active in a three-dimensional state which exists within a four-dimensional universe. As we pass through the latter (as a two-dimensional inhabitant of Flat-land might pass through our three-dimensional world), "we leave behind us in what we regard as the passage of time the result of our actions built into the structure of our lives". This enables Lord Conway to envisage something in the nature of the Pauline conception of a "spiritual body", built up by a life's activities much in the way that a crystal is built up.

The last pages of the book consist of extracts from a diary kept by the author while staying with a small Franciscan community on an island near Venice. These are of particular interest, and the author seems to plead for something in the nature of a modern Third Order of St. Francis.

> "After all, St. Francis was not a mere visionary but a practical reformer. Why should not practical men of our day take up his work in a new form suitable for our present needs? Has not the passion for worm-eaten speculation yet made victims enough?"

The reader must come to this somewhat unconventional book with a sympathetic mind; but if he does so, he will find it very fruitful, even fascinating.

J. C. H.

Bibliographia Coleopterologica

Pp. xv + 149–323. (Den Haag: W. Junk, 1935.) 10*s.*

THIS publication is a special cloth-bound catalogue issued by the well-known entomological publisher, Herr W. Junk, now of The Hague. While, in principle, it is a priced list of books, reprints and journals, bearing, in the main, upon insects of the order Coleoptera, in reality it serves a much wider purpose. It is, in fact, a partial bibliography of the order, which is accompanied by a most useful index, so arranged with cross-references that publications on practically every aspect of the order can be readily found. It is intended also to serve the purpose of marking the jubilee of Herr Junk's most famous publication, the "Coleopterorum Catalogus", which was begun in the year 1910.

An interesting preface by S. Schenkling discusses the origin, history and purpose of this great work. The "Catalogus", which is now nearing completion, is the largest single work ever published dealing with the literature of any section of biology. It lists all the described species of beetles of the world, and the 141 parts (in twenty-one volumes), published to date, comprise 21,000 pages, containing the names, synonymy, distribution and taxonomic and biological literature of some 175,666 species. When completed, it will be comprised in thirty volumes, listing about 240,000 species in 134 families. The necessity for a reference work of this kind is borne out by the fact that its precursor—the Catalogue of Gimminger and Harold (1868–1876)—listed only 77,000 species.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry

By Dr. J. W. Mellor. Vol. 15: Ni, Ru, Rh, Pd, Os, Ir. Pp. viii + 816. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 63*s.* net.

VOL. 15 of "Mellor" includes nickel and five out of six elements of the platinum group. Only platinum itself remains, with a general index, to complete the final volume, which is described as "in the press". As the author's huge task approaches completion, the admiration called forth by its monumental character increases to a climax. For example, the reviewer was surprised to find his own name cited under nickel as joint author of a paper in which he himself had forgotten that this element was investigated. Such a thorough scouring of the literature can leave very few gaps to be filled up, and provides a wonderful guide to all the work done up to the date of compilation of the volume in question.

As in previous volumes, the dictionary aspect is relieved by occasional discussions, for example, on the atomic weight and valency of osmium, with special reference to the formulation of the tetroxide.

At this stage, no further commendation is needed, since in a short time the present notice will give place to congratulations when the final volume appears.

Einführung in die angewandte Akustik:

insbesondere in die neueren Probleme der Schallmessung, Schallübertragung und Schallaufzeichnung. Von Dr. H. J. von Braunmühl und Walter Weber. Pp. v + 216. (Leipzig: S. Hirzel, 1936.) 9.20 gold marks.

FROM the physics point of view, this text is admirable. It covers most of the important applications of acoustics in the field of electrical communication, amongst which may be mentioned the measurement of performance of loudspeakers and microphones, the recording and reproduction of sound in its varied forms, acoustic perspective and the technical acoustics of enclosures. The last chapter appropriately deals with the measurement of fidelity of speech in communication systems, but the more difficult problem of measuring the fidelity in musical reproduction is not discussed.

L. E. C. H.

Polarization of Light and some Technical Applications

By Prof. A. F. C. Pollard

WHATEVER may be the nature of light, it is convenient to regard it as the propagation of an electro-magnetic disturbance in the ether. In an isotropic medium, free of electric charge, the electric and magnetic vectors are perpendicular to one another and to the direction of propagation. Either of these may be selected as the periodic vector—the light vector—associated with the disturbance, but it is usual to define the plane of polarization as that containing the magnetic force with the electric force perpendicular to it.

There are three fundamental qualities which are of major importance to the control of light. The wave-length, which determines the frequency or colour and the amplitude upon which the intensity of light depends, are two of these qualities which have been under almost unlimited control for centuries. But the third—the direction and type of the transverse vibration—has continued to be under very limited control up to the present time only since 1669 when Erasmus Bartholinus observed the double-refraction of Iceland spar. A few years after the publication of Bartholinus's work, Huyghens indicated the distinctive character of the two beams transmitted by the spar, and Newton's discussion on the two-sidedness of the beams led to their subsequent description as polarized light. Curiously enough, this great discovery lay dormant as an isolated fact in science until about 1808, when Malus accidentally observed that the light reflected from the glass windows of the Luxembourg palace in Paris was polarized. Biot, making use of Malus's discovery, constructed his reflecting polariscope, which was one of the first devices to produce polarized light somewhat inefficiently by reflection.

It was not until 1828, however, that the optical anisotropy of Iceland spar was utilized by William Nicol as an efficient means for producing a plane polarized beam of light. With his famous prism, one of the beams—the ordinary ray—is shunted to one side, whilst the other—the extraordinary ray—is transmitted with but slight absorption as a pencil of wholly polarized light.

The working aperture of Nicol's prism, however, is limited by the size of optically perfect crystals of the spar, and the largest which has been made has an aperture of about 4 inches. Usually, nicols are much smaller than this, and even moderately sized optically perfect crystals of the spar have already become scarce.

Commencing with Foucault in 1857 a number of investigators—Dove, Hartnack and Prazmouski, Jamin, Glan, Feussner, Zenker, Abbe, Ahrens, Silvanus Thompson and others—have devised various prisms with the object of taking every advantage to increase the aperture and economize the precious spar.

Nothing has yet been devised which equals the nicol for transparency and for the perfection of the polarization of the transmitted light; but when large apertures are required the only alternative has been the reflecting polarizer, which produces an imperfectly polarized beam with much loss of light. The recent work of E. H. Land, who makes use of the dichroic properties of certain substances, has, however, resulted in simple means for filtering out of common light a component with high percentage plane polarization by transmission through any sized aperture desired.

To understand Land's invention fully, it must be remembered that optical anisotropy may be manifest as double refraction in which the ordinary and extraordinary rays are transmitted with unequal absorption, when the difference of the coefficients of absorption may be called true dichroism.

The decrease in the intensity of the light when passing through an optically anisotropic plate may be partly due to scatter and partly due to true absorption. The difference of the coefficients of scattering is called 'dityndallism', and this with the true dichroism makes up the total dichroism. In most crystalline substances the dityndallism is negligible, but in colloidal anisotropic systems it may be important.

The absorption depends not only upon the thickness of the plate but also upon the wave-length, and consequently in nearly all dichroic crystals the transmitted light is coloured. The outstanding and historical example of a dichroïc uniaxial crystal, in which the transmitted light is strongly polarized and nearly colourless, is tourmaline. In certain tourmalines the ordinary ray is completely absorbed, but the extraordinary ray vibrating in a plane parallel to the trigonal axis is transmitted unfortunately with so much absorption as to render most good polarizing tourmalines useless in feeble illumination.

In 1851 Dr. William Bird Herapath[1] discovered a remarkable compound of iodine and quinine sulphate, iodosulphate of quinine, $4Qu.3H_2SO_4.2HI.I_4.6H_2O$, which aroused great interest at the time and was afterwards called Herapathite by Haidinger. Later, he discovered a similar dichroic compound of strychnine.

The double refracting Herapathite can be crystallized in minute hexagonal plates, and it has been stated that such a plate 1/200 inch thick will completely absorb one of the rays, permitting the other to be transmitted with scarcely perceptible absorption. Large crystals cannot be made, though some were made large enough by Dr. Herapath to be used by Beale as polarizing components in the microscope[2]. These crystals were used for the microscope very shortly after their discovery, but their permanence could not be depended upon[3]. If exposed to the air or mounted in Canada balsam dissolved in xylol, the iodine disappears and the crystals lose their polarizing properties. They can be preserved, however, in Canada balsam dissolved in ether.

I have succeeded in making crystals 2–3 mm. in diameter, but they were not flat and far too friable to be ground into parallel plates.

Dr. Herapath's arresting discovery seems to have passed into oblivion until Land succeeded in making a thin sheet of nitrocellulose packed with ultra-microscopic crystals of Herapathite with their optic axes all parallel to one another. Such a sheet behaves like a single extended crystal, with the difference that since the crystalline particles overlap in the direction of the thickness of the film the transmitted beam is absorbed more than it would be in a single crystal and the sheets have a smoky brown appearance.

In his patent specification[4], Land describes processes by which these sheets may be made. One way is to prepare a gel-like mass containing Herapathite which is thoroughly mixed with a viscous nitrocellulose or cellulose acetate solution. Since the particles are asymmetrical, they will orient themselves in the same direction when the viscous mass is extruded through a slit-like die. But the retarded flow of the outer surfaces of the material during its passage through the die as compared with the flow of deeper layers will give rise to surface shear upsetting the regular arrangement of the crystals. To overcome this difficulty a layer of the charged plastic is placed between two layers of uncharged plastic before extrusion through the die. The middle charged layer then flows with practically uniform velocity over the cross section and the particles are uniformly distributed parallel to one another.

Another method is to place the viscous polarizing material in contact with a substratum of viscous non-polarizing material, such as fluid celluloid or other colourless oily ester, spread upon a glass plate or sheet of celluloid in such a way as to stretch the polarizing medium. Orientation of the particles may also be brought about by subjecting a diluted colloidal suspension to an electric or magnetic field during the setting of the mass.

It is by some such means described by Land that the Polaroid Corporation of Boston, U.S.A., has succeeded in manufacturing the 'Polaroid' sheets of polarizing material now on the market. Other firms have secured the right to employ the material in special applications. Thus, one firm supplies Polaroid analysers and polarizers for the microscope, as well as for projecting lanterns and other instruments. Another manufactures ophthalmic instruments employing Polaroid. The Eastman Kodak Co. employs the material for photographic purposes under the trade name of 'Pola Screen'; the Royal Photographic Society has awarded the Hood Medal to Mr. Edwin H. Land for his meritorious invention.

There are two grades of Pola screen at present available—Types I and II. Type I consists of sheet material cemented between glass plates of *A* or *B* quality intended for use over the camera lens. The *A* quality glass plates are optical flats hand surfaced of the highest quality, and the *B* plates are of optical glass of good quality which will not affect definition. The plates are mounted in light metal circular rims with an aperture up to 4½ inches. Similar screens with Bakelite rims are also supplied in Great Britain by Polarizers Ltd. Type II is intended for use over light sources and consists of a Polaroid sheet cemented to a single plate of glass. In this form the polarizer slightly diffuses the incident light, but may be had in sheets up to 12 inches square. The amount of polarization by single plates of Polaroid and the transmission of ordinary light through two films parallel and crossed as well as two plates parallel and crossed has been determined by L. R. Ingersoll, J. G. Winans and E. H. Krause[5] for wave-lengths 4000A. to 20,000A. and by J. Strong[5] for wave-lengths 3000A. to 11,000A.

As the behaviour of this new material cannot be judged without some knowledge of such measurements, the following table gives the average figures taken from the curves obtained by these authors. There appears to be some variance with different samples.

The dichroic properties of the material can be plainly seen by the smaller percentage of polarized light in the violet and red ends of the spectrum as compared with the intermediate portions where the absorption of one ray is almost complete. Consequently when a bright light is observed through two crossed plates, it is seen to be coloured a deep red.

The transparency of films and plates to ordinary light is also not without interest. The material is opaque to the ultra-violet but very transparent to the infra-red, when parallel or crossed ; so that a pair of crossed films will serve as an excellent infra-red filter and will not polarize the transmitted radiation. The transparency of films in the visible spectrum is not so great as that of plates, due apparently to greater scatter, but of course the glass in the plates absorbs a large percentage of the infra-red.

	Percentage Polarization	Percentage Transmission			
		Films		Plates	
		Parallel	Crossed	Parallel	Crossed
3000A	—	0	0	0	0
4000	70	1·5	0	22	5
4500	70	12	0·5	28	4
5000	95	13	0	32	3
5500	98	15	0	33	2·5
6000	98	16	0	33	2·5
6500	96	25	0	33	2·5
7000	91	34	2·5	32	2
8000	32	63	62	28	5
9000	9	77	77	37	29
1 μ	5	85	85	39	43
1·1 μ	—	85	85	41	41
1·5 μ	1	—	—	—	—
2·0 μ	0·5	—	—	—	—

In a subsequent patent specification[6], Land describes the use and preparation of films of nitrocellulose containing polarizing ultra-microscopic particles of inorganic periodides, particularly purpureocobaltchloridesulphateperiodide. He states that films prepared with particles of this substance, suitably oriented, give complete polarization, with a colourless transmitted beam and extremely small loss by absorption. The material should be a great improvement on the Herapathite material.

The scientific and technical applications of Polaroid are almost unlimited. The most obvious and most important application which first springs to the mind and which is specifically mentioned by Land in his first patent specification is to the vexed problem of glare from the headlights of motor vehicles. By covering the aperture of the head lamps with Polaroid with its plane of polarization in a specified position, parallel say to the vertical plane, then an observer looking through a Polaroid screen with its plane of polarization parallel to the horizontal plane will see the head lamp merely as a faint dark red source, but all objects illuminated by the headlight will be seen almost as clearly as without the screen. The light from the head lamp is polarized with its intensity reduced by a little more than fifty per cent, but this polarized light is depolarized into ordinary light when diffusely reflected from the surfaces of objects, the visibility of which is therefore unimpaired by the observer's crossed screen.

To be effective as an anti-glare device on the road, it would be necessary to enforce the use and the manner of using this material by legislation. But it is not manufactured in Great Britain, and, moreover, the patent rights are in the hands of one body which is very much alive to the immense value of this epochal invention.

Since ordinary light when specularly reflected from non-metallic surfaces at about 32° to 37° to the surface is strongly polarized in the plane of incidence, that is, the vibrations are parallel to the surface, it will be absorbed by transmission through a Polaroid film with its plane of polarization parallel to the surface. Consequently the details of reflecting objects can be seen more clearly through Polaroid films and are invaluable in photographic work. A Pola screen placed in front of the lens of a camera will enable otherwise impossible photographs to be taken obliquely through glass or water. Oblique reflections which hide surface detail or interfere with good composition can be subdued.

A single screen used in the form of spectacles will give the observer all the above advantages and aid his view of glazed pictures obstructed by surface reflections in picture galleries. But such spectacles will not cut out effectively the surface glare of roads from the setting sun which is so troublesome when motoring, since such oblique reflections are scarcely polarized.

If, however, a second screen adjustable by rotation is used in the spectacles a variable anti-glare goggle is at once available, and has been described by E. H. Land in a patent specification[7]. The screens arranged in this way can be used as a practically neutral variable density device of great simplicity and utility in many applications. The light scattered from the blue sky in and about a plane perpendicular to the sun's rays is strongly polarized in the plane containing the sun and the ray from the sky. Consequently the tone of a clear blue sky in a direction perpendicular to the sun's rays can be varied in photography from light to very dark by rotation of a Pola-screen placed in front of the lens, and surrounding objects can be made to stand out in a remarkable manner.

When the illumination is plane polarized by placing a Pola screen type II over the light source, various useful effects can be obtained by observation or photography through a second screen. Though polarized light becomes ordinary light when diffusely reflected, it retains its polarization when specularly reflected from non-metallic surfaces, and troublesome reflections can be cut out by the second screen.

Reflection from metallic surfaces, however, is more complicated. Common light is only partially polarized by metallic reflection, and plane polarized light is reflected as such only when the plane of polarization is in or perpendicular to the plane of incidence. At all other azimuths, plane polarized light is converted into elliptically polarized light by metallic reflection and so the second screen cannot completely cut out such reflections.

The advantage of polarized illumination depends upon the fact that specular reflections can be quenched by the second screen but reflections depolarized by scatter pass through it. When semi-transparent objects are examined or photographed in polarized light, the surface specular reflections can be quenched, but the light diffused from deeper layers passes the second screen and such objects assume a new appearance. Thus the true texture of the skin becomes more apparent, when the illumination is intense.

It has been stated that stereoscopic cinema projection was demonstrated by the inventor of Polaroid in New York a short time ago. For this purpose the two stereoscopic film pictures are projected on to the same screen one over the other, through Polaroid plates with their planes of polarization set at right angles to one another. The audience were supplied with Polaroid spectacles with the plate over the left eye set to cut out the right-eye picture and that over the right eye set to cut out the left-eye picture. But the nature of the projection screen surface has not been disclosed. The usual interference colour effects produced by introducing plates of uniaxial crystals or substances such as Cellophane which behave optically like uniaxial crystals, between two crossed Polaroid screens, might be used for the projection of coloured backgrounds of changing hue on the stage.

The Polaroid screen will also find many scientific uses, more particularly if the somewhat fanciful prices at present demanded are very considerably reduced when mass production starts. It cannot replace the nicol in measuring instruments in which the polarization of the light must be complete, but obviously it can be used with great advantage in photo-elastic apparatus, strain viewers, and projecting lanterns, microscopes, telescopes, ophthalmic instruments in which the nicol restricts the aperture or interferes with the definition of the optical image.

Now that E. H. Land has so successfully demonstrated the possibility of manufacturing polarizing screens, without doubt attention will be concentrated upon the production of more transparent material, transmitting a higher percentage of plane polarized light uniformly throughout the visible spectrum. It would seem that when the remarkable phenomena of photoanisotropy observed by Weigert and by Zocher and Coper in recent years are more fully understood, means will be found by which we may completely control the production of plane, circularly or even elliptically polarized light.

Weigert discovered that plane polarized light may turn an isotropic solid colloidal system into an anisotropic one with double refracting and dichroic properties. By exposing a dry layer of silver chloride suspended in gelatine to common light a bluish-red photochloride is formed. If now the photochloride is exposed to intense polarized red light the photochloride becomes double refracting and dichroic, with the plane of polarization parallel to that of the exciting light. Violet or ultra-violet light has no such effect, neither does the photoanisotropy develop at very low temperatures. Werner and Kuhn have found also that photoanisotropy is produced in an aqueous gel of the dyestuff cotton yellow when excited by plane polarized light.

But Zocher and Coper have found that circularly polarized light will convert thin photochloride layers prepared by chlorinating silver mirrors into layers exhibiting circular dichroism and circular double refraction. The circular dichroism produced is of the same sign as the dichroism produced by plane polarization. That is to say, the photoanisotropic layer is more transparent to circularly polarized light of the same sense as the exciting red light than to circularly polarized light of the opposite sense.

Circular double refraction in which the circularly polarized wave of one sense is retarded relatively to the wave of the opposite sense of rotation is simply optical activity, and this is the first case in which optical activity has been produced by light itself.

For those who are not fully acquainted with these interesting and important investigations on photoanisotropy it might be mentioned that a brief and lucid description of them has been given by Prof. H. Freundlich[8], with an extensive bibliography.

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[1] *Phil. Mag.*, 3, 161 (1852); 6, 346 (1853); 7, 352 (1854); 9, 366 (1855).

[2] "How to Work with the Microscope", by Lionel S. Beale. 5th edn., 1880, p. 28.

[3] "The Microscope and its Revelations", by William B. Carpenter. 2nd edn., 1857, pp. 127, 128.

[4] British Patent No 412,179. Dec. 16, 1932.

[5] *J. Opt. Soc. Amer.*, 26, p. 233 and p. 256 (1936).

[6] British Patent No. 433,455. Jan. 15, 1934.

[7] British Patent No. 442,825. June 17, 1935.

[8] *Photographic J.*, 76, 395 (1936).

Tree-Ring Chronology in American Prehistory

AN archæological reconnaissance in 1920 of the Chaco Canyon, New Mexico, on behalf of the National Geographic Society of Washington, D.C., was followed by the decision of that Society to assume responsibility for the exploration of the two prehistoric sites of Pueblo Benito and Pueblo del Arroyo. Of these, the former is the most famous and important of the prehistoric remains of the south-western United States, the ruined structure consisting of a thousand rooms of stone and adobe. Its size alone bears out the evidence of the numerous ruined pueblos immediately adjacent that this now arid area once supported a large and densely concentrated population.

The investigations of the National Geographic Society were under the field direction of Dr. Niel M. Judd. They were carried out by successive annual expeditions in the period 1921–27. In addition to the exploration of the two villages, which were the main objective, observations were made on more than forty other sites in this important archæological area. The purpose of the expedition was not merely the study of the distinctive culture of Bonitian civilization, but also to determine as closely as possible the conditions which had led to the remarkable concentration of population and efflorescence of culture at this point, and above all, the causes of the decay of this civilization before the advent of the Spaniard to the American continent.

An investigation, which began more or less as a sideline, eventually produced a result of far-reaching importance for American archæology, of which the end is not yet in sight. This was the application of the tree-ring method of dating to the chronological problem of Pueblo Bonito and other related prehistoric remains of this region.

When the expedition of the National Geographic Society in the Chaco Canyon area came to an end in 1927, it was intended to issue a comprehensive account of the exploration as a whole ; but owing to a variety of circumstances this project has had to be abandoned. The results of the expedition and the reports of those who have co-operated in the work, therefore, will appear in a series of independent papers to be known collectively as the Pueblo Bonito Series. Of these, the first, by Dr. A. E. Douglass, on the dating of the ruins by the study of tree-rings shown in the timbers of the buildings, is now available.*

The Pueblo Bonito Expedition first made contact with Dr. Douglass in 1921, when samples of timbers obtained in the first year of the expedition were submitted to him for examination ; but it was not until the following year that intensive application of the method was made to the chronological problem at this ruin. Dr. Douglass, when engaged in an attempt to correlate climatic conditions with the periodic recurrence of sunspot activity through the study of tree-ring growth in northern Arizona, had been invited, in 1918, by Dr. Clark Wissler, of the American Museum of Natural History, to attempt a determination by this method of the comparative ages of the ruins of Aztec and Pueblo Bonito. His attention was thus directed to the possibility of dating prehistoric remains by the study of beams of timber surviving in the numerous ruins of the south-west, which presumably had been subject to like climatic conditions, and of constructing from this evidence the beginnings of a time-scale. When the operations at Pueblo Bonito came to an end in 1927, the dating of the ruin had not been determined to his complete satisfaction, and the second beam expedition of 1928—the first expedition took place in 1923—was followed by a third expedition in 1929. By this expedition what had appeared a gap in the evidence was successfully eliminated.

The tree-ring method of dating elaborated by Dr. Douglass is sufficiently well known by now to obviate detailed description. The essential feature is the identification in borings or sections of timber of certain distinctive sequence groups of the ring-growth of the tree due to the influence of an identical annual succession of variation in climatic conditions. Although some thousands of specimens have been examined, no sequence has been found to be exactly duplicated in the course of a period of more than twelve hundred years. By means of the overlap in ring growth in timber at different stages of age at given points in time, it has been possible to build up a time-scale, which proceeds from living trees to historic timbers, namely, beams from buildings of known date, and from historic to prehistoric. Dr. Douglass here figures a complete series of ring growths, which extends from 1929 right back to A.D. 698. The woods which have been found best for the purpose of the investigation are the western yellow pine (*Pinus ponderosa*) and the Douglas fir (*Pseudotsuga taxifolia*), while the next best is the pinyon (*Pinus edulis*).

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* National Geographic Society. Contributed Technical Papers, Pueblo Bonito Series, No. 1 : Dating Pueblo Bonito and other Ruins of the South-West. By A. E Douglass. Pp. 74. (Washington, D C.: National Geographical Society, 1935)

This elaborated time-scale has been applied to determining the age of a large number of ruins which have furnished the material from which it has been built up; but perhaps of even greater interest for the archæologist than the dating of individual structures is the precision given to the cultural periods, of which the time relation had been determined previously by archæological methods. For example, the beautiful cream-coloured Hopi ware is seen to begin in the early part of the fourteenth century, the polychrome red pottery largely filled the thirteenth, red pottery was common in the twelfth, and black-on-white ware was characteristic of the tenth and eleventh centuries. In more general terms, of the succession of cultural periods into which archæologists have classified Pueblo civilization, Pueblo III, the golden age of south-western prehistory, took its early form in Chaco Canyon about A.D. 919, reached its local climax in the late eleventh century, and probably closed with the great drought which endured from 1276 until 1299. Pueblo IV began in the early thirteen hundreds. Dating, however, is complicated by the problem of centrifugal diffusion. Pueblo culture, it is thought, probably originated at a single centre, from which it spread outwards. It is not, therefore, everywhere contemporaneous.

So far as the dating of individual ruins is concerned, Pueblo Bonito is now shown to be the oldest of the south-western ruins. Its building began in A.D. 919, and the major construction took place in the decade 1060–70, with a lesser activity twenty years later. The important site of Aztec, notwithstanding its size, was built in a period of twelve years 1110–21. The dates determined for the beginning of construction on forty-five sites range from A.D. 919 until 1417, except for two instances, dated at 1550 and 1770 respectively.

The investigation has thrown light on a number of collateral problems. For example, there is the question of the former existence in this area of considerable pine forests, which have now disappeared, and by their extinction, no doubt, contributed their share to the aridity of the area. Some specimens which have been examined were evidently dead wood at the time they were used, and the confused and almost indistinguishable rings at the end of their growth bear witness to the aridity which caused their death. This formation has been paralleled from trees which have died recently.

The evidence of the grouping of sequences of poor growth is interpreted as pointing to a succession of droughts, which recurred with extreme severity at intervals of about three hundred years. One of these droughts, the most severe, covered the closing years of the thirteenth century (1276–99); another appears from 1573 until 1593; and still another in 1890, with a period of maximum intensity from 1896 until 1904. Periods of drought earlier than these are also perceptible, which go back so far as A.D. 904. The study of these cycles should prove of importance for the future of climatology. Archæologists will look forward with keenest anticipation to the extension of this technique to conditions which will throw light on the beginnings of Pueblo culture and its dating in relation to the culture of the Basket-makers.

Obituary

Mr. R. D. Oldham, F.R.S.

RICHARD DIXON OLDHAM, whose death took place at Llandrindod Wells on July 15, was an original and independent thinker—a little too independent sometimes for those in authority. He was most widely known for his geological work in India and his seismological investigations; but he wrote on other subjects, and his writings are always interesting and suggestive. He was the third son of Dr. Thomas Oldham, F.R.S., the first director of the Geological Survey of India, and was born on July 31, 1858. He was educated at Rugby and the Royal School of Mines, and appears to have been elected to a science scholarship at Emmanuel College, Cambridge, but never took it up. His father, who had retired two years earlier, died in 1878; and he, following his father's footsteps, accepted an appointment on the Indian Geological Survey in 1879.

In the regular fieldwork of the Survey, Oldham had a wide and varied experience, chiefly in the north, ranging from Manipur to Baluchistan; and he also visited the Andaman Islands. The results are to be found in many papers in the "Memoirs" and "Records" of the Survey. In addition to his fieldwork, he edited his father's unpublished papers on earthquakes and thermal springs in India. The most important of these dealt with the Cachar earthquake of 1869, and the editing included the whole of the discussion of the observations collected by his father, a very useful grounding for his later work in seismology. He also compiled a "Bibliography of Indian Geology" (1888), and prepared the second edition of the official "Manual of the Geology of India" (1893). This was essentially a new work, though it incorporated much of the original edition; and several of the new chapters written by Oldham are of great interest to all geologists, not only to those in India. But perhaps his most important work for the Survey was the "Report on the Great Earthquake of 12th June 1897", forming vol. 29 of the "Memoirs" (1900). Seismology was now his chief interest. He was the first to show (*Phil. Trans.*, A, **194**, 135) that the disturbance set up by a great earthquake splits into three distinct forms of wave-motion which, travelling at different rates and along different paths, give rise to the three distinct phases observed in distant seismographic records.

Oldham retired from the Survey in 1903, and for some time lived in the Isle of Wight, where he was near the seismographic station of his great friend, John Milne. His seismological studies were continued; in 1906 he showed that the records of distant earthquakes indicate that the earth has a core very different in properties from the rest, and he determined its diameter approximately. He was indeed a pioneer in the application of seismology to the investigation of the interior of the earth.

In his later years, Oldham spent much time in the south of France, where he studied the history of the Rhône delta, and finally he withdrew to Llandrindod Wells.

Oldham was awarded the Lyell Medal of the Geological Society in 1908, and was president of that Society in 1920–22. He was elected a fellow of the Royal Society in 1911. P. L.

Prof. Snouck Hurgronje

WE regret to record the death of Prof. Christian Snouck Hurgronje of Leyden, the distinguished authority on the religion and customs of Islam, which took place on June 26 at the age of eighty-one years.

Prof. Hurgronje was not only one of the foremost oriental scholars of his time, but he was also a great exponent of the value in affairs of the study of living native institutions, his intimate knowledge of the languages of the East and of the customs, religion and laws of Islam having proved of signal service to the Colonial Government during his residence in the Dutch East Indies.

Hurgronje was born in 1855; and in 1885 was admitted by the University of Leyden to the degree of doctor in Semitic languages and literature for a dissertation on the Feast of Mecca. He continued his oriental studies at Strassburg, and was then appointed instructor in Arabic and the institutions of Islam at the School of Instruction for Dutch-Indian officials at Leyden. In 1884, with the object of obtaining a first-hand knowledge of the religious exercises of Islam, he went to Jiddah, the landing place of pilgrims to Mecca. Here he remained until fully equipped to enter the holy places of Mecca. This he did with pilgrims from the Dutch East Indies in February 1885, and remained in the city until the following August, living with the pilgrims and carrying out their religious observances, until the killing of the French orientalist, Dr. Huber, while trying to penetrate into the interior from Jiddah, led to his expulsion by the Turkish authorities.

In 1889, Hurgronje began his work in the Dutch East Indies, when he was sent out by the Government at The Hague to act as adviser on Moslem institutions in Java. His appointment, originally for two years only, lasted for many years, so valuable did his services prove to the Government. One of his more notable achievements was in tendering advice to the Colonial Government and the Government at The Hague, which was framed in the light of his study of Achinese institutions, and contributed largely to the pacification of northern Sumatra, where the Government had been carrying on a desultory war with the Achinese since 1873.

Although both Cambridge and Leyden had offered chairs to Hurgronje, he declined all such offers until he could regard his work in the East as completed; but he accepted the professorship of Arabic at Leyden in 1906. Here he was not forgetful of his practical experience in the East, and for the remainder of his life he continued to be a close observer of the effect of modern trends in international relations on the development of Islam, a matter upon which he produced several important and authoritative articles. He presided over the Congress of Orientalists when it met at Leyden in 1931, having also been a member of the Congress when it met previously at Leyden in 1883.

Hurgronje was the author of a large number of contributions to the literature of oriental studies. Among his best-known works are "Mekka" (1888), a study of the Achinese (1893–94), and "Une Nouvelle Biographie de Mohammed" (1894).

Dr. F. J. F. Shaw, C.I.E.

DR. F. J. F. Shaw, whose death in India was recently announced, joined the Indian Agricultural Service in 1910 as a mycologist attached to the Agricultural Research Institute, Pusa. He remained at Pusa for the whole of his service except for a short period at Coimbatore in Madras, and was engaged in research in plant pathology and work on the control of plant diseases until 1928, when he was appointed Imperial economic botanist. Even in this latter appointment much of his work was the breeding of crop plants for resistance to disease, so that he retained his interest in plant pathology in the broad sense. Of late, much of his time was occupied in administrative duties, for he was appointed director of the Imperial Institute of Agricultural Research at Pusa in 1934, and as such had the supervision of the arrangements for transferring the Institute, wrecked by the Bihar earthquake that year, to a new site near Delhi. For the last few months he was at Simla officiating as agricultural expert with the Imperial Council of Agricultural Research; but he left to supervise some of the difficult operations of the transfer of the Institute, and was overcome by the heat at Agra.

Dr. Shaw was best known for his researches on the important fungal parasites of Indian crops belonging to the genus *Rhizoctonia*, and for his studies on the diseases of jute and the control of diseases of fruit trees and pulses. He was little interested in systematic mycology, and was led astray in the identification of the difficult members of the genus *Rhizoctonia* with which he worked, but he effected a considerable advance in knowledge of their biology and morphology. Of recent years, his chief work was a study of the types of the important Indian pulse crop, pigeon pea (*Cajanus indicus*), with the object of breeding for resistance to the wilt disease caused by *Fusarium vasinfectum*; in this difficult problem, for the crop is extensively out-pollinated, he achieved a considerable measure of success. If the work can be carried to a conclusion it will be of great benefit to Indian agriculture, for the disease is extremely destructive and the parasite so completely infests the soil as to necessitate prolonged rotation if the crop is to yield an adequate harvest. Other work on similar lines has been in progress at Pusa under Dr. Shaw's control on a number of crops such as cereals, linseed, gram (*Cicer arietinum*) and other pulses, tobacco and various fibre and oil seed crops; continuity in such work is essential, and Dr. Shaw's untimely death will greatly accentuate the difficulties of carrying it on, already made serious by the aftermath of the earthquake.

Dr. Shaw, who was fifty years of age, was educated at St. Olave's Grammar School and the Royal College of Science, obtaining the A.R.C.S. and D.Sc. (London). He was made a C.I.E. in the King's birthday honours list of this year.

Prof. Kikunaé Ikeda

By the death of Prof. Kikunaé Ikeda on May 3, Japanese science loses one of its foremost students of chemistry. Some details concerning his life and work appear in the May issue of the *Proceedings of the Imperial Academy, Tokyo*. Prof. Ikeda, who was born on October 8, 1864, studied science at the University of Tokyo and graduated in 1889. During the next seven years, he taught chemistry in the Tokyo Higher Normal School, where, both by his teaching and by the text-books that he published, he greatly assisted the general appreciation in Japan of the new science of physical chemistry.

In 1896, Ikeda was appointed assistant professor of chemistry in the University of Tokyo, in which capacity he came to Europe three years later for further study of physical chemistry. During his stay in Europe, he worked in Ostwald's laboratory, where, in collaboration with Bredig, he published important work on the poisoning of colloidal platinum catalysts. He also worked for a short time at the Davy Faraday Laboratory in London. On his return to Japan in 1901, he was appointed to a full professorship in chemistry, which he held for twenty-two years. During this time he was particularly occupied with the study of chemical kinetics and the theory of solutions. During this period he was appointed chief of the Chemistry Division of the Institute of Physical and Chemical Research, and he served also on the National Research Council of Japan.

On retiring from his professorship in 1923, Prof. Ikeda continued to take an active interest in chemistry. After a stay of seven years in Germany, he returned to Japan in 1931 and established a private laboratory where he studied various problems concerned with the applications of chemistry. The high esteem in which he was held was shown on his sixtieth birthday, when his friends and former pupils arranged a celebration and raised a large sum of money which, by his wish, was given to the Chemical Society of Japan for the extension of the scientific publications of the Society.

Mr. F. S. Stacey

We regret to announce the death, on August 11, of Mr. Francis Samuel Stacey, one of the pioneers of radiotelegraphy, at the age of fifty-six years.

Mr. Stacey was a student of Finsbury Technical College, and joined Marconi's Wireless Telegraph Co., Ltd. (then known as The Wireless Telegraph and Signal Co., Ltd.), in July, 1899, at the age of twenty years. After a short period in the Company's works he was employed for some time in experimental work as an assistant to Marchese Marconi, and, in 1900, was engaged in the execution of a contract for the installation of wireless on the whole fleet of Belgian cross-channel steamers. Shortly afterwards he was transferred to Marconi's Wireless Telegraph Company of Canada, where he remained until 1910, engaged in the construction of stations, experimental work, and the operation of the Glace Bay trans-Atlantic wireless station.

Between 1910 and 1912 Mr. Stacey was employed at the Marconi station at Poldhu in Cornwall in connexion with experimental work and development of long-range high-power stations which had their birth at Poldhu. From 1912 until 1914 he was acting chief of the Constructional Section of the Marconi Company, and in 1914 became chief of one of the contract sections which deals with the supply of every kind of commercial wireless telegraph apparatus. Among other things, his department of the Marconi Co. has been concerned with the execution of contracts for nearly all the broadcasting stations in England, and a very large number in Europe, Japan, South Africa, and South America.

Mr. Stacey was married in 1909 to Miss M. McLeod, a Canadian lady, and leaves a widow and two daughters.

We regret to announce the following deaths:

Prof. Luigi Devoto, professor of industrial diseases and director of the clinic of industrial diseases in the University of Milan, on July 22, aged seventy-two years.

Prof. Aubrey C. Grubb, professor of physical chemistry in the University of Saskatchewan, known for his work on the electrical activation of hydrogen and nitrogen gases, on July 29, aged fifty-two years.

Dr. H. A. D. Jowett, manager of the Wellcome Chemical Works, Dartford, an authority on medicinal alkaloids, on August 10, aged sixty-six years.

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News and Views

Jean-Baptiste-Louis Romé de l'Isle (1736–90)

AUGUST 26 is the bicentenary of the birth of Jean-Baptiste-Louis Romé de l'Isle, an assiduous student of natural history and a writer on crystallography. He was born at Gray in Haute-Saône. After being educated in Paris, he sailed to the East Indies as secretary of a company of artillery, and in 1761 became a prisoner of the English at Pondicherry, being held captive for three years. Having acquired a taste for science, on his return home he became a student of the chemist Balthasar-George Sage (1740–1824) and applied himself to mineralogy, forming a mineralogical cabinet, and in 1772 publishing his "Essai de Cristallographie". This work he afterwards enlarged and published in 1783 under the title "Cristallographie, ou Description des formes propres à tous les corps du règne mineral dans l'ètat de combinaison saline pierreuse ou métallique". It contained tables of all the crystals then known. Another subject to which he devoted much time was metrology, stimulated no doubt by the chaotic state of the weights and measures in France at the time. He collected a great mass of material relating to the subject, some of which he embodied in his "Métrologie, ou Table pour servir à l'intelligence des poids et mésures des anciens . . ." which appeared in 1789, the year the Revolution broke out. Through his close application to study he suffered somewhat from failing eyesight, and this being brought to the notice of Louis XVI, he was granted a small pension, although he had held no official position. His death took place in Paris on March 7, 1790.

Water Resources and Supply Control

THE Parliamentary Joint Committee appointed to consider and report on measures for the better conservation and organization of water resources and supplies in England and Wales has, in its report just issued (London : H.M. Stationery Office. 3*d*. net), made some caustic comments on the attitude of the Ministry of Health towards the general aspect of the whole question of national water administration, pointing out the one-sided nature of the composition of the Advisory Committee on Water, upon the reports of which the proposals of the Ministry of Health have been framed. The Joint Committee states that it is of opinion "that the methods of the Ministry of Health justify in no small degree the criticisms that have been levelled against them by reason of their apparent failure either to consider the point of view of, or to consult with, opposing interests before submitting their proposals to the Committee". Accordingly, the Committee does not see its way to endorse the memorandum submitted by the Ministry of Health, in which it is proposed that power should be given to the Minister to make orders scheduling areas within which the conservation of surface or underground water resources for water supplies is of public interest, the object of the orders being to prevent water from being drawn from those areas for water undertakings, or for industrial or other purposes, without his consent. The evidence of witnesses who appeared before the Committee showed unmistakably the hostility of interests connected with industry, agriculture and fisheries to any such form of dictatorship in water administration, alleging the incompetence of the Ministry of Health to appreciate needs other than those which are associated with water for domestic and sanitary uses. The Committee's judgment is that all proposals for the appropriation of supply areas should remain, as heretofore, under direct parliamentary control, and it is unable to recommend any procedure other than the continuance of that by Private Bill.

Proposed Central Advisory Water Board

THE principal constructive feature of the Joint Committee's report is its recommendation that a statutory Central Advisory Water Board should be set up, comprising representatives of the various ministries affected and other interested bodies, such as catchment and fishery boards, water undertakers and mill and riparian owners. In addition, it recommends the extension and development of the nine Regional Advisory Committees, at present in existence in various parts of the country, by the addition of three or four others, so as to cover the remaining areas, and it expresses the view that these bodies, which are purely voluntary with representation confined to water undertakers and the Ministry of Health, should be enlarged to include representatives of the catchment boards and other interests, and that they should discuss and report to the Central Advisory Water Board on any difficulties or differences and on general matters concerning their respective areas. The Central Board would collect and marshal all the available statistical data and information of the country's water resources and requirements, and advise the appropriate Minister as to the initiation of any schemes or proposals considered necessary in the public interest. The Central Board should further submit reports to all Select Committees of Parliament considering Bills on water supply, and make an annual report to be laid before both Houses of Parliament. The Joint Committee's report also deals with the question of compensation water, admittedly beset with complications, some of which are pointed out. Rejecting the formula proposed by the Ministry of Health, and indeed any formula, since no suitable formula can be found for general application, the Joint Committee concludes its report with a statement of the considerations which must apply in the assessment of compensation water, each case being, of necessity, determined on its particular merits.

Native Medical Practitioners in the South Seas

The Government of Fiji recognized many years ago the need for a medical service for the native population, but realized that the employment of European doctors on a large scale was impracticable on account of cost, and that practitioners of their own race would be best suited to attend to the needs of the natives. The Government therefore established the Native School of Medicine at Suva for the benefit of Fijians, and for many years its 'graduates' did excellent work. A few years ago, the Rockefeller Foundation commenced investigations upon the problems of disease and of depopulation in these islands, and was so impressed with the success of this Native School that it offered to co-operate with the Fijian Government, and suggested the training of natives from eight groups of islands in the School at Suva. The Government agreed to work in conjunction with the Foundation, and the School was then reorganized and reconstituted in its present form. The School is residential, and is attached to the Suva Memorial Hospital. Its direction is in European hands, the students are under reasonable discipline, and the cost of maintenance is small—something less than £3,000 a year—which is contributed in various ways.

Sir James Barrett, Vice-Chancellor of the University of Melbourne, gives an account of the activities of the School in an article in the *Morning Post* of August 7. The students are mostly Polynesians, and must pass a matriculation examination before admission, based upon the New Zealand proficiency examination, which ensures a good knowledge of English. The first year of the present four-years' course is devoted to elementary basic science, and the remaining three years provide the student with a sound, practical medical training in the Suva Hospital. After graduation, the practitioners return to their own islands as health or medical officers among their own people. The initial salary of a graduate is £60 a year, rising to a maximum of £150, which suffices for local requirements. If no European doctor is available, as is often the case, the native practitioner may attend to the medical requirements of Europeans. At present, eighty-four practitioners are at work, distributed over Fiji, Samoa, Tonga, the Cook Islands, Gilbert and Ellice Islands, Solomon Islands, and New Hebrides; of these, Fiji takes fifty-six. In addition, native nurses have been trained in large numbers; the Suva Hospital is staffed by twenty European and twenty Fijian nurses, and there are forty-seven obstetric nurses in Fiji alone. Sir James Barrett endorses the very favourable opinion on the efficiency of the School and of the practitioners it has trained expressed by Profs. Wright and Buckmaster, who, having visited Australia and New Zealand on behalf of the Royal College of Surgeons of England, passed through Suva on their return journey. Sir James envisages the adoption of some such system to meet the medical needs of the natives in other parts of the British Empire, referring to the existence of somewhat similar schools already founded in West Africa and Uganda.

The Radcliffe Observatory in South Africa

The 'turn-over' article in *The Times* of August 7 by Mr. H. E. Wood, the Union Astronomer, deals with astronomy in South Africa in general, and refers in particular to the forthcoming re-establishment of the Radcliffe Observatory at Pretoria. The history of astronomy in South Africa begins in 1685, when Father Tachard called at the Cape on his way to Siam and determined the longitude by observations of Jupiter's satellites. During the next century, two expeditions visited the Cape, and 1820 saw the foundation of the Royal Observatory, which has made such notable contributions to our knowledge of the southern stars. In 1834 Sir John Herschel landed there and made his famous catalogues of nebulæ and double stars. There are now four other observatories in South Africa: the Union Observatory and the southern station of Yale University Observatory at Johannesburg, and those of Harvard and Michigan at Bloemfontein. The Radcliffe Observatory, for more than a hundred and sixty years at Oxford, will, it is hoped, have started its new life at Pretoria within the next two years. Good progress is being made with the construction of its 74-inch reflector by Sir Howard Grubb, Parsons and Co. This will differ in several respects from its sister telescope at Toronto, as it will have, in addition to facilities for observation at the Newtonian and Cassegrain focuses, an arrangement for sending the beam of light down the polar axis to a fixed spectrograph, and it will be driven by a synchronous motor, the frequency of the alternating current being controlled by a tuning fork. The disk of Pyrex glass for the large mirror has been cast by the Corning Glass Co. and is now being annealed. The five secondary mirrors will be of fused silica, and the disks for these are being made by the Thermal Syndicate, Ltd.

Archæological Excavations in Britain

With the coming of university and school vacations, numbers of voluntary workers are released for archæological investigations in the field. Since July, excavations have been resumed or initiated on many sites in Britain. The scheme of training in field work through voluntary assistance organized by Dr. R. E. Mortimer and the late Mrs. Wheeler is again in being, this year on an extended scale. Nearly a hundred students drawn from universities in the British Isles, Australia, India, Canada, the United States and China are at work on the continued excavation of Maiden Castle, near Dorchester, under the direction of Dr. Wheeler and Col. C. D. Drew. Although the season has only just opened, some important results already have emerged. On the hill-top in the neighbourhood of the temple of the Roman period discovered in 1934, according to a report in *The Times* of August 14, further stone age habitations, with stone implements and pottery, have been discovered. A series of pits has been uncovered, in which were pottery and animal bones, including those of large oxen of a type now extinct. The neolithic site underlying the fortifications is also being explored. Extensive areas containing stone implements and pottery have been opened up; and a stone age trench now being examined is found to be covered with a well-marked line of turf underlying the later prehistoric rampart. It contains large masses of material of the stone and early bronze ages, while on top of the trench numerous sherds of elaborately decorated Early Bronze Age pottery are being identified.

EXCAVATIONS have also been resumed on behalf of the Ipswich Museum under the direction of the curator, Mr. Guy Maynard, on the Stanton Chair Farm Roman site between Ixworth and Stanton in Suffolk, where investigations were initiated last autumn as a result of the observation of Roman potsherds and tile fragments in a field. Although it is known that the area of the site is at least two hundred feet across, operations at present are confined to a narrow strip, as the ground is under crops. Work, accordingly, has been concentrated on clearing the remains of a bath-house, of which the hypocaust pillars are well preserved, and a drain from the cement floor of an adjacent room still remains. Two levels of flooring and coins of Marcus Aurelius (A.D. 161–186) and Eugenius (A.D. 393) suggest a prolonged, but interrupted occupation. Six weeks of excavation at Castle Dore, an Iron Age hill-fort, near Fowey, in Cornwall, under the direction of Mr. Ralegh Radford, with the unemployed for labour, has confirmed previous conclusions as to its character. It was evidently a strong point commanding the ancient prehistoric road and trade route across the peninsula. It is now considered beyond reasonable doubt that this was, as has been suggested, the palace of the King Mark of Arthurian legend. Students of the University of Liverpool excavating, also with the assistance of local unemployed, on Eddisbury Hill, Cheshire, have brought to light traces of an ancient fortress in the form of walls of local sandstone, five to six feet in height, in an excellent state of preservation.

Ultra-short Wave Radio Communication

THE practical application of ultra-short waves to radio communication made a step forward on June 11, when R.C.A. Communications Inc. gave a public demonstration of their new circuit connecting New York with Philadelphia. A brief illustrated description of this demonstration is given in the June issue of *Communication and Broadcast Engineering* (U.S.A.). The circuit operates over a distance of about 91 miles with the aid of two automatic relay stations situated between the terminal stations at New York and Philadelphia, the longest individual link being 36 miles. A two-way service is provided, and the six wave-lengths required are in the neighbourhood of three metres; the stations are equipped for the transmission of drawings, typescript and other visual material in facsimile, with simultaneous operation of typewriter and telegraph channels. The article referred to above includes a schematic diagram of the circuit which is reproduced from one actually transmitted to New York by the facsimile circuit. The transmitters make use of resonant line circuits in order to secure frequency stability, while the receivers incorporate the new acorn tubes specially produced for ultra-short wave purposes.

AN interesting feature of the new installation is the method by which the unattended relay stations may be turned on or off from either of the terminal stations. The receivers at each of the four stations are always alive and available for reception from their corresponding transmitters. When it is desired to make the circuit ready for traffic, New York or Philadelphia sends out a tone modulation on its carrier wave. This tone is accepted by the receiver at the first relay station, and is caused to start up its own transmitter, which then passes the tone modulation on to the second relay station. The operation is repeated here and also at the other terminal station, where the tone is re-transmitted back through the relay stations on the return circuit. Thus when the tone signal is received back at the terminal station from which it originated, it is known that all six transmitters are in operation and the radio circuit is ready to pass traffic. When the circuit is no longer required, the tone is removed and the transmitters are automatically switched off, one by one, in the same sequence.

League of Nations Reform

IN a pamphlet entitled "Anarchy or Peace", Lord Davies discusses the dangers of the present situation in Europe and the possibilities of avoiding the outbreak of an even more disastrous European war (London: The New Commonwealth. 9*d*.). Referring to the defects of the League of Nations as demonstrated by recent events, Lord Davies asserts that these were due to the absence of an equity tribunal and international police force, and more particularly to the lack of cohesion and determination on the part of States members of the League. Accordingly, he heavily discounts a good many of the proposals to reform the League as designed rather to deprive the League of the very functions which would enable it to secure the peace of the world if its machinery were honestly and whole-heartedly used. Proposals to substitute a series of regional pacts are only too certain to plunge us back in the pre-War system with its inevitable outcome. Lord Davies argues that the only solution of our present dangerous situation lies first in the creation of peaceful procedure for the settlement of all disputes and the revision of treaties. For this purpose, in default of a more satisfactory solution, an equity tribunal holds the field. Secondly, an international police force is required, and he urges once more the equipment of a European air police force under the control and direction of a neutral authority, a reconstituted League. This force must be superior in numbers and equipment to the national air force of any European State which refuses to join in the guarantee. Only a scheme on these lines will suffice to restore the confidence of the smaller powers in the integrity and good faith of the great powers, and endow the League with the superiority of force essential for the establishment of the rule of law.

Liverpool Learned Societies

The newly issued handbook of the Associated Learned Societies of Liverpool and District shows there are about four thousand members of the twenty-four scientific, industrial, literary, art and educational societies in the association. One of the largest of the industrial societies, the Liverpool Engineering Society, has some seven hundred members, and the Liverpool Naturalists' Field Club is the largest of the Nature and outdoor societies. Since the last handbook was issued ten years ago, the number of learned societies in the association has fallen by two. Local societies which have increased their membership in the past ten years are the British Association of Chemists, the Institute of Chemistry and the Liverpool Naturalists' Field Club; those that have remained at the same strength include the local branch of the Pharmaceutical Society and the Amateur Photographic Association, while those that have declined in membership somewhat include the Liverpool Botanical Society, Geological Society, Biological Society, Literary and Philosophical Society, Astronomical Society, Engineering Society, Lancashire and Cheshire Entomological Society, Society of Chemical Industry and the New Education Fellowship. The Associated Learned Societies of Liverpool and District was formed in 1922, though since 1880 there had been a scheme of co-operation between local societies, chiefly for staging annual exhibitions and soirées of their activities. The work of the present association includes holiday prize contests in the local schools, outdoor and indoor joint meetings of an educational nature, periodical public scientific exhibitions, lectures, etc., and various schemes for closer co-operation amongst the various learned societies of the district.

Research and the Jute Industry

The prosperity of Bengal, both agricultural and industrial, is dependent very largely on jute, and the intense period of depression which has overtaken the industry since 1929 has caused widespread distress. The Agricultural Commission, of which the present Viceroy was chairman, in a strongly worded paragraph of its report, directed attention to the necessity for the application of scientific methods in the industry; the position has since been surveyed by Dr. S. G. Barker. In the March issue of *Science and Culture*, Dr. Barker's report is discussed. Dr. Barker has recommended a comprehensive scheme of research which includes the establishment of a laboratory with arrangements for the collection of general and technical information and for foreign representation. This new organization is estimated to cost £27,000 per annum, and it would be under the control of the Jute Mills Association. *Science and Culture* appears to doubt whether the control suggested by Dr. Barker is likely to prove successful, since it is feared that the mill owners may be prone to look for immediate financial returns. It is suggested that a scheme organized on the lines of the Indian Central Cotton Committee might be more advantageous. In view of the urgency of the problem, we regard the nature of the controlling body to be of minor importance, since the success of the scheme will depend mainly upon the director of research and upon the personnel of the new laboratory. It is gratifying, therefore, to learn that the Government of India has already accepted Dr. Barker's proposals, and that it has appointed an Indian Central Jute Committee. The Committee will be financed by Government, which will place at its disposal approximately £30,000 per annum for a minimum period of five years. We extend a cordial welcome to this new research organization, which we have no doubt will do much to restore the ancient prosperity of Bengal.

Road Transport Vehicles

Instructive figures are given in *World Power* of June showing the relative progress made by the three principal types of road transport vehicles—tramways, motor-buses and trolley-buses. In 1930–31, tramways transported 72·7 per cent of all passengers, the motor-bus 24·2 per cent and the trolley-bus 3·1 per cent. In 1934–35 the figures were 59 per cent, 35 per cent and 6 per cent respectively. Although the tramways with 2,479 million passengers in 1934–35 still convey more persons than the motor-bus and trolley-bus combined, the decline of tramway passengers since 1930–31, when it was 3,018 millions, has been continuous. During the year 1935, the number of passengers carried by the trolley-buses was 255 millions, an increase of 36 per cent on the preceding year. The London Passenger Transport Board recently reported an increase of 20 per cent in the London area along trolley-bus routes. It has been calculated that an oil-driven bus would require a 250 horse-power engine to equal the performance of a 100 horse-power trolley-bus with a capacity of 36 seats carrying a full load up a 7 per cent gradient at a speed of 30 miles per hour. From the point of view of national economy, it is a pity, although trolley-bus progress is satisfactory, that it is not making more rapid headway. In the near future, it may be of primary importance to consume home-produced fuel to produce the necessary motive power for traction. When the traffic is very heavy, electric tramways are the most economical, but tram-cars often stop the traffic to unload passengers, whilst trolley-buses can unload them directly on the pavement.

A Horticultural Colour Chart

The naming of colour is notoriously difficult, and it is unfortunate that the standard works by Ridgway, Oberthur and Dauthenay, and others, are either out of print or too expensive to have wide application. Gardeners are, perhaps, the community most in need of a comprehensive manual portraying accurate shades of colour, and the Royal Horticultural Society is to be congratulated upon its attempt to meet this pressing need. It is proposed to print a volume of a hundred colours, each in four shades, and, if successful, to follow it by a second volume of similar dimensions. The plates would be either loose in a cover, or held by a loose-leaf binder, and the estimated price is 10*s*.

per volume. This, however, may possibly be reduced if sufficient applications follow the prospectus now issued. A specimen sheet indicates that each colour would be named, and referred also to the British Colour Council's classification, to the "Repertoire des Couleurs", and to the standards of Ridgway and Ostwald. A brief history of the name appears, horticultural examples are cited, and French, German, Italian and Spanish synonyms are given. The chart should have great utility, not only in the garden, but also wherever colours have to be compared with accuracy. A preliminary application form is now available, and those interested should communicate with the Royal Horticultural Society, Vincent Square, S.W.1. It is expected that the first volume will appear towards the end of 1936 or early in 1937.

Medal Awards for Inventions

THE Council of the Institute of Patentees has decided to suspend the award of the Institute Bronze Medal and in place thereof to substitute the Institute's Silver Medal to rank equally with the Founder's Silver Medal. These medals will be awarded in each section of the Exhibition of Inventions to be opened in the Central Hall, Westminster, S.W.1 on September 30 and in Newcastle on November 25; therefore ten silver medals will be awarded throughout the five sub-sections of the New Inventions Section of the Exhibition. The Gold, Silver and Bronze Certificates will be awarded as in previous years. As the Institute proposes to organize a series of exhibitions throughout the country, it has been decided that the Grey-Wilson Memorial Gold Medal, supported by cash prize, together with the Yorkshire Medal, will be competed for during January of each year, the successful exhibitors at any Exhibition organized by the Institute being eligible to compete. The Yorkshire Medal is a new medal which was provided for under the will of the late Mr. Hoffman-Wood, an architect of Addingham, Yorkshire, who died three years ago, and the Institute will make recommendations annually to the trustees regarding its award. The medal is valued at twenty-five guineas, and sufficient funds are available for an award in perpetuity. The award of the Yorkshire Medal must be for an invention not relating to warfare.

International Naval Architecture and Marine Engineering

THE first international meeting of naval architects and marine engineers to be held in the United States takes place in New York on September 14–19, at which papers will be read dealing chiefly with safety of life at sea and large Atlantic liners. The Dominion of Canada, France, Germany, Great Britain, Italy, Japan, Spain and Sweden are sending delegations at the invitation of the Society of Naval Architects and Marine Engineers of New York. The British delegation, under the leadership of Lord Stonehaven, president of the Institution of Naval Architects, and Dr. J. T. Batey, president of the North-East Coast Institution of Engineers and Shipbuilders, will number about a hundred, including ladies, and will represent the Institution of Naval Architects, the Institute of Marine Engineers, the Institution of Engineers and Shipbuilders in Scotland, and the North-East Coast Institution of Engineers and Shipbuilders.

International Congress of the History of Science

THE fourth International Congress of the History of Science will meet in Prague, in 1937, during the last week of September. The principal theme of the Congress will be "Science in the Eighteenth Century". The chairman of the Congress and of the Organizing Committee is Prof. Quido Vetter, the actual president of the International Academy of the History of Science. The announcement was made and discussed at the meeting of the Academy of the History of Science at Cluj (Rumania) in conjunction with the International Committee of Historians, in April last. During the meeting, several papers of great interest were read: (1) A. Mieli, "Our Present Knowledge of Arabian Science"; (2) Prof. A. Reymond (Lausanne), "Occult Sciences and Exact Science in Ancient Times"; (3) Prof. A. Singh (Lucknow), "History of Trigonometry in India"; and (4) Prof. V. Bologa (Cluj), "Foreign Influences on Rumanian Medicine". In a business session of the meeting, Drs. Reymond, Ulrich, Sergescu, Singh and Greenwood read reports on the organization of the teaching of the history of science in their various countries. The "Chronological Repertory of the Exact Sciences during the Sixteenth Century" was adopted for publication as a special number of the *Bulletin du Comité des Sciences Historiques*.

British School of Archæology at Athens

IN October next the British School of Archæology at Athens will celebrate the fiftieth anniversary of its foundation. As part of the celebration an exhibition will be held at the Royal Academy of Arts, Burlington House, London, to illustrate the discoveries in Greece and Crete, which have resulted from the work of the School. A special section of the exhibition will be devoted to the Minoan civilizations of Greece and the excavations at Knossos, which were conducted by Sir Arthur Evans, honorary student of the School, and in which the architects of the School took part. This section of the exhibition is being prepared by Sir Arthur Evans himself, with the facilities given him by the authorities of the Ashmolean Museum, Oxford, to which the antiquities brought from Knossos by Sir Arthur were entrusted. It is understood that the exhibition will be inaugurated by H.R.H. the Duke of Kent on October 13, at 3 p.m., and will be open to the public from October 14 until November 14. The occasion of the jubilee of the School will also be marked by a special fund which it is proposed to raise to enable the School to increase its staff, improve its library and accommodation, and provide for the needs of the graduates who are sent to Greece in increasing numbers for advanced study by the universities.

Congrès Préhistorique de France

IT is announced that the twelfth session of the Congrès Préhistorique de France will be held at

Toulouse on September 13–16 and continued at Foix on September 17–20. This is the third occasion only on which the Congress has met since the Great War, the meetings, held biennially between 1905 and 1913, having been intermitted during and after the War until 1931. The coming session, which is the first to be held in the Pyrenean region, will afford members an opportunity to visit a number of famous and important archæological sites, such as Aurignac, Mas d'Azil, Marsoulas, Gargas, Niaux and Portel. Excursions to these are being arranged as part of the daily programme. As is usual in congresses of this character, a number of topics is suggested for the communications to be submitted. These include the earlier palæolithic of the area, the terraces of the Garonne and their quartzites, prehistoric art, the mesolithic and the neolithic periods, and artificial caves and subterranean refuges. Arrangements are being made by the local committees at Toulouse and Foix for a special exhibition of prehistoric finds from the excavations and collections of the archæologists of the two departments of Haute Garonne and Ariège. It is also to be noted that the Musée d'Histoire Naturelle de Toulouse has a collection of cave exhibits which is considered to be the finest in the whole of France. The Congress, of which M. le Comte H. Begouen will act as president, has the official support of the University of Toulouse, the municipal authorities of Toulouse and Foix, and the Departmental Councils of Haute Garonne and Ariège. Subscriptions (members, 30 francs; members receiving the report, 100 francs; associates, 20 francs) should be forwarded to the General Secretary and Treasurer, M. Ch. Schleicher, 9 rue de Verneuil, Paris (vii^e).

Announcements

AMONG the appointments and promotions in the Colonial Service recently announced are the following: C. C. Webster to be agricultural officer, Nigeria; D. A. B. Davies to be field geologist, British Guiana; H. A. Smith to be divisional engineer, Posts and Telegraphs Department, Nigeria; A. A. Strachan to be senior engineer, Posts and Telegraphs Department, Malaya.

ON August 14, M. Georges Détré, a French airman, established a new world altitude record of 14,836 metres (48,674 ft.) at Villacoublay. According to the Paris correspondent of *The Times*, this figure exceeds by more than 400 metres (1,749 ft.) the previous record set up by the Italian, Signor Donati, in April 1934. The machine used by M. Détré was a Potez 50 Special fitted with a Gnôme-et-Rhône *K*.14 engine.

The Council of the Iron and Steel Institute makes annually a limited number of grants from the research fund founded by the late Mr. Andrew Carnegie in aid of metallurgical research work. The object of the scheme is to enable qualified students to conduct researches on problems of practical and scientific importance relating to the metallurgy of iron and steel and allied subjects. Candidates, who must be less than thirty-five years of age, must apply before September 30, on a special form to be obtained from the Secretary of the Institute. The maximum amount granted in any one year will, as a rule, not exceed £100.

OF 2,590 offenders examined in the psychiatric clinic of the Court of General Sessions, New York, within the past year, less than 1 per cent were found to be definitely insane.

DR. MAXIMILIAN EHRENSTEIN, research fellow in physiology, Department of Medicine, University of Virginia, has been awarded one of the prizes of the Van't Hoff Fund by the Royal Academy of Sciences of Amsterdam in recognition of his work on the alkaloids of tobacco and the catalytic dehydrogenation of cyclic bases.

WE have received from the City Librarian of Leeds eight bulletins or catalogues of technical engineering books. They are divided into the following eight groups: (1) mechanics and materials; (2) mechanical engineering; (3) workshop practice; (4) civil engineering; (5) mining engineering; (6) metallurgy and metal working; (7) electrical engineering—part I; (8) electrical engineering—part II. Each of the catalogues is subdivided, so it is a very simple matter to find out the standard technological works dealing with a particular subject. The address is Leeds Public Libraries, Municipal Buildings.

IN the letter "Anomalies in the Fine Structure of the First Spark Spectrum of Iodine" (NATURE, June 20, p. 1030), the line λ 4060·2 is said to consist of three components: 0·000 (4), + 0·081 (3), + 0·121 (2) cm.$^{-1}$. Dr. K. Murakawa informs us a mistake occurred in his manuscript; this line should read: 0·000 (2), + 0·081 (3), + 0·121 (4) cm.$^{-1}$.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

Temporary assistant civil engineers in the Air Ministry—The Secretary (W.B.9), Room 712, Adastral House, Kingsway, W.C.2 (August 22).

A part-time teacher of zoology and/or biology in the Northern Polytechnic, Holloway, N.7—The Clerk (September 4).

An experimental assistant in a War Department establishment at Woolwich—The Superintendent, Signals Experimental Establishment, Woolwich Common, S.E.18 (September 4).

Junior scientific officers in the National Physical Laboratory, Teddington—The Director (September 15).

An instructor in electrical engineering in the Bulawayo Technical School—The Official Secretary, Office of the High Commissioner for Southern Rhodesia, Rhodesia House, 429 Strand, W.C.2 (September 19).

A professor of anatomy in the University of Manitoba—The Dean, Faculty of Medicine.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 332.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Variation of Cosmic Ray Intensity with Sidereal Time

HOURLY records of the intensity of the cosmic radiation have been made at Cape Town since February 1933 in accordance with a scheme organized by Steinke, Hess and others for the study of the radiation. The instrument consists of an ionization chamber and electrometer provided with photographic registration. The rise of collector potential is compensated every half-minute by a condenser potentiometer device, and the accuracy of a single hourly observation is 0·1 per cent.

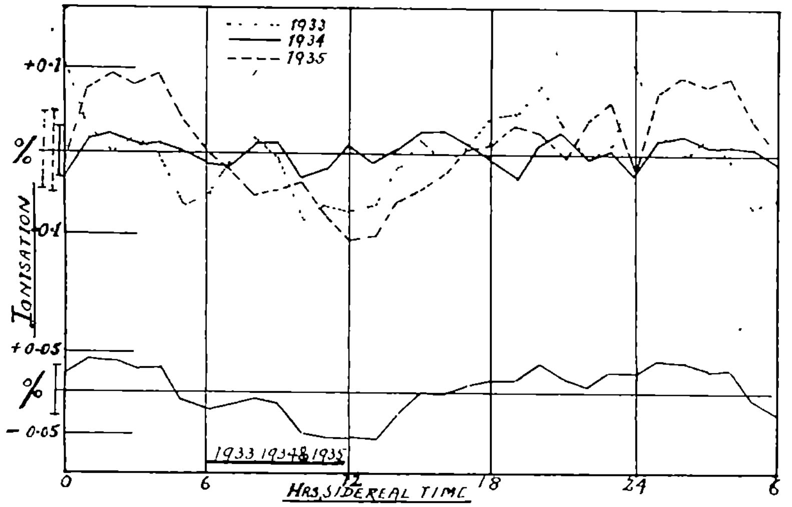

FIG. 1.

We wish to report upon the sidereal time variation during three years of observation, in which for two thirds of each month the chamber was totally enclosed in a shield of lead 10 cm. thick. Each observation has been reduced to a standard pressure of the absorbing atmosphere. Hourly means of intensity have been plotted in the upper set of curves (Fig. 1) for the years 1933, 1934 and 1935, and the combined observations for the three years are shown in the lower curve. The total number of hours of observation is 14,094. Probable errors (root mean square deviations) are indicated by vertical lines on the left-hand side.

It will be seen that the lower curve shows a variation of some 0·04 per cent of the mean, roughly sinusoidal, with maximum at about 24 hr. local sidereal time and minimum at 12 hr. A similar variation is found in the separate curves for 1933 and 1935, but is not definitely indicated in 1934. A variation of this character and phase has been noticed in the observations of Hess and Steinmaurer[1] on the Hafelekar in 1932. Compton and Getting[2] have ascribed it to the effect of the galactic rotation, which if the rays came uniformly from outer space would cause a maximum to be observed in both hemispheres at 21 hr. local sidereal time. They have pointed out the importance of observations in the southern hemisphere, for if the effect observed in the northern hemisphere were due to a seasonal change in the well-known solar diurnal variation, that in the southern hemisphere should show a maximum at 9 hr., being shifted in phase by 12 hr.

Since no such phase shift is observed, we conclude that the very small variation found in both hemispheres is a true sidereal time effect.

B. F. J. SCHONLAND.
B. DELATIZKY.
J. P. GASKELL.

University,
Cape Town.

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[1] V. F Hess und R. Steinmaurer, *Sitzb Pr. Akad der W.* (Phys. Math Klasse), **15**, 15 (1933).

[2] A H. Compton and V. Getting, *Phys. Rev.*, **47**, 817 (1935).

Measurements of Cosmic Ray Intensity in a Deep Mine

IN a coal mine in the neighbourhood of Budapest, at a depth of 315 m. below the surface, we made measurements of the cosmic ray intensity with triple coincidence apparatus. To obtain still thicker layers of material we measured the intensity at different angles from the vertical, using a very narrow aperture. The results of these experiments show that cosmic rays penetrate through a layer with a thickness of 2,500 m. water-equivalent. For corpuscular rays this will mean that the energy of the particles must surpass 10^{11} e.volt, using the formula of Bethe. The intensity distribution was found to be as follows: 1,700 coincidences per hour on the surface, 0·78 coincidences per hour at an effective depth of 700 m. of water and 0·09 coincidences per hour at 2,500 m. effective depth.

We found, further, that cosmic rays may produce showers even after passing through 700 m. water-equivalent, and that the penetrating power of the shower-particles is of the same magnitude as that usually stated for level measurements.

J. BARNÓTHY.
M. FORRÓ.

Institute for Experimental Physics,
University of Budapest,
Budapest. July 22.

Ranges of Particles emitted by Samarium

In view of some divergences in the determinations of the range of the α-particles of samarium, Prof. Wertenstein suggested that I should make some new experiments on this subject.

The ionization chamber used for determinations of ranges consisted of a spherical glass bulb, of 6·9 cm. radius, with silvered inner walls, and a concentric steel sphere of 1 cm. radius, on which a thin layer of the substance under examination could be deposited. This sphere was connected to a Hoffmann electrometer, while the bulb was put into communication with a vacuum pump. The ionization due to samarium was measured at different pressures. The sensitivity of the electrometer varied within small limits, but was on the average 30,000 ions for a division.

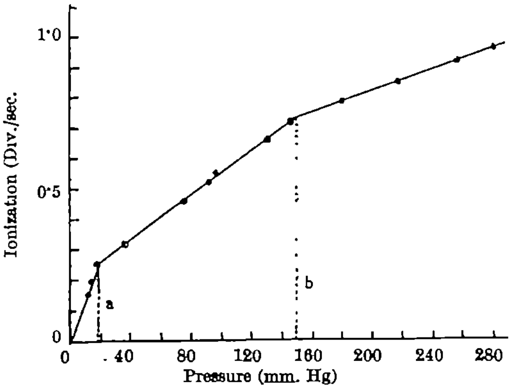

Fig. 1. Ranges of α-particles from samarium. *a* is the new range observed; *b* is the known range of samarium particles.

The curve in Fig. 1 shows the ionization current as a function of the pressure for a film of samarium oxide (Sm_2O_3) of 0·416 mgm./cm.². (A specimen of pure samarium oxide was kindly lent by Prof. G. v. Hevesy to Prof. Wertenstein.) The position of the kink corresponding to the range of α-particles of samarium can be determined with great precision. From this position I find that this range is equal at 760 mm. and 15° to 1·150 cm., in good agreement with the value recently found by R. Hosemann[1].

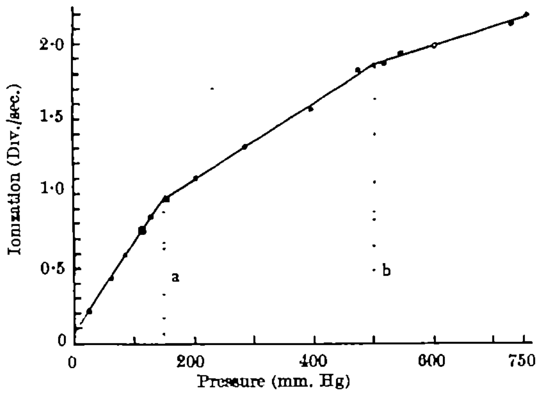

Fig. 2. Ranges of α-particles from samarium and polonium. *a* is the range of particles from samarium, *b* is the known range for particles from polonium.

The curve in Fig. 2 was obtained with a film of 1·05 mgm./cm.² of samarium oxide to which a very small amount of polonium was added for calibration. The position of the kink due to α-particles of samarium is exactly the same as in Fig. 1, while the range of α-particles of polonium I find to be 3·907 cm., in excellent agreement with recent data.

The interesting fact is that the curve in Fig. 1 shows also another kink, clearly indicating the existence of ionizing particles of much shorter range, namely, 0·13 cm. The existence of these particles is also confirmed by the fact that the straight line continuation of the curve in Fig. 2 does not pass through the origin of co-ordinates but above it.

The total ionization due to these particles is equal to about 35 per cent of the total ionization due to α-particles, which makes it highly improbable that the particles of short range should be recoil atoms of any element formed during the disintegration of samarium. No adequate explanation of the nature and origin of these particles has so far been found, and further experiments are in progress.

Leon Lewin.

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Free University of Poland,
Warsaw.
July 16.

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[1] R. Hosemann, *Z. Phys.*, **99**, 405 (1936).

Absorption of Thermal Neutrons in Silver at Low Temperatures

We have measured the absorption curves for neutrons of Fermi's[1] group 'C' using a silver target (2·3 min. activity) as detector, in the centre of a large Dewar vessel containing either liquid hydrogen or water at room temperature. Source, absorber and target were kept at room temperature. The intensity of the *C* group was determined in the usual way by taking the difference between the whole activity and that obtained by screening the target with 0·3 mm. cadmium. If a Maxwellian distribution for the energies of neutrons of this group be assumed, and if the $1/v$ absorption law predicted by theory is valid for silver, the ratio of the absorber thickness necessary for equal absorption at different temperatures would be expected to be independent of the absorption itself and to be equal to the square root of the inverse ratio of the temperatures. Experimentally we found that this ratio for 290° K. and 20·4° K. is in fact constant over the whole of the absorption curves; its value, however, was found to be 2·2 ± 0·2, instead of 3·8 to be expected from the $\sqrt{T_2}/\sqrt{T_1}$ hypothesis. One of the silver absorbers was measured also at 77° K. in paraffin and the ratio of thickness was also in this case considerably smaller than that given by the theory, the point being nearer to 290° K. than to the 20·4° K. curve. The results of the measurements are given in the table below.

Temperature (Kelvin)	Thickness of absorber mm.	Thickness of absorber gm./cm.²	Transmission for C-neutrons per cent
20·4°	0·26 0·50 0·64 2·0 3·0	0·0273 0·0525 0·0672 0·210 0·315	58·5 ± 3·8 48·1 ± 2·5 40·0 ± 2·0 15·3 ± 2·2 9·4 ± 3·6
77°	0·64	0·0672	57·5 ± 2·8
290°	0·64 2·0 3·0	0·0672 0·210 0·315	68·8 ± 2·0 31·4 ± 4·4 22·2 ± 1·2

We must conclude, therefore, that at low temperatures either the energy distribution of neutrons in the C group is not given by Maxwell's law or the $1/v$ law does not hold for the absorption of C neutrons in silver, using the second period as detector.

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L. SHUBNIKOV.
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Kharkov.
June 18.

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[1] E. Amaldi and E. Fermi, *Ricerc. Scient.*, ser. II, 7, vol. 1, No. 11-12. See also F. Rasetti and G. A. Fink, *Phys. Rev.*, **49**, 642 (1936) and P. N. Powers, G. A. Fink and G. A. Pegram, *Phys. Rev.*, **49**, 650 (1936).

Cross Linkage Formation in Keratins

OWING to the breakdown of salt and sulphur linkages, and consequent rearrangement of the peptide chains, untreated wool fibres contract 30 per cent in length in boiling sodium bisulphite solution, whereas fibres containing stable linkages between the peptide chains fail to contract under similar conditions[1]. This fact has been used to show that baryta-treated fibres contain —S—Ba—S— bonds[2], and set fibres contain —S—NH— bonds[3] between the peptide chains. In addition, since caustic soda-treated fibres fail to contract in sodium bisulphite solution, it was suggested that $-\overset{|}{\underset{|}{C}}-S-\overset{|}{\underset{|}{C}}-$ bonds are formed by the action of caustic soda on the cystine linkage, thus explaining why skins are more difficult to unhair after treatment with alkali[4]. In support of this view, it was pointed out that Harris had failed to reduce the sulphur content of wool fibres to less than half its original value by caustic soda treatment[5], and that Küster and Irion had isolated a $-\overset{|}{\underset{|}{C}}-S-\overset{|}{\underset{|}{C}}-$ derivative from the products of the action of sodium sulphide on wool[6]. More recently, Harris[7], taking advantage of the work of Zincke and Farr[8], and of Schöberl[9], has shown that aldehyde groups are produced by loss of hydrogen sulphide from the sulphenic acid derived from the disulphide bond by alkaline hydrolysis, and Phillips[10] has suggested that the aldehydes may condense with the basic side chains of wool to produce —N=CH— bonds between the peptide chains.

This suggestion appears to be valid, because caustic soda-treated fibres, which fail to contract in boiling sodium bisulphite solution, contract after being subjected to treatments calculated to break —N=CH— bonds. For example, caustic soda-treated fibres, boiled in $N/5$ hydrochloric acid for 30 minutes, contracted 16 per cent in boiling 5 per cent sodium bisulphite solution; and treated fibres boiled in $N/10$ pyruvic acid for 1 hour contracted 14 per cent under similar conditions[11]. It seems probable, therefore, that —N=CH— bonds are present in caustic soda-treated fibres, although the incompleteness of the contraction implies that other types of bond are present, possibly the $-\overset{|}{\underset{|}{C}}-S-\overset{|}{\underset{|}{C}}-$ bond first mentioned in this connexion.

Although Phillips makes no such suggestion in his note[10], it might be assumed that the new linkages formed in 'setting' stretched fibres in steam are —N=CH— in type, rather than the —S—NH— bonds first postulated. This does not seem to be the case, because fibres set in boiling 2 per cent borax solution fail to contract in boiling $N/5$ hydrochloric acid or $N/10$ pyruvic acid. Not only so, but the fibres boiled in $N/5$ hydrochloric acid retain a set even in boiling sodium bisulphite solution. Similarly, if permanent set were due to the formation of —N=CH— bonds, the response of fibres to setting processes should be increased by pretreatment with alkalis to develop aldehyde groups. In actual fact, setting power decreases steadily with increasing time of treatment with alkali, the amount of permanent set being a linear function of sulphur content in the case of baryta-treated fibres. These and other observations, which will be described elsewhere, find a ready explanation in terms of —S—NH— bond formation in setting processes, but no explanation in terms of the —N=CH— bond.

J. B. SPEAKMAN.

Textile Chemistry Laboratory,
University, Leeds.
July 25.

[1] Speakman, NATURE, **132**, 930 (1933).
[2] Speakman, Applied Chemistry Reports, **20**, 164 (1935).
[3] Speakman, *J. Soc. Dyers and Colourists*, Jubilee Number, 1934, p. 34.
[4] Whewell, Ph.D. Thesis, University of Leeds, 1935.
[5] Harris, *Bur. Stand. J. Research*, **15**, 63 (1935).
[6] Küster und Irion, *Z. physiol. Chem.*, **184**, 225 (1929).
[7] Harris, *Bur. Stand. J. Research*, **16**, 475 (1936).
[8] Zincke und Farr, *Annalen*, **391**, 57 (1912).
[9] Schöberl, *Annalen*, **507**, 111 (1933).
[10] Phillips, NATURE, **138**, 121 (1936).
[11] Fischer, *Annalen*, **253**, 63 (1889).

Effect of Dichlor-diethyl-sulphone on Brain Respiration

MY colleagues and I have been developing recently the theory that vitamin B_1 is a specific factor in the oxidation system of pyruvic acid. In a search for substances which would inhibit specifically this action of vitamin B_1 in its relation to the pyruvate oxidase of brain, I tried ten months ago the effect of dichlor-diethyl-sulphone $(Cl.CH_2.CH_2)_2\ S.O_2$, for a specimen of which I am indebted to Dr. E. Walker. I am encouraged to communicate the results by the recent publication of Berenblum, Kendall and Orr[1], who state that D.E.S. with tumour tissue inhibits respiration some 50 per cent and glycolysis some 84 per cent. I have found that the action of D.E.S. upon our brain respiration systems *in vitro* resembles in detail the effect of iodoacetic acid[2]; the significant points are as follow:

Noticeable effects upon respiration in lactate Ringer phosphate solutions are produced by so little as 0·000087 M. (up to 50 per cent inhibition) D.E.S. With 0·000174 M. (similar concentration for iodoacetic acid, 0·005 M. approx.) and our usual technique, pyruvate is not oxidized, but accumulates from normal respiring brain tissue in presence of lactate. Hence at this concentration in the reactions

$$\text{Lactate} \underset{C}{\rightarrow} \text{Pyruvate} \overset{\begin{array}{l}\text{D.E.S.}\\ \downarrow \text{ iodoacetic acid}\end{array}}{\underset{D}{\rightarrow}} \text{oxidation products}$$

there is no appreciable effect upon step C, but only upon D. Lack of vitamin B_1 also affects stage D, but as with iodoacetic acid, the action is not upon the vitamin B_1 component. Addition of excess vitamin B_1 will not restore the action with normal brain tissues, nor is the toxic effect removed by addition of glutathione (GSH), provided that time has elapsed to permit complete action of the D.E.S., which is rather slow (it needs some 30 min. at 38° C., pH 7·3). Further proof that the vitamin B_1 component is not involved lies in the following: Vitamin B_1 incubated for 35 min. at 38° C. with D.E.S. in excess (pH 7·3) can be proved to be still active by detoxicating the excess D.E.S. present with GSH and testing the solution so formed.

The similarity in action of iodoacetic acid and D.E.S. upon the pyruvate oxidase system is of interest in relation to the similar vesicant action of these compounds, and possibly of interest in tumour research.

RUDOLPH A. PETERS.

Department of Biochemistry,
Oxford.
July 29.

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[1] Berenblum, Kendall and Orr, *Biochem J.*, **30**, 709 (1936).
[2] Peters, Rydin and Thompson, *ibid.*, **29**, 53 (1935).

A Hardness Tester for Microscopical Objects

INCLUSIONS and structural elements of metallographic specimens can be identified by examining the effect of various etching reagents. This method not only takes up a great deal of time, but also demands considerable experience on the part of the examiner.

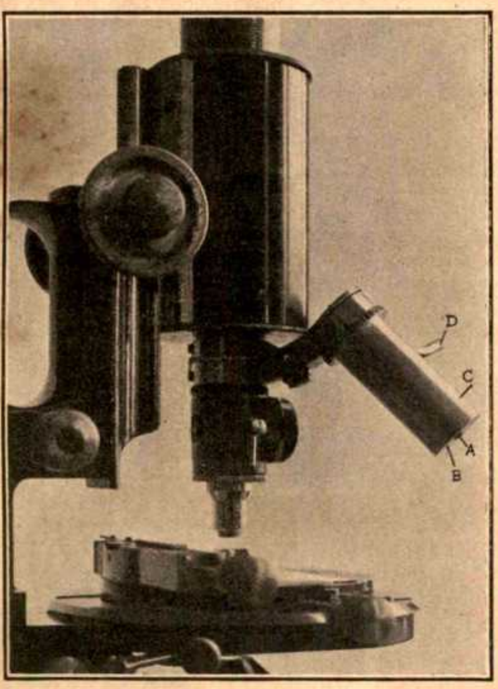
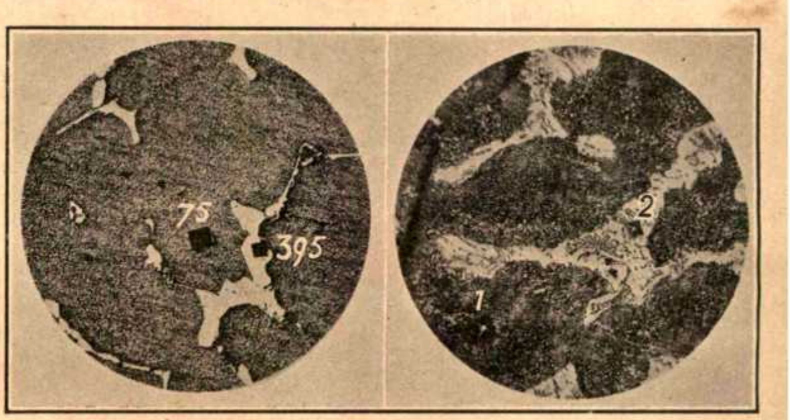


FIG. 1.

A more convenient and objective identification can be obtained by measuring the hardness of the inclusions and structure elements themselves. Instead of using the scratch hardness tester, which offers considerable difficulties[1], we have designed for this purpose a small and simple instrument, the basic principle of which corresponds exactly with that of the hardness testers of Vickers and of Firth. Fig. 1 shows the instrument mounted in the revolving head of a microscope with a vertical illuminator. The hardness tester consists of a Vickers' diamond A with a pyramid-shaped point, which is fixed in a piston B. The piston, having a certain weight, can move freely in a cylinder C.



(*a*) (*b*)

FIG. 2. Micrographs of (*a*) cast aluminium alloy containing 7·5 per cent copper (× 150); (*b*) pearlitic cast iron containing 0·8 per cent phosphorus (× 300).

The hardness, for example, of an inclusion or of a structural element, is tested in the following manner. The element to be tested is brought into the centre of the field of vision. Then, by turning the revolving head, the hardness tester is brought into the optical axis of the microscope. The tube of the microscope is moved downwards to such an extent that the diamond rests on the specimen and makes a small square impression in the structural element. After a certain time (for example, 30 sec.) the tube of the microscope is again moved upwards and the revolving head turned through 180°. By means of an ocular micrometer, the length of the diagonal of the square is measured, which can be expressed in Vickers numerals in the usual manner.

Fig. 2 (*a*) is a micrograph of a cast aluminium alloy containing 7·5 per cent of copper. The impressions caused by the diamond are clearly visible. The corresponding hardness numerals have been inserted in the figure.

Fig. 2 (*b*) is a micrograph of pearlitic cast iron, containing 0·8 per cent of phosphorus. The diamond impressions in the pearlite and the phosphide eutectic are marked 1 and 2 respectively. The corresponding hardnesses are 395 and 775 respectively. The Vickers hardness $V/20$ was 243.

In the case of malleable cast iron, the hardness of the ferrite was 182, that of the pearlite 300. For martensite a hardness of 865 was measured, whilst cementite showed a hardness of 820.

In the examples mentioned above, the load of the diamond is equal to the weight of the piston, namely, 35 grams. It is, however, possible to use arbitrary loads by means of air pressure above the piston. For this purpose an air inlet D is fitted to the cylinder C (Fig. 1). In this way the instrument can be applied to normal metallographic microscopes. A further advantage of the apparatus described is that it can be used during ordinary examination of metallographic specimens.

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June 2.

[1] Bierbaum, "The Microcharacter", *Trans. American Society for Steel Treating*, **18**, 1009 (1930). Gillet, "Properties of Ferrite as Revealed by Scratch Hardness Tests", *Metals and Alloys*, **5**, 159 (1934).

Measurements of Noise

THOSE interested in noise measurement will be aware that a new unit of equivalent loudness, the British Standard Phon, has been introduced by the British Standards Institution (Glossary of Acoustical Terms and Definitions B.S. 661—1936). The standard of reference is a plane sound wave of 1,000 cycles per sec., heard alternately with the noise to be measured by an observer facing the source and listening with both ears. When the reference tone is judged by a 'normal observer' to be as loud as the noise, the equivalent loudness in phons is given by the intensity level of the reference tone above a reference pressure of 0·0002 dyne per sq. cm. The experimental realization of the definition requires the resources of a laboratory, so that it becomes of interest to inquire how far the indications of portable secondary meters used for measurements in the field conform to the standard.

Many subjective secondary meters developed before the formulation of the standard, including one developed by us, operate by the observer listening simultaneously to the noise with one ear and a pure reference tone, presented by a telephone receiver, with the other. The reference tone is then adjusted by trial to loudness equality with the noise, the magnitude of which is expressed as the intensity of the reference tone in decibels above a stated reference intensity. In view of the disparity in listening conditions, it is important to ascertain whether the meter indications conform to the standard. We have carried out measurements, in accordance with the definition, of the equivalent loudness of noises of many types with a group of ten observers, such noises being also measured by the same group using a subjective meter of the type indicated above. It is found that with an instrument adjusted to read correctly for 1,000 cycle high-intensity tones, there are discrepancies of varying amounts up to + 15 db., depending upon the type of noise. For some purposes a correction of − 6 db. to the reading brings the indications sufficiently near to the standard.

A mode of listening approximating more to the definition is made possible by using a meter with two receivers. If suitable sealing is provided, the noise and reference tone may be heard alternately by quickly removing or replacing the receivers on the ears. The reference tone intensity is adjusted by trial until no loudness change is heard on removing or replacing the receivers. Tests with a meter constructed on these lines and calibrated in a 1,000 cycle free field show that for a variety of types of noise from 30 to 95 phons, the true value is given on an average to ± 2·5 phons, the largest discrepancy in mean reading noted being 4 phons.

A meter of this type thus enables the measurement outside the laboratory of any type of steady noise in phons. It has been used for measuring the noise of large engineering plant and has been found more trustworthy than the single-telephone method. The two-telephone meter also forms a link between the plane field distribution of the phon definition and the irregular field distributions which may occur in practice. Such an irregular sound field is thereby assessed in terms of the intensity level of the 1,000 cycle plane wave which, for a 'normal observer', produces an equal loudness sensation. Thus the pronounced directional properties of some microphones, which may have an arbitrary effect in objective noise measurements, may be eliminated.

The performance of secondary meters in terms of the phon will be discussed in a paper which it is hoped to publish in the near future.

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July 18.

Influence of Temperature on Crossing-over in *Drosophila*

ALTHOUGH it has now been demonstrated by several workers that crossing-over in certain regions of the chromosomes of *Drosophila melanogaster* is affected by temperature, the experiment reported in Table 8 of Plough's classical paper[1] still remains the only attempt to trace the magnitude of the effect throughout the range of temperature over which *Drosophila* is fertile. Unfortunately, when correcting the data for differences among the controls, a mistake was made which led to the false conclusion that crossing-over showed two maxima, at 13° and at 31° C. The *b–pr–c* region of chromosome II was used for the experiment. The observed percentages of crossing-over between *b* and *pr* are reproduced in the table below:

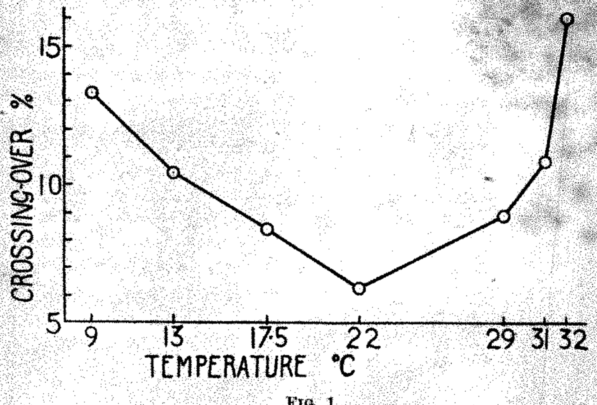

FIG. 1.

Table 1.—Crossing-over between *b* and *pr*. (Data from Plough's Table 8).

Temperature °C.	Observed per cent	Control at 22° C.	Corrected values, that is, 6·0 (Observed)/Control
9	13·5	6·1	13·3
13	13·5	7·8	10·4
17·5	8·3	5·9	8·4
22	6·0	—	6·0
29	8·8	5·9	8·9
31	14·0	7·8	10·8
32	15·7	5·9	16·0

When corrections for the controls are properly applied the relation between crossing-over and temperature is seen to conform to a simple *U* curve (Fig. 1).

This mistake came to my notice in 1927, but having no first-hand interest I was content to communicate the error to colleagues more specifically interested in genetics of *Drosophila*. It has recently, however, been brought to my notice that the mistake is still a source of trouble. Besides having been reproduced in a number of text-books, the supposed maximum at 13° is of some importance in correlating these data with observations on the effect of temperature both on contraction of muscles (Plough[1]) and on chiasma frequency in *Acridiidæ* (White[2]).

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July 22.

[1] H. H. Plough, "The Effect of Temperature on Crossing-over in *Drosophila*". *J. Expt. Zool.*, **24**, 147–209 (1917).

[2] M. J. D. White, "The Influence of Temperature on Chiasma Frequency". *J. Genetics*, **29**, 203–215 (1934).

Tetraploidy and Hymenoptera

A COMMUNICATION[1] from B. R. Speicher has directed attention to certain genetical data which do not seem to favour my suggestion[2] that the 'pre-conjugation' phenomena observed in the gametogenesis of the honey bee and of *Cynips kollari* may be interpreted in terms of derived tetraploidy. Now while I admit that the findings of the experiments of Dzierzon, Michailoff and Newell, as quoted in Mr. Speicher's letter, do suggest a simple condition of female diploidy and male haploidy, the facts are by no means fatal to a theory of derived tetraploidy–diploidy based on cytological observations. It has recently been shown that tetraploid hybrids do not necessarily exhibit independent segregation of chromosomes in gametogenesis and also that gametic viability in these forms is often differential, and only those gametes carrying one complete genom or the other are functional. It is thus possible for an organism to behave *genetically* as a diploid while in its gametogenesis traces of a different cytological condition may be shown. Genetical methods, therefore, may not be infallible criteria of evolution.

In this connexion, it should be observed that, in my original communication, the phenomena under discussion were regarded as vestiges in the evolutionary sense. At the same time it may be noted that there is probably conflict in the use of the terms tetraploidy, diploidy and haploidy, as employed by geneticists and by cytologists.

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4 Airlie Terrace,
Dundee.
July 28.

[1] B. R. Speicher, NATURE, **138**, 78 (1936).

[2] F. Greenshields, NATURE, **137**, 662 (1936).

Refractive Indexes of Ordinary and Heavy Ammonia

MEASUREMENTS of the refractive index of light and heavy ammonia were performed in continuation of former investigations[1]. The interferometer and the experimental arrangements were the same as before with the exception that this time one tube was made of glass and the other of quartz. A discharge tube containing hydrogen, a mercury lamp and a sodium lamp served as sources of light. The spectral lines in question were separated out by means of a monochromator from Winkel-Zeiss.

NH_3 (or ND_3) were produced by adding ordinary water drop by drop (or heavy water, 99 per cent, from Norsk Hydro-Elektrisk Kvælstofaktieselskab) to magnesium nitride. The drying and purification of the gas were performed in a manner similar to that described in the paper dealing with ordinary and heavy hydrogen selenide. The pressure of the gas was between 25 cm. and 28 cm. of mercury, the temperatures between 15° and 20° C. The reduction of the refractive index to the normal conditions and the state of an ideal gas was performed by using the coefficient of dilatation at constant pressure:

$$\alpha_{15,H} = 0{\cdot}00366 + 0{\cdot}000182\,\frac{H}{76}.$$

For the quantity φ which gives the deviation from Boyle's law the value 0·015 was used from the "International Critical Tables".

The results of the measurements are to be found in the accompanying table.

$(n_0 \div 1) \times 10^6$.

$\lambda \times 10^8$ cm.	6562·9	5893	5461	4916	4358
NH_3	373·6	375·7	377·7	381·4	386·3
ND_3	369·4	372·6	374·1	378·2	383·3
Δ	4·2	3·1	3·6	3·2	3·0

The refractive indexes of NH_3 are in good agreement with the measurements of C. Cuthbertson[2], while the measurements of S. Friberg[3] and E. W. Cheney[4] are perceptibly higher.

The method used by the measurements of NH_3 and ND_3 being completely consistent, the differences found between $n_{0,\,NH_3}$ and $n_{0,\,ND_3}$ are to be regarded as real in all circumstances.

O. E. FRIVOLD.
O. HASSEL.
S. RUSTAD.

Department of Physics and
Department of Physical Chemistry,
University, Oslo.
June 9.

[1] O. E. Frivold und O. Hassel, "Brechungsindex u. Molrefraktion des SeH_2 für die D_3–linie", *Z. phys. Chemie*, B, **27**, 316 (1934).
O. E. Frivold, O. Hassel und T. Skjulstad, "Brechungsexponent u Molrefraktion des Selenwasserstoffs u. des Selendeuterids", *Phys. Z.*, **37**, 134 (1936).

[2] Loria, "Lichtbrechung in Gasen".

[3] *Z. Phys.*, **41**, 378 (1927).

[4] *Phys. Rev.*, **29**, 292 (1927).

Range of Action of Surface Forces

THE letter by Bowden and Bastow, published in NATURE[1] (as well as their communication to the Royal Society[2]), not only may give, but already has given, rise to the view that the rigidity of thin water films observed by myself has not been confirmed by the above authors[3].

A thorough discussion and comparison of Bowden and Bastow's data with mine renders it manifest, however, that there is no contradiction between our respective results. Indeed, it has been shown by my data that the rigidity of water is exhibited when the thickness of the film is less than $1\cdot5 \times 10^{-5}$ cm., that is, at a distance less than $0\cdot75 \times 10^{-5}$ cm. from the glass surface. Rigidity equal to that of lead has been observed in my experiments for distances of $0\cdot5 \times 0\cdot7 \times 10^{-5} = 0\cdot35 \times 10^{-5}$ cm. from the walls.

In accord with the subsequent measurements of Bowden and Bastow, my measurements have, therefore, refuted the indications of the existence of rigid films of liquids of considerably greater thickness to be found in other papers, among them in those by the late Sir William Hardy. The only difference lies in the fact that my measurements have established a smaller and at the same time a more accurate upper limit of the range of surface action for the case of a glass-water interface.

It only follows from Bowden and Bastow's experiments that the range of surface action modifying the mechanical properties of a liquid film does not exceed 2×10^{-5} cm. for a glass surface, the liquid films in their experiments being located between a glass surface and a metal one, that is, one of another kind, and, moreover, a hydrophobic one. More than this, the data given in Table I of their Royal Society paper show that the thickness of the mobile part of the liquid is on the average *less* by 2×10^{-5} cm. than the optically determined thickness of the gap between the solid surfaces. Although no great weight can be attached to the latter positive result, it shows that there is no question of Bastow and Bowden's data refuting my experiments.

B. DERJAGUIN.

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[1] NATURE, **135**, 828 (May 18, 1935).
[2] *Proc. Roy. Soc.*, A, **151**, 220 (1935).
[3] NATURE, **135**, 834 (1935), "Points from Foregoing Letters".

Effect of Molecular Nitrogen on Molybdenum at High Temperatures

TREATING molybdenum wires of 0·2 mm. in a stationary manner by passing electric current through them and testing the behaviour of the wires under tensile stress, we have found that specimens heated in nitrogen are of quite a different character from those treated in hydrogen, argon or *in vacuo*. The yield point (in general, at the yield point of the wire plastic deformation of the metal commences) and the elongation of the wire in particular are very markedly influenced by nitrogen. Fig. 1 shows the load-extension curves of wires treated in nitrogen, the arrows indicating the yield point of the wire.

The following are the chief points of interest obtained in the course of our experiments. Different pre-treatments of wires exert an appreciable influence on the rate of nitriding. Thus cold-worked wires react much more slowly with nitrogen than they do if they are annealed, whilst the reaction is the slowest of all if the wires are fully recrystallized. In the later case, the characteristic stage represented in Fig. 1, No. 4, cannot be reached at all.

If nitrided wires (Fig. 1, No. 4) are permanently deformed, say, by being bent on little pulleys, they regain fully the original normal properties (Fig. 1, No. 1) which they possessed prior to nitriding. It seems possible that the failure to detect hitherto the effect of nitrogen on molybdenum wires is due to this peculiar fact. But nitrided wires after being bent revert again to their 'nitrided' stage (Fig. 1, No. 4) if they are flashed even in argon for 1–2 sec.

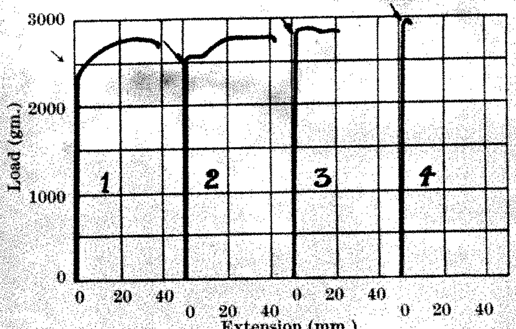

FIG. 1. (1) Wire treated at 1400° C. for 2 min. only in hydrogen. (2), (3) and (4). Wire pre-treated as (1) and then at 1300° C. for 20 sec., 40 sec. and 1 min. respectively in nitrogen.

On nitriding, no changes in the electrical resistivity was observed. The quantity of nitrogen sorbed corresponding to the stage of No. 4 in Fig. 1 is not more than about 0·007 per cent[1]. If nitrided wires are heated in hydrogen or *in vacuo*, denitriding takes place. Both contamination of the surface of the wire by carbon and minute traces of oxygen or/and water-vapour present in the gas retard the penetration of nitrogen into the wire.

Our observations appear to be of interest in relation both to the nature of plastic deformation of metals in general and to that of the catalytic action of molybdenum on ammonia synthesis[2].

We hope to publish fuller data elsewhere at a later date.

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STEPHEN KRAUSZ.

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June 22.

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[1] C. J. Smithells and C. E. Ransley state that nitrogen diffuses through molybdenum (*Proc. Roy. Soc. London*, **152** (1935).
[2] W. Frankenburger, "Zum heutigen Stand der Theorie der Ammoniak-Katalyse". *Z. Elektrochem.*, No. 1, 2, 5 (1933).

Flora of the Canadian Eastern Arctic

IN preparing a flora of the northernmost regions of eastern North America, nowadays generally referred to as the "Canadian Eastern Arctic", I am attempting to gather together, revise and record fully all of the more substantial plant collections that have been made within the area concerned from the times of the earliest navigators and pioneer explorers to the present day. This area for the present purpose is to be defined as excluding Greenland, Ellesmere (the flora of which is well known) and Boothia Felix, but otherwise as comprising all the mainland of eastern North America that lies east of long. 95° W. and north of lat. 60° N., and all the islands of the arctic archipelago (including the 1,000-miles long Baffin Land) that lie either wholly or in part within these bounds.

Since a number of collections have already come to light in unexpected places, I am taking the liberty of asking you, through the medium of your widely read correspondence columns, kindly to make known my great desire to hear of any further collections from within this area that I have not already seen in North America or shall not be likely to see in visiting the main European herbaria. I am now returning to the field with the Canadian Eastern Arctic Patrol to gather further material; from this or my other collections I should be pleased to make a presentation of duplicate specimens of high arctic plants in return for the courtesy of any loans of older collections that prove of interest.

Nicholas Polunin.

Gray Herbarium, Harvard University,
Cambridge, Massachusetts, U.S.A.,
and
Department of Botany, Oxford.
July 10.

The Mysterious Number 137

In Nature of July 11, Sir Flinders Petrie points out that Sir Arthur Eddington's cosmical number, 137, is nearly the well-known 'Byrne's' number, 137129, the mantissa of the logarithm of which shows the *same succession of digits*. It is sometimes said to be the number which is equal to its logarithm; but actually of the number 137·129 . . we should say that one thousandth of the number is the logarithm, to base 10, of one hundredth of the number. This coincidence between Eddington's and Byrne's numbers can have no physical significance, because the coincidence depends on 10 being used for the scale of notation and the base of the logarithms. The older wisdom of Mars may have adopted scales and bases of twelve; if so, the Martian Eddington would have discovered the number $e5$ ($11 \times 12 + 5 = 137$), while the Martian Byrne would have shown that log (to base twelve) $1{\cdot}38e66 = 0{\cdot}138e66$. Raising this number two duodecimal places, we have $138{\cdot}e66$, in the scale of twelve, which equals 188·961 in our notation.

Other such Byrne type numbers can be found in all scales of notation, and they are all different. For example, in the scale and base of three, the Byrne number is 2110220, and 211·022 (in scale of three) only equals 22·296 in our notation.

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July 31.

Points from Foregoing Letters

Graphs showing the average hourly intensity of cosmic rays at Cape Town for the years 1933, 1934 and 1935 are submitted by Dr. B. F. J. Schonland, B. Delatizky and J. P. Gaskell. A slight sinusoidal variation is apparent, with a maximum at about 24 hr. local sidereal time and a minimum at 12 hr. The variation appears to be a true sidereal time effect, since it occurs simultaneously in both hemispheres.

Measurements of cosmic ray intensity in a deep coal mine, carried out by Drs. J. Barnóthy and M. Fórro, indicate that some of the rays penetrate through a thickness equivalent to 2,500 m. of water. These would correspond to particles having an energy greater than 10^{12} electron volts.

New measurements by L. Lewin of the range of particles emitted by samarium show, in addition to the alpha-particles of 1·15 cm. range, also the presence of ionizing particles of 0·13 cm. range, amounting to about one third the total ionization due to alpha-particles.

The absorption by silver of 'thermal' neutrons at low temperatures (20·4° and 77° K.) has been determined by a group of investigators from the Ukrainian Physico-Technical Institute. They find that the ratio of the absorber thickness necessary for equal absorption at different temperatures, though constant, has a value of only about two thirds that to be expected if the absorption were inversely proportional to the velocity and a Maxwellian distribution for the energies of the neutrons be assumed.

The nature of the chemical linkages responsible for the contraction of wool when treated by various reagents is discussed by Dr. J. B. Speakman. He considers that the 'permanent set' is to be explained by the formation of —S—NH— bonds rather than in terms of —N=CH— bonds.

Prof. R. A. Peters describes the effect of dichlordiethyl-sulphone upon the respiration of brain tissue *in vitro*. As in the case of iodoacetic acid, there is no interference with the change of lactic to pyruvic acid, but the further oxidation of pyruvic acid is inhibited.

An instrument for testing the hardness of microscopic objects is described by Dr. E. M. H. Lips and J. Sack, who submit photomicrographs of copper-aluminium alloy and of cast iron containing phosphorus to illustrate the usefulness of the new apparatus.

Results of noise measurements made with earlier types of meters are compared by B. G. Churcher and A. J. King with values obtained by means of the new standard apparatus. The authors indicate conditions under which approximately equivalent results can be obtained.

H. F. Smith recalculates the percentage 'crossing-over' effect in the chromosomes of the fruit-fly at different temperatures, from the experimental results of Plough, allowing for differences among the controls. He points out that the graph has a U-shaped form with a minimum at 22° C., and that there are no maxima at 13° and 31° as sometimes stated.

The refractive indexes of ordinary and of heavy ammonia gas (ND_3) for various wave-lengths between 4358 and $6562{\cdot}9 \times 10^{-8}$ cm. have been determined by O. E. Frivold, Prof. O. Hassel and S. Rustad. The values for the heavy ammonia are slightly lower than those for ordinary ammonia.

Dr. B. Derjaguin directs attention to the fact that there is no disagreement between his findings that films of water of less than $1{\cdot}5 \times 10^{-5}$ cm. thickness have great rigidity, and the results of Bowden and Bastow, who have found no change from normal behaviour at thicknesses greater than 2×10^{-5} cm.

Diagrams showing the hardening of molybdenum wires heated in nitrogen at 1300° C. (by passing an electric current) are submitted by P. Túry and S. Krausz. The quantity of nitrogen 'sorbed' by the molybdenum is small (about 0·007 per cent).

Research Items

Tuberculosis and Inheritance

As part of the laboratory work in connexion with a course in human biology in Johns Hopkins University, Baltimore, Prof. Raymond Pearl initiated a study of family history records with reference to families in which tuberculosis had occurred. Analysis and discussion of the data have elicited some interesting results (*Z. Rassenkunde*, **3**, 3). The records examined include 3,608 individuals in the classification of parents and children. Taking all the offspring together, 11·3 per cent were tuberculous, which is in reasonable agreement with the known prevalence of tuberculosis in Baltimore at the time the records were taken. The families average between 4 and 4·6 children. Four types of mating were differentiated and the percentage of tuberculous offspring in each type noted. There were : Both parents tuberculous, 35·7 per cent ; father tuberculous, 14·0 per cent ; mother tuberculous, 13·0 per cent ; neither parent tuberculous, 8·3 per cent. The smoothness and regularity of the results are noteworthy. The incidence in the non-tuberculous parentage is a little more than half that of the tuberculous – non-tuberculous mating. The rates of the two latter types are essentially in agreement, as might be expected theoretically, if it is assumed that tuberculosis is neither a sex-linked nor a sex-limited phenomenon. Further, the full tuberculous mating gives an offspring incidence a little more than four times that from the full non-tuberculous mating. The regular increase in the offspring percentage incidence, as the amount of parental tuberculosis increases, seems impossible of rational explanation on any other basis than that of hereditary influence, as the risk of contact infection is not quantitatively doubled. The risk of infection as between the children of tuberculous and non-tuberculous parentage would seem greater than is indicated by the figures. It seems impossible, with the data at present available, to postulate any simple rational Mendelian formula that will accurately describe the results.

Archæology in Western Colombia

In 1935 Dr. Henry Wassén had the opportunity of examining a number of graves belonging to an ancient Indian settlement on the estate of El Dorado in the western Colombian Cordilleras, midway between Yotoco and Rostrepo in the Department of Valle del Cauca (*Ethnologiska Studien*, 1936, No. 2 : Göteborg Museum). Among the objects found in the neighbourhood described, but not found by the author, are two vessels painted in red-brown, of a characteristic shape, the neck rising from a horizontal plane. Three strong handles, adapted for carrying the vessel on the back, are at different levels. This arrangement does not appear to have been recorded previously among archæological finds in South America, but can be paralleled from Mexico. Further examples were obtained from the graves. Nine graves in all were opened up on four different sites. The type form is a shaft, oblong in section, the long sides orientated north and south, with a recess, or chamber, usually on the north, but here on the south side, elliptical or rectangular in shape. The shaft is here four to six metres deep, between one and two metres long, and approximating to a metre in breadth Examples have been recorded in which the shaft is 14–17 metres deep (Cauca) and even so much as 25 metres (Quinidio). The elliptical recess, with its long axis east and west, approximates to a metre in height, two to two and a half metres long and from 0·75 to 1·35 m. in breadth. One recess was a rectangular chamber of considerable size. In one group the recess was scarcely perceptible and not deep-seated. One grave had no recess. Another grave of a distinct type had a square shaft, 6·10 m. deep, with the chamber below the level of the bottom of the shaft, the entrance to the recess being closed by a grinding stone. This had evidently contained the body of a woman, as was shown by spindle whorls. A hair ornament in the form of nippers and a part of a nose ornament, as well as the position of the teeth, indicated that the head had been placed to the north. On analysis the nose ornament proved to be composed of gold (64 per cent), silver (9 per cent) and copper (27 per cent). Green stain on the teeth indicated the presence of copper. The skeletons had completely perished, except for a few fragments and some teeth.

The Medusæ *Eirene* and *Helgicirrha*

Dr. P. L. Kramp clears up much confusion in his paper "On the Leptomedusæ of the Genera *Eirene* Eschscholtz and *Helgicirrha* Hartlaub" (*Vidensk. Medd. fra Dansk naturh. Foren.*, **99** ; 1936). True cirrhi are absent in *Eirene* but present in *Helgicirrha*, and on this character the genera may be divided. Twelve species of *Eirene* are distinguished here, and five or six species of *Helgicirrha*, the genotypes being *Eirene viridula* and *Helgicirrha schulzei*. A re-examination of material previously identified by the author as *Eirene viridula* shows that specimens from the coast of Belgium and the Straits of Dover (1930) are correctly identified, but the majority of those from the coast of Jutland (1927) belong to *Helgicirrha schulzei*, a few being *Eirene viridula* ; those from the Straits of Gibraltar and the coast of Tunis (1924) are *Helgicirrha schulzei*, and those from the coast of Portugal (1910) are *Helgicirrha cari*.

Sponges of the North Sea and Baltic

Dr. W. Arndt in his monograph Porifera (Systematische Teil) in "Die Tierwelt der Nord- und Ostsee", Lief. 27, Teil $3a_1$ (Leipzig : Akademische Verlagsgesellschaft m.b.H., 1935) makes a very complete systematic survey of the sponges in these regions. There is a large sponge fauna to be found in the North Sea and Baltic, including representatives of many families. These are all described in detail, with good text figures, whilst useful keys of families, genera and species are given, with instructions for technique for studying living and preserved material, and an excellent bibliography. This most useful work on the fauna of the North Sea and Baltic keeps well up to standard in the present part, which also includes an interesting account of Thalassobionte und thalassophile Diptera Nematocera (Teil 11, e_3) by W. Hennig.

Experimental Neoplasms

THE developing blastoderms of birds and reptiles occasionally exhibit, in the region of the primitive streak, proliferating masses of cells which, while they multiply freely, show no tendency to transform into embryos or embryonic structures. These pathological masses grow with considerable rapidity and exhibit all the characters of neoplasms, and for that reason they have been termed by Tur "neoplasmoides embryonnaires". This author has produced the same type of growth experimentally by means of a thermoelectric cautery (*Bull. Int. Acad. Polonaise*, July 1935). The platinum needle, which becomes white hot, is carried by a mechanism which enables it to be applied accurately to any given point on or near the blastoderm, and also to apply the heat for a definite period. It also allows the heat to be controlled without the loss that would take place in manipulating a heated needle through the albumen layer. After treatment, the aperture in the egg shell is sealed with a cover slip and incubation allowed to proceed. Freshly laid eggs are employed, and the heat applied to the centre of the area pellucida. In this manner, a neoplasm can practically always be produced, and like those occurring naturally they not only exhibit remarkable power of proliferation but also blood elements appear precociously. The author suggests that this phenomenon should be considered in relation to cancer.

Haploids in Cotton

SEA ISLAND cotton produces haploids—known as 'man cotton'—in the proportion of one in three or four thousand plants. This type was described by Dr. S. C. Harland in 1920, but its haploid nature was not recognized until much later. By removing the testas of several thousand seeds of one variety, Harland found (*J. Hered.*, **27**, No. 6) that twenty seeds contained two embryos, which yielded in nearly every case one haploid and one diploid seedling. Indian workers have shown that in rice, where a high proportion of haploids also occurs, the same form of polyembryony exists. Such ovules may contain two embryo sacs, or it is possible that the diploid embryo arises from nucellar budding while the haploid develops from a parthenogenetic egg. Many of the cotton haploids are fertile with the pollen of other forms, although some are completely sterile. Harland suggests that if diploids could be produced from the haploids by the decapitation method, the resulting homozygous strains would be of much value in breeding work, especially in cotton, which is a highly heterozygous crop plant.

Control of Downy Mildew of Tobacco

AN interesting method of controlling the fungus disease known as downy mildew, or blue mould, of the tobacco plant, is reported in an account by Science Service from Canberra, Australia. This describes the work of Dr. H. R. Angell, Messrs. J. M. Allan and A. V. Hill, who have shown that early infection can be prevented by raising seedlings in an atmosphere containing vapour of benzol or toluol. Special seed-beds covered with glass have been prepared, and numerous shallow vessels containing the benzol or toluol are placed within. The young seedlings make healthy growth, and when transplanted do not contract the disease. Large-scale field tests are in progress, and their results will be awaited with interest.

The Heat Capacity of Ice

IT has been known for some years that the entropy of ice as given by the integral $\int_0^T C_p \, d\ln T$ does not agree with the value calculated from the entropy of water vapour as found from its band spectrum, there being a discrepancy of about 1 gm.cal. per degree per mol. W. F. Giauque and J. W. Stout (*J. Amer. Chem. Soc.*, **58**, 1144; 1936) have now redetermined the heat capacity of ice from 16·4 to 267·7° abs. The latent heats of fusion and evaporation are accurately known, and the value of the integral is thus found to be $44{\cdot}28 \pm 0{\cdot}05$ gm.cal./1°/mol. at 1 atm. and 298·1° Abs. The spectroscopic value is 45·10, leading to a discrepancy of 0·82. This is in agreement with a discrepancy of 0·806 calculated by Pauling on the assumption of random orientations of hydrogen bonds in ice, and the supposition that when ice is cooled to low temperatures it fails to attain the ordered arrangement which would correspond with zero entropy. It has been found that ice has no measurable heat capacity between 0·2 and 4° Abs., and the authors state that no difference in thermal properties of ice could be detected in samples prepared by slow or rapid cooling.

Manganese Trichloride

ALTHOUGH the existence of a higher chloride of manganese, probably $MnCl_3$, has often been reported, its existence in the pure state has only recently been demonstrated. A. Chrétien and G. Varga (*Bull. Soc. Chim.*, **3**, 1263; 1936) have obtained the trichloride as a brown crystalline mass by acting upon manganic acetate, $Mn(C_2H_3O_2)_3$, with liquid hydrogen chloride at $-100°$. A violent reaction occurs, and an olive-green liquid is produced. This is evaporated to dryness at the same temperature. The solid may be heated to room temperature in a closed vessel with little decomposition. On heating, it evolves chlorine and leaves a white residue of manganous chloride.

Spectra of *B*-Type Stars

Two papers by E. G. Williams on *B*-type stars have appeared recently in the *Astrophysical Journal* (**83**, 279 and 305). The first paper describes the spectrophotometric observations of 84 stars over the range 4922–3820 A. Intensities (expressed in equivalent widths) were obtained for all measurable lines in this range, and in addition line depths were measured for H and He lines. In the case of H and He lines it was also possible to obtain reliable contours, which were observed to be exponential in form except in diffuse-line stars, where the centres were rather blunt. The results of the first paper have been used in the second in an attack on the problem of classification, which presents well-known difficulties in the case of *B*-type stars. These difficulties, together with earlier attempts to overcome them, are first reviewed by the author, who decides that line ratios, rather than simple intensities, are preferable as criteria of classification. He suggests seven ratios, some of which involve the combination of line intensities from several different elements. The resulting classification is arranged to agree in the mean with the Henry Draper system, but with added subdivisions and with the numbers of stars in each subdivision progressing smoothly with type. Statistical relations between spectral type (as redetermined) and line intensities of various atoms are discussed, and some interesting luminosity effects are also obtained.

New Heating Laboratory at the Building Research Station

By A. F. Dufton

> "*In the field of heating and ventilation many phases are still beyond the realm of scientific analysis: as far as possible these topics should be studied for the benefits that might accrue. Scientific methods alone can give us the assurance that we are headed in the right direction, particularly in those departures from standard practice occasionally necessary in everyday application.*"—
> RIETSCHEL, 1893.

PRACTITIONERS in the art of heating are dependent to a great extent upon rules-of-thumb, and are finding, in this age of progress, some difficulty in adapting standard practices and calculations to meet modern requirements. The introduction of panel-heating, for example, has not only made necessary a revision of ideas as to what constitutes a comfortably warmed environment but has brought out also the important fact that the received methods of computing the heat losses of a building are only directly applicable when the building is heated in the 'traditional' manner. The introduction of electric-heating, moreover, particularly of schools, has lent an added interest to the effect of the fabric of a room upon the rate of warming and to the general question of the economics of intermittent heating. The Institution of Heating and Ventilating Engineers, fully appreciating the importance of scientific research, expressed the desire to associate itself as closely as possible with any researches on heating and ventilation under the auspices of the Department of Scientific and Industrial Research, and offered to provide funds to enable this work to be accelerated and extended. With this encouragement, it has now been possible to implement a proposal that a room should be erected with walls, ceiling and floor exposed to controlled conditions, in order to facilitate the study not only of different methods of heating, of the problems of intermittent heating and of the influence of ventilation upon heating, but also of those phases of building construction of interest to heating engineers.

It has been considered a matter of first importance that the controlled conditions should be clearly defined and reproducible, and that they should be independent not only of outside weather conditions but also of the condition of the interior of the room. The idea of a test-room within a controlled enclosure is not new, and a certain number of such rooms have been described and built elsewhere. In each case, however, the controlled conditions have been secured by regulating the air-temperature throughout the enveloping space. This is extremely difficult to accomplish satisfactorily and it does not provide, moreover, a clearly defined enclosure, since it permits of variations in the temperatures of the enclosing walls, to which, of course, the walls of the test-room radiate.

In the heating laboratory which has now been erected at the Building Research Station, Garston (Fig. 1), the temperature of the air in the enclosure is not regulated, and the enclosure is controlled by means of an extensive system of panel-warming and panel-cooling pipes in the walls, floor and ceiling. This enclosure is defined when the temperatures of the various surfaces are specified.

As will be seen from Fig. 2, the heating laboratory comprises the test-room, surrounded by its enclosure, together with an engine-room and an instrument room. The test-room, which measures 18 ft. by 12 ft., is built of 9-in. brickwork, plastered internally, and the floor and ceiling are constructed of wooden joists, lathed and plastered below, and boarded above. The height of the ceiling can be adjusted between the limits of 8 ft. 6 in. and 11 ft. 6 in.

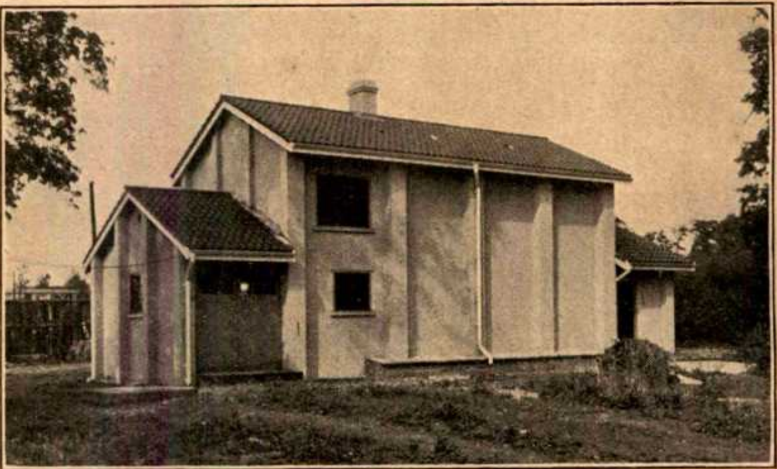

FIG. 1. Heating Laboratory at the Building Research Station, Garston.

The walls of the enclosure are heated or cooled by means of calcium-brine pumped through the embedded pipes which are spaced at 6-in. centres, and their mean surface temperatures are individually controlled to 0·1° F. by copper resistance-thermometers in conjunction with a sensitive relay system. Each wall surface is tested once in every 6 minutes and the controls then automatically raise or lower the temperature of the brine by means of specially designed modulating valves. Each modulating valve is driven by a Warren motor of 10 micro-horse-power.

The modulating valves, which are in the engine room, are fed with hot or cold brine from two insulated storage tanks of 200 and 400 gallons capacity respectively, and the necessary cooling is provided by a 4½-ton ammonia refrigerating plant which is automatic in operation.

Provision is made for the air in the test-room to be changed at rates up to four air changes per hour, with incoming air controlled at 40° F. or other suitable temperature.

In the programme of research which has been under consideration by the Heating and Ventilation Committee of the Department, on which are members of the Institution of Heating and Ventilating Engineers, emphasis has been placed upon the study of the conditions obtaining in a room warmed by extended surface heating and upon the investigation of floor and ceiling heating. It should perhaps be made clear that the new laboratory is specially designed for comparative work, and in the examination of floor heating, for example, it is clearly important to obtain an adequate comparison with other forms of heating. The most common form of central heating in use at the present time is by cast-iron radiators, and it is proposed, therefore, to adopt this as a standard of reference. This will not only provide a very convenient 'yardstick' but will also ensure that a substantial body of data will be obtained relative to this important type of heating.

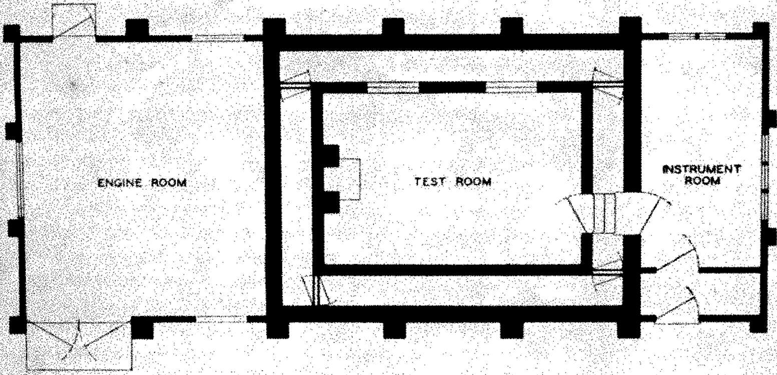

FIG. 2.

The new laboratory was open for inspection on the occasion of the annual visit of the Institution of Heating and Ventilating Engineers on July 22, when the members were received by Sir Raymond Unwin, the chairman of the Building Research Board, and the laboratory was formally opened by Sir Frank Smith, secretary of the Department of Scientific and Industrial Research.

Petroleum Fuels in Canada

DURING recent years, importers and consumers of petroleum fuels in Canada have furnished statistics of deliveries and uses of these products to the Department of Mines. Resulting from correlation of data supplied, a report has been prepared entitled "Petroleum Fuels in Canada" (Department of Mines, Bulletin 772; 1936) from which many interesting facts emerge.

Fuels are divided into four classes: fuel oil, kerosene, gasoline and petroleum coke; after summary tables showing quantities of each marketed in Canada during 1933 and 1934, and amounts distributed in each of the Provinces, the classes are studied separately. In 1934 more than 86 per cent of the total fuel oil was processed in Canadian refineries, the rest being imported; of this, 26 per cent was used for domestic heating, 23 per cent for industrial heating and power, more than 5 per cent for tractor fuel and more than 46 per cent for rail and water transportations. In the same year deliveries of kerosene were less than one eleventh of the volume of fuel oil and represented only one twenty-fifth of the total of petroleum fuels; actually only 36·2 million gallons were delivered in Canada, which is substantially less than was delivered in 1933; approximately 66 per cent of this was used for domestic heating, cooking and lighting, 24·5 per cent for tractor fuel and the remainder for other general uses.

Gasoline statistics included in the report are not strictly comparable with those of fuel oil and kerosene as they represent totals recorded by provincial tax departments of the Bureau and are interpreted subject to provisos as to amounts sold, etc., effective each year in each province. The gallonages supplied under each purpose use are therefore treated as estimates; nevertheless tables showing gasoline sales by provinces and quantities sold for motoring and other purposes are of interest as indication of destination of gasoline marketed in Canada.

Petroleum coke is used primarily as a fuel for domestic and industrial heating but is also a useful component of electric batteries, carbon lamps, crucibles and other manufactured articles; in 1934 approximately 57,000 short tons were sold for fuel, of which about 39,000 tons were destined for domestic heating and 18,000 for industrial heating.

Problems of Translocation in the Plant

MESSRS. Mason, Maskell and Phillis continue their analysis of the movement of substances in the cotton plant in two papers published in the *Annals of Botany* (50, January 1936).

They first give their reasons for rejecting, on present evidence, either the Münch theory of mass flow in the phloem, or the theory of protoplasmic streaming, as providing a satisfactory mechanism for the movements that take place. Any view of mechanism must be influenced by definite information as to whether the phloem can function at the same time to deliver different materials in opposite directions, and these two papers describe the results of experiments designed to elucidate this point. The first paper (by Mason, Maskell and Phillis) shows that whilst very slow import of sugar into darkened leaves is suggested by a formation of starch around the veins of such leaves when they remain in communication with illuminated foliage, yet the behaviour of such darkened leaves isolated by rings as compared with non-isolated leaves does not permit a safe conclusion that sugar may still move in whilst nitrogen moves out. Experiments with defoliated plants with tops in a humid atmosphere suggest that even when transpiration is so reduced, the nitrogen supply of the tops can still be adequately furnished by the xylem. An attempt by suitable ringing technique to demonstrate the movement of stored nitrogen from a basal adult region of the shoot upward into the growing tops when sugars were moving downwards was more promising, but the authors recognize that this stored nitrogen may still have moved down to the roots via the phloem and then upwards via the xylem if the nitrogen is released into the tracheæ in the root.

The later experiment, by Phillis and Mason, is regarded by its authors as giving a more definite answer on the point at issue. The cotton plants in this experiment were all ringed at the base, the basal leaves darkened and one series ringed between the basal region and the apical region. In this case when the plants were starved of all phloem mobile elements, the nitrogen travelled upwards in considerable amount from the basal to the apical region when these were not separated by a ring, whilst little or none entered the apical region when separated by a ring from the basal region.

As carbohydrate was still passing downwards from apical to basal regions in the same plant, these experiments are regarded as supplying good evidence that sugar and nitrogen may travel simultaneously in opposite directions through the phloem.

Science News a Century Ago

The British Association at Bristol

THE work of the British Association at its first Bristol meeting began on Monday, August 22, 1836, there being seven sections, namely, Mathematical and Physical Science, Chemistry and Mineralogy, Geology and Geography, Zoology and Botany, Medicine, Statistics and Mechanical Science. Among the contributors of papers were Brewster, Baily, Lubbock, Whewell, Hamilton, Babbage, Sedgwick, Buckland, Conybeare, Daubeny, Murchison, Dr. Hare of Philadelphia, Lardner, Snow Harris and Scott Russell.

The general meeting of the Association was held on the evening of August 22 in the Theatre, when some 2,000 persons were present. The Rev. Dr. Lloyd, Provost of Trinity College, Dublin, the retiring president, was in the chair, and in the course of his address said that among the purposes of the Association was that "by a more rapid and extensive communication of the lights of science as they are struck out, and by carrying these things home to the doors of all, to awaken to exertion those gigantic powers of mind, which are not confined to a few favoured spots; but which are everywhere to be found; and by establishing a more immediate and intimate communication among those engaged in kindred pursuits, to unite their exertions, as it were, into one simultaneous effort, and thereby to accelerate the progress of discovery in every line in which the mysteries of nature may be penetrated by the ingenuity and perseverance of man".

At the conclusion of his address, Dr. Lloyd resigned the chair to the Marquis of Northampton, whose first action was to invite some of the ladies present who were without seats to occupy places on the stage, although they were "by law excluded from the platform reserved for the General Committee". His Lordship congratulated the meeting on the great accession of members the Association had received at Bristol. "Here," he said, "were men of every shade of denomination and opinion engaged in one united effort in the cause of science and truth—eminent men from foreign lands, united by the glorious brotherhood of mind, were here assembled to cement the intellectual union of nations. This he regarded as a political result of the highest and most gratifying order. The moral effect of the Association arose from truth being the great object of all its labours."

Death of Louis-Marie-Henri Navier

ON August 23, 1836, the eminent French engineer Louis-Marie-Henri Navier died in Paris at the age of fifty-one years. He was the son of a well-known lawyer of Dijon, where he was born on February 15, 1785. As a boy, owing to the death of his father, Navier came under the influence of his uncle Émilian-Marie Gauthey (1732–1806), an inspector-general of the Corps des Ponts et Chaussées. At the age of seventeen years, he entered the École Polytechnique and two years later the École des Ponts et Chaussées, the Government school for civil engineers founded in 1747 under the directorship of Perronet, and in 1804 directed by Prony. The mathematical training Navier received in these famous schools was reflected in all his later work. His first literary work was the publication of his uncle's "Traité de la Construction des Ponts", 1813. In 1819 he was made a professor of mechanics in the École des Ponts et Chaussées, and in the same year contributed to the Paris Academy of Sciences his "Mémoire sur la flexion des verges élastiques courbes", which was followed by his "Mémoire sur les lois de l'équilibre et du mouvement des corps solides élastiques", 1821, and his "Rapport et mémoire sur les ponts suspendus", 1824. In 1827 he investigated the general equations of equilibrium of an elastic solid, starting from an assumption as to the molecular constitution of matter.

While engaged in teaching and writing, Navier was responsible at the same time for the design of bridges, among which was a chain suspension bridge over the Seine at the Invalides in Paris, the bars for which he required to be tested to 11 tons per sq. in. Constructed in 1826, unfortunately one of the pylons failed, and the bridge had to be taken down. It was afterwards shown by Prony that the mishap was due to circumstances the designer could not have foreseen. The incident for a time had an unfavourable effect on Navier's reputation; but the esteem in which he was held was shown by his appointment in 1830 to the chair of analysis and mechanics at the École Polytechnique. Two years before his death he was given the rank of divisional inspector in the Corps des Ponts et Chaussées. His collected works were published after his death, and to the third edition of them Saint Venant added many valuable notes and corrections.

Christoph Wilhelm Hufeland (1762-1836)

Christoph Wilhelm Hufeland, physician, author, editor and philanthropist, the centenary of whose death falls on August 25, was born at Langensalza in Thuringia on August 12, 1762, the son and grandson of court physicians at Weimar. After studying medicine at Jena and Göttingen, he qualified in 1783, his inaugural thesis being on the value of electricity in asphyxia. For the next ten years he remained in practice at Weimar, where he was brought into close contact with Goethe, Schiller, Wieland and Herder, as well as with members of the court. In 1793, he was invited by the Duke of Weimar to accept a professorship at Jena, and his lectures attracted considerable attention. In 1880 he succeeded C. G. Selle as royal physician at Berlin, where he became director of the Medico-Chirurgical College and senior physician to the Charité Hospital.

Hufeland was an extremely prolific writer, more than four hundred articles being attributed to him, but his best known works are "Makrobiotik" (1805) or the art of prolonging life, which was translated into every European language and passed through eight editions, and "Encheiridion Medicum; or Manual of the Practice of Medicine", of which six editions were published, an English translation appearing in 1842. Of the four medical journals which he edited, the best known is the *Journal der practischen Arzneikunde und Wundarzneikunst*, which he founded in 1795 and edited until his death in 1836, after which it continued until 1844.

Hufeland was an enthusiastic supporter of Jenner, and did much by his influence to diffuse the practice of vaccination throughout Germany, in addition to founding a vaccine institute at Berlin. He took an active part in the sanitary reorganization of Berlin, recommended the general use of warm baths and deprecated the abuse of spirits. In 1810 he founded a medical polyclinic, the first of its kind in Germany, for the treatment of the indigent poor, and for the next twenty-four years published annual reports of its activities. Finally, he did much useful work in combating popular errors concerning the Brunonian system of philosophy, mesmerism and phrenology. He was generally regarded as one of the noblest characters of his age.

Sudden Deaths and Suicides in Russia

According to the *Gazette des Hôpitaux* of August 25, 1836, official reports show that during the course of 1832, 405 persons, of whom 324 were men and 81 women, died a sudden death in St. Petersburg. In 1833 the figures were considerably higher; 569 such deaths (353 in men and 216 in women) being registered. Most of these deaths were the result of intemperance. It is rare in St. Petersburg, the report continues, as in all the large towns in Russia, for public rejoicing not to cause the death of a large number of individuals. In 1833, for example, 78 men and 24 women were picked up in the streets of the capital whose deaths were due to drunkenness and cold. It is a well-known fact that in Russia, those who are so imprudent as to fall asleep in the open air after excessive consumption of strong drink never wake up again. In the course of the triennium 1831–33, 104 suicides were committed in St. Petersburg. It was noted that young persons made use of firearms or sharp instruments almost exclusively, while old people preferred drowning or hanging.

Societies and Academies

Dublin

Royal Dublin Society, June 23.

P. O'Connor: A contribution to knowledge of Irish fungi. A complete list of the fungi recorded by the author in Ireland during the past three years, with sites, dates and host plants and trees. A number of the species have not previously been observed in Ireland, and a few are new to the British Isles.

P. A. Murphy and J. B. Loughnane: A comparison of some Dutch and Irish potato mosaic viruses.

Phyllis Clinch, J. B. Loughnane and P. A. Murphy: A study of the aucuba or yellow mosaic of the potato.

H. H. Poole and W. R. G. Atkins: The standardization of photo-electric cells for the measurement of energy. The cells and colour filters used for the measurement of daylight have been standardized by means of a standard filament lamp so as to enable the radiant power per square centimetre in various parts of the spectrum to be found in absolute units. The relatively low temperature of the standard source and the relatively large effect of errors in its assumed colour temperature reduce the accuracy of the results.

J. Lyons: The influence of chemical composition on the firmness of butter. The exceptional firmness of New Zealand and Australian butters as compared with Danish and Irish butters is attributed to the relatively low unsaturated fatty acid content and high stearic acid content of the former.

J. A. C. Teegan: The comparison of γ-ray intensities from radium preparations. A valve method of measuring the ionization current allows the natural leak to be compensated, and is very rapid and convenient for routine measurements.

Paris

Academy of Sciences, July 6 (*C.R.*, 203, pp. 1–136).

Lucien Cayeux: The reticulated structure of the silica observed in pre-Cambrian phtanites and Suessonian phosphates.

Marin Molliard: The yield of green plants as a function of the proportion of oxygen in the atmosphere. With the radish as the experimental plant, the maximum yield was obtained with an atmosphere containing 5 per cent of oxygen, and the high yield coincided with a more intense green. It is suggested that, with proportions of oxygen above 5 per cent, some oxidation of the chlorophyll pigment may take place.

Serge Winogradsky: Researches on the morphology and physiology of *Azotobacter* in the soil.

Pierre Lejay: New determinations of the acceleration of gravity in France. A table is given showing the values of g for 57 new stations.

Maurice Nicloux: The identification of ethyl alcohol.

Mlle. Elisabeth Lutz: The solutions of the equation $y^2=x^3-Ax-B$ in $\mathfrak{p}$-adic bodies.

André Weil: The $\mathfrak{p}$-adic elliptic functions.

Wolfgang Dœblin: The discrete chains of Markoff.

Jean-André Ville: The notion of the collectif.

E. J. Gumbel: Floods and the theory of the greatest value.

CHRISTIAN PAUC: Some local properties of Euclidian continua.

JULES GÉHÉNIAU: The generalization of Th. De Donder of Hilbert's theorem of independence.

S. MANDELBROJT and NORBERT WIENER: Lacunous Fourier's series. Direct theorems.

CHARLES PLATRIER: The problem of Barré de Saint-Venant in a homogeneous medium which is deformed starting from a state of constraint.

NICOLAS STOYKO: The irregularity of the earth's rotation. From a comparison of data obtained at Charlottenburg (0·35 sec.) and at Paris (0·39 sec.) over the period October 1934–August 1935, there appears to be a retardation in the rotation of the earth of 0·37 sec.

RENÉ DUGAS: A definition of the validity of quantic mechanics.

PIERRE VERNOTTE: The theoretical dimensions of the cellular vortices of Bénard.

LÉON DUBAR: The influence of the gases of the atmosphere on the electrical conductivity of cuprous oxide. After a preliminary heating in a vacuum, contact with oxygen causes a regular increase in conductivity. This increase is removed by admitting water vapour.

M. LAMBREY and S. KRAUTHAMER: The abnormal combinations of frequencies of conversion values.

EMILE PIERRET: The properties of triodes with large diameter plate in very high frequencies. Triodes with plate of large diameter can be used for the production of oscillations of very short wave-length, and the frequency can be varied between certain limits as a function of the voltage of the plate. This arrangement is specially useful in measurements of dielectric constants.

J. HENRION: Dielectric losses in an alternating field of high frequency and molecular dimensions. The experimental results given show that the method can be advantageously applied to the determination of mean molecular dimensions.

J. SWYNGEDAUW: A new electro-chemical method of preparing proteins in the isoelectric state.

THÉODORE V. IONESCU: The true periods of vibration of ionized gases in the magnetic field.

JACQUES STOHR: An arrangement with self-induction circuit for determining the derivative with respect to time of a function represented by an electric current.

MARCEL LAPORTE and FRANÇOIS GANS: The physical photometry of tubes containing luminescent gas.

ROBERT BOSSUET: The search for the alkaline metals in natural waters. The waters examined came from Corsica, Algeria, Tunis and Madagascar. The results are classified under two headings: those containing all five alkali metals, and those not containing cæsium.

(*To be continued.*)

Brussels

Royal Academy (*Bull. Classe Sci.*, No. 5, 1936).

L. GODEAUX: Cyclical involutions of the third order and genus one belonging to an algebraic surface.

P. FOURMARIER: Some observations on slaty cleavage in the Palæozoic regions of north Devon and north Cornwall.

E. W. BETH: Proof of a theorem concerning the principle of the excluded third.

M. BARZIN: Note on M. E. W. Beth's proof.

G. HIRSCH: Logical foundations of the theory of probabilities.

B. GAMBIER: Study of the cubic surfaces which can possess Eckardt points.

L. FALLA: An involution of the second order, the groups of which belong to the radii of a linear complex.

YVONNE DUPONT: Theory of elastic deformations in space-time.

J. VAN MIEGHEM: Intrinsic form of the conditions of compatibility. Application to the calculation of potential discontinuities.

M. DÉSIRANT and A. MINNE: Researches on the 'fluctuation bands' of the diatomic vapour of tellurium.

Geneva

Society of Physics and Natural History, June 4.

ARNOLD PICTET: The heredity of a novelty in fur: the silver guinea pig.

CHARLES BAEHNI: A case of generic convergence in the Iridaceæ. Normal *Geissorhiza* and abnormal *Antholysa.*

PAUL ROSSIER: (1) The calculation of the apparent diameter and effective wave-length of stars. (2) The effective photographic wave-length. (3) The width of the lines of stellar hydrogen.

FERNAND LÉVY: The local distribution of the pressures in an elastic medium.

L. W. COLLET and ED. PAREJAS: (1) Contribution to the study of the Salève Tertiary. (2 and 3) The region comprised between Esserts and Usses, and a general survey.

June 18.

A. MERCIER: The relations between the spinorial and Clifford magnitudes.

R. WAVRE: The four logarithmic potentials of a circumference.

F. BEER: The extension of the Hadamard-Schmidt theorem to the case of the logarithmic potential created by a real body in a complex domain.

K. H. MEYER and BRENTANO: Researches on maize starch.

E. C. G. STUECKELBERG: The absolute electromagnetic potential as a new property of light.

July 2.

P. WENGER, CH. CIMERMAN and G. TSCHANUN: The electrolytic microdetermination of zinc, and its application to brass.

CH. CIMERMAN and P. WENGER: The volumetric microdetermination of zinc.

E. PERROTET and B. SUSZ: The Raman spectra of the *cis* and *trans* isomers of isoeugenol.

S. FRIED and B. SUSZ: Note on the Raman spectrum of the trimethyl ether of oxyhydroquinol.

P. ROSSIER: Discussion of the spectrograms of the *B5* stars.

J. BUFFLE: Observations on the surface waters and deep waters of the canton of Geneva.

DOM ZIMMET: (1) The use of the nickel-nitroprusside reagent as an external indicator in the determination of reduced glutathione with iodine. (2) The amount of glutathione in some oil-producing plants: walnut, Brazil nut, hazel nut, almond and peanut. (3) The biological analogy between the bile acids and the sterols. The influence of the bile salts on the growth and morphogenesis of tadpoles.

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(*Atti*, 23, 3–92; 1936).

U. CISOTTI and A. MASOTTI: Ballast effects in space.

G. A. MAGGI and B. FINZI: Conditions at the wave-front and harmonic electro-magnetic waves.

E. BORTOLOTTI: Non-linear relations: geometry of a system of equations with partial derivatives of the second order. Preliminary (1).

O. CHISINI: Branching curve of multiple planes.

G. PALAMÀ: Two new generalizations of Vandermonde's determinant.

B. CALDONAZZO: Free regulating source in the problem of a lamina.

G. LAMPARIELLO: Asymptotic irrotational motion of every stationary current of a perfect fluid subjected to conservative forces.

G. D. MATTIOLI: Second form of the equations of turbulence according to the hypothesis of a single direction of transport (1). Energetic equation of turbulence and conditions of integration of indefinite equations (2).

G. NEBBIA: Tracing the shapes of gradually varying permanent liquid currents.

E. JOLLES: Derivatives of the azoxy-carboxylic acids.

C. ANTONIANI and A. SPICA CLERICI: Glucidic metabolism of the mammary gland *in vitro*.

M. FENOGLIO: Vogesite from Ginepro (Elba).

A. MESSERI: Primary organizing sieve tissue of the secondary cambium.

G. NEGODI: Contribution to the cariology of *Calendula* (L).

M. VENTURA: Some embryological data of *Sapium sebriferum* (L.), Roxb.

(*Atti*, 23, 95–159; 1936).

G. ANDRUETTO: New expression for the total curvature of a surface (1). Geodetically parallel lines and hyper-surfaces (2).

E. BORTOLOTTI: Non-linear relations: geometry of a system of equations with partial derivatives of the second order. Intrinsic properties of the system (2).

U. BROGGI: Determinant functions and polynomials of Laguerre.

L. CROCCO: New function of a current for the study of the rotational motion of gases.

G. KRALL: Equations of vibratory motion of a bridge traversed by inert and pliant loads (1). Limits for the vibrations of any bridge traversed by mobile loads with uniform motion (2).

A. MASOTTI: Planar motions produced from two vortex sources.

A. BARONI: Sulphide, selenide and thioselenide of thiocyanogen. The preparation of $Se_2(CNS)_2$, of $SeS(CNS)_2$ and of $S(CNS)_2$ is described. All these substances polymerize readily at ordinary temperatures.

O. BOTTINI: Thermal decomposition of NH_4-clays.

E. PARISI and G. DE VITO: Contribution to the knowledge of the ripening of cheeses. Polypeptides containing phosphorus (2). By the action of proteolytic enzymes fragments of relatively low molecular weight, which contain practically all the phosphorus of the original substance, are broken off from the casein molecule.

M. BENAZZI: Influence of the cephalic region on the movement and sensitivity of tricladic Planaria.

T. PERRI: Growth of the crystalline in anurid Amphibia (2). Experiments on *Rana esculenta*.

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Department of Scientific and Industrial Research. Forest Products Research Records No. 11 (Timber Series No. 3): The Properties of Home-Grown Oak. Pp ii+14. (London: H.M. Stationery Office.) 6*d*. net. [307

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Bernice P. Bishop Museum. Bulletin 137. Dinoflagellates of the Coastal Waters of the Western Pacific. By Anton Bohm. Pp. 54. Bulletin 138. Ethnology of Futuna. By Edwin G. Burrows. Pp. iv+239+11 plates. Bulletin 139: Marquesan Insects; Environment By A. M. Adamson. (Pacific Entomological Survey: Publication 9) Pp ii+73+8 plates. Bulletin 140: Report of the Director for 1935. By Herbert E. Gregory. Pp. 52. (Honolulu. Bernice P. Bishop Museum.) [317

Bernice P. Bishop Museum. Occasional Papers. Vol. 11, No. 15: Native Trade in Southeast New Guinea. By Laura Thompson Tueting. Pp. 43. Vol. 11, No. 16: Effect of X-Rays on Regeneration of Chelipeds of *Atya bisulcata*. By Charles Howard Edmondson. Pp. 15. Vol 11, No. 17: Society Islands Pounders. By Henry Silverthorne. Pp. 17. Vol. 11, No. 18: Check List of the Serphoidea, Bethylidæ and Anteonidæ of Oceania. By Robert Fouts. Pp. 15. Vol. 11, No. 19: The Hawaiian Silverswords; Systematics, Affinities and Phytogeographic Problems of the Genus Argyroxiphium. By David D. Keck. Pp. 38. Vol. 11, No. 20: Contribution to the Mosses of Fiji. By Edwin B. Bartram. Pp. 30. Vol. 11, No. 21: Notes on the Flora and Fauna of Lehua and Kaula Islands. By Edward L. Caum. Pp. 17. Vol. 11, No. 22: Two New Species of Terminalia from the Austral Islands and Mangareva. By A. W. Exell. Pp. 4. Vol. 11, No. 23: A New Species of Schiedea. By Edward L. Caum and Edward Y Hosaka. Pp. 5. Vol 12, No. 1: Review of the Genus Orochlesis (Coleoptera, Curculionidæ). By Elwood C. Zimmerman. Pp. 19. Vol. 12, No. 2: Amarantaceæ of Southeastern Polynesia. By K. Suessenguth. Pp. 10. Vol. 12, No. 3: Baridinæ of Southeastern Polynesia (Coleoptera, Curculionidæ). By Elwood C. Zimmerman Pp. 8. (Honolulu: Bernice P. Bishop Museum.) [317

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Union of South Africa: Department of Agriculture and Forestry. Bulletin No. 156: Seasonal Variations in the Freezing Point of South African Milk. By Dr L. Denis-Lester. (Chemistry Series No. 143.) Pp. 14. 3*d*. Science Bulletin No. 153: The Composition of Pineapples. By J. C. Bodenstein. (Chemistry Series No. 146.) Pp. 14. 3*d*. (Pretoria: Government Printer.) [58

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International Economics and Social Reconstruction

THE narrow outlook which continues to characterize much of the controversy regarding sanctions, the refusal to face the implications of collective security, and the disposition to blame a mere organization such as the League of Nations for failures due to lack of courage and foresight on the part of statesmen in using the machinery ready to their hand, should dispel any optimism that we are beginning to grasp the essential principles upon which the future well-being of mankind must be constructed. We may well doubt that there is sufficient political sense and stability in Europe or Asia to make world recovery possible at all. To those who maintain that our whole civilization is slipping into disintegration and dissolution from which all our mastery of the material universe is impotent to preserve it, a satisfactory answer is not readily found.

Reasons such as these, and the way in which the continued difficulties experienced by our own and other Governments in handling international affairs betray lack of capacity for real leadership and foresight, may well lead to misgivings as to the future in spite of the undoubted fall in unemployment and increase in industrial employment and trade. How well-founded are such misgivings is indicated by the admirable survey of world economic and social conditions provided by Mr. Harold Butler, Director of the International Labour Office, in his Annual Report*. It is clear from this survey that no certain answer can yet be given to the question whether the past year should be regarded as marking the emergence of the world into the flowing tide of recovery or as merely an interlude of mitigated depression.

On the credit side of the economic balance sheet must be set a gradual improvement in prices and a continued decline in unemployment. In many countries, the general index of industrial production has moved steadily upwards; but in so far as this industrial prosperity is founded on the expansion of armaments, which notoriously is taking place in the principal industrial countries, it is hollow and unusual as well as sinister. The manufacture of arms adds nothing to national wealth, and the economic consequences of rearmament must be set in the scale against the apparent sign of economic revival. The universal alarm and anxiety which accompany intensive competition in armaments check the expansion of healthy trade and investment, and block the path of normal recovery.

The armament situation itself is thus reason enough for some misgivings about the present situation. The slight improvement in the volume of international trade, and the extent to which economic nationalism continues to hold the field, are other reasons for anxiety. Confidence in foreign investment is still lacking, and the major obstacle to the re-birth of confidence is the fear of war, imminent or not remote; and economic recovery is an impossible dream until this fear of another and more catastrophic collapse of the whole international political system has been dispelled.

Given a general will to seek that end in a constructive and co-operative spirit, the task is not yet impossible in spite of its increased difficulties; but it calls for the display of statesmanship of the highest order. It must be realized that the most radical flaw in the recent peace settlement was the failure to ensure economic and social equilibrium. Territorial claims and armament programmes are the symptoms—not the causes—of our present condition. The roots are to be found in actual or threatened impoverishment, declining standards of life, insecurity for the future of themselves and their children which darkens the outlook of the present generation in so many countries. The question of peace can no longer be discussed apart from that of social justice.

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* Report of the Director, International Labour Office, Geneva, 1936.

On such grounds as these, Mr. Butler is led to a point of view which many scientific workers have reached, from their survey of the possibilities of the applications of science being utilized to raise the general standards of and amenities of human life, and to assist in the distribution of the economic resources now at our disposal. No longer can we think of life in terms of sub-divisions only. Artificial barriers which hamper our thought about men in society must be broken down and a synthesis of all the social sciences achieved which will permit a true notion of the structure and possibilities of society, just as it is only by a synthesis of all the sciences concerned with man and his environment that we can understand his nature.

Mr. Butler's brief summary of the immediate problems of social reconstruction which call for consideration has points in common, such as housing, with those which in Great Britain are already receiving the attention of such groups as P.E.P. (Political and Economic Planning), or nutrition, on which scientific workers have done much to provide a basis for action. Mr. Butler refers to the way in which these questions are linked to those of international trade and finance. The question of raw materials is similarly linked and is not even mainly a colonial problem. The countries which have real difficulties in procuring their supply of raw materials are those which have imposed restrictions in dealings in foreign exchange, due to their monetary or commercial policies. The problem cannot be divorced from the whole question of restrictions on commerce, including the question of the 'open door' in colonial territories which are large providers of certain raw materials.

These problems in themselves raise broad questions of colonial policy, not only in regard to raw materials but also in regard to labour and migration. The need for investigating such problems is now becoming generally admitted, and they can only be dealt with on practical lines if account is taken not only of general principles, such as are embodied in the Mandates Article of the Covenant of the League of Nations, but also of the conditions and requirements of each particular case. Not the least untoward consequence of Italian aggression in Abyssinia is the way in which it has enhanced the difficulties of an impartial and adequate treatment of questions which were already sufficiently thorny.

Last and most important of all in the programme of reconstruction is the problem of liberating commerce from the restrictions which have been imposed upon it by nationalist economic policies or on account of currency disorders. From whatever angle we approach the problem of reconstruction, the only path leading to its solution is that of closer international intercourse. The doctrines of nationalism and self-determination may within limits be beneficial and stimulating in the field of politics and culture, but in the field of economics they are fatal. Economic nationalism in its recently developing forms is incompatible with economic stability and therefore with the peace of the world.

The only way out of our troubles is, therefore, to restore so far as possible exchange of goods, services, money and population on which pre-War prosperity was founded, and which the rapid progress in means of communication has made all the more imperative. The new world economy to be built up, however, must take account of all the developments which have taken place since 1914. The great internal transformation in industry and agriculture cannot be set aside without causing still further confusion and upheaval. They necessitate a complete readjustment of method, but the ultimate objective is unchanged.

Mr. Butler gives us once more a survey which commends itself to the scientific worker alike for its presentation of the facts on a broad canvas free from the distortion of material or party bias as for its insistence on the necessity of viewing life as a whole. Economics cannot be separated from ethics, social justice from material well-being, or social and ethical aspirations from political activities. Peace itself is not possible without social justice between nations and between individuals, and only through an equitable organization of the world's economic life can peace and justice and freedom be made secure.

These views to-day are in danger of becoming platitudes, though they touch the quality and direction of scientific life and thought as of every other intellectual or physical activity. It is only as creative thought is brought patiently and impartially to bear on these questions that we can hope to find the lines of a solution; and the major question is whether sufficient moral and social pressure can be mobilized in support of constructive policies in which science plays its fitting part, before the reactionary forces of militarism and economic rivalry and autarchy bring the whole fabric of our civilization to collapse.

The root question behind this appeal for world co-operation is the choice between freedom and slavery of the spirit. Freedom of thought and speech, belief and investigation, subject only to the recognition of the same liberty on the part of others, is exactly what is threatened by the new tyrannies which, through their militarism and economic nationalism run mad, seek often in subtle ways to reduce the citizen to a soulless unit, to moral and intellectual servitude. The perpetuation of economic antagonism and military rivalries is as grave a danger to scientific thought and investigation, upon which so many of its material achievements are based, as it is to the continuance of our material civilization.

Manifolds of Plenary Space

Intrinsic Geometry of Ideal Space
By Dr. A. R. Forsyth. Vol. 1: pp. xxvi+553. Vol. 2: pp. xiv+655. (London: Macmillan and Co., Ltd., 1935.) 2 Vols. £6 6*s*. 0*d*. net.

IT is desirable to give the reader immediately an idea of what is an ideal space and its intrinsic geometry. Prof. Forsyth writes: "The present work is occupied with investigations of those intrinsic properties and differential measures of geometrical amplitudes which are connected with the corporate characteristics and the organic constituents of the amplitudes". Hence we see, if we do not know what is an ideal space, we know at least that we can substitute the word "amplitude" for it; and instead of "intrinsic" we can use "corporate" and "organic". That is all. We must seek an interpretation of these mysterious words going through the 1248 pages of this work. Before we can do that, we must become acquainted with some other words: plenary uncurved or homaloidal (Euclidean space); flat and block (Euclidean spaces of dimensions three and four); amplitude (manifold); regions and domains (manifolds of three and four dimensions); tilt and coil (third and fourth curvature); gremial, orbicular, and globular curvatures; and other curiously used words.

Passing over Eleusinian statements like this: "The homaloidal space is free from all native measures that can modify the geometrical character of included figures: its standardising influence is impartially neutral", we begin to examine the contents.

Section I, after an introduction where we discover the identity between homaloidal and Euclidean space (How can that be? Was it not free from any native measure?) and where we find the old Frenet equations, gives a sketch of Riemannian geometry (geodesics, Riemann's curvature), with a mixture of properties not belonging to this geometry but to the ordinary Euclidean geometry of the manifold (as embedded in a Euclidean space). Such are the researches on the locus of the centres of first curvatures of geodesics of a manifold V_n concurrent at a point: the cases when the dimensions of the plenary space (Euclidean space embedding the V_n) are $n+2$ or $n+3$ are discussed. In this second case two subcases arise; but no hint is given of the projective ground on which this distinction stands. Neither is there any suggestion of what may happen when that space has more than $n+3$ dimensions, although the number of possibilities is finite.

With Section II begin the limitations of the field of research; the author restricts his studies to surfaces (Section II), regions (Section III) and domains (Section IV) and to their subamplitudes. Here also we find properties of Riemannian character (geodesics, Riemannian curvature, Levi-Civita's parallelism, minimal surfaces and regions) scattered in different chapters, according to the dimensionality of the amplitude; also, when they are independent of it, mixed up with properties relating the amplitude to its Euclidean space. There is a wealth of particular results (new or not, that is difficult to state from quotations in the book), but no general idea. It is a kind of empirical 'going on', step after step, with apparently no goal to be reached. The method of attack has also the same empirical character: it would certainly be inadequate for a research of broader frame.

Now some selected topics. Section I contains some theorems which can be summarized as follows: the second, third and fourth normal of a geodesic of an amplitude (at a point) lie in the tangent homaloid of the amplitude. This is a serious mistake, and no calculations are necessary to check it. In fact, not only is the reasoning on which it is established evidently wrong, but, should it be true, it would lead to the amusing conclusion that the geodesics of any surface whatever belong to spaces of three dimensions! This mistake is of no little moment: it invalidates many results in different sections of the book.

Section II opens with the following question: Is it possible to find a lower limit to the dimensionality of the Euclidean space (plenary homaloid) containing a surface with a given arc-element? The answer, given by Darboux in 1872, and referred to in all standard treatises on the subject (like Darboux's and Bianchi's) is in the affirmative. It is always possible to construct such a surface in a space of three dimensions by integrating a Monge-Ampère equation and by quadratures. Prof. Forsyth's answer is in the negative*: it is true that he speaks of an upper limit, but what he means (as can be seen from the discussion) is a lower limit. This is all the more reason that a search for an upper limit has no value, it being evident that, given a surface in a 3-space, surfaces with the same arc-element can be found in a space with greater number of dimensions. Prof. Forsyth seems struck by the example he gives of a surface in a space with an infinite number of dimensions: there is nothing surprising in it, the dimensionality of the space having nothing to do with the arc-element of the surface (it is not a Riemannian character).

Another topic to be mentioned—and this will be the last one—is the statement, often repeated and invalidating many results, that when a certain determinant vanishes (see, for example, vol. 1, p. 369) or, what is the same thing, when the first and second derivatives of the co-ordinates of a point of a surface are not linearly independent, the surface lies in a quadruple homaloid. To make the mistake more curious, the example given before of a surface belonging to a space with infinite dimensions contradicts the last statement. But this is only one example, and the simplest one, of the contradictions which arise when the projective characters of the manifold are not considered. I have emphasized many times the fact that, when studying the differential properties of a given order (of differentiation), the basic element to be considered is not the dimensionality of the space in which the manifold is immersed (which may also be infinite, with no danger) but the dimensionality of certain osculating spaces (as I call them) projectively connected with the manifold.

The author describes his book as an adventure into the realm of investigating manifolds (not curves or hypersurfaces) existing in a plenary space. Thirty years ago, E. E. Levi (who is not quoted in this work) entered the same realm, harvesting the first results (for two-dimensional surfaces) and showing its difficulties. More than twenty years ago, I tackled the problem again, and conceived the idea of Riemannian geometries of higher species ("Geometrie Riemanniane di specie superiore". *Mem. R. Accad. d'Italia*, 1935), showing that the differential properties of a given order r of a manifold (whatever its embedding space may be) can be described in terms of r differential forms of the first order and of $2, 4, \ldots, 2r$ degree. But the step was not easy. To fill the gap it was necessary to build up the projective differential geometry of manifolds, or more exactly of linear partial differential equations. In the meantime, other investigators have taken part in the work, as Vitali, Enea Bortolotti, Burstin, Duschek and Meyer; apparently passing over all this work, Prof. Forsyth has followed his own way.

E. Bompiani.

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* The correct result is given in a corrigenda sheet which has been issued since publication of the book.

Sea Urchins

A Monograph of the Echinoidea
2: Bothriocidaroida, Melonechinoida, Lepidocentroida and Stirodonta. By Th. Mortensen. Text. Pp. vi+647. Atlas. Pp. ii+16+89 plates. (Copenhagen: C. A. Reitzel; London: Oxford University Press, 1935.) 2 vols., 140s. net.

THIS monograph attracts a review, for it exhibits features of a distinctly novel nature and it approaches perfection as near as can be. The animals are the box-like sea-urchins, starfishes with radiating segments and brick-like walls (tests) decorated with spines and fine sculpturing. They walk by outpushings of fine tubes (tube-feet) with terminal sucking-disks arranged in five rays, such as cause starfish to be of unique personality. They belong to Mortensen more than to anyone else, for he has pursued the living forms in most parts of the world. Here, his study of the urchins' habits, food and ecology was antecedent to that of their classification, and he thus by analogy can tell us much of the life of the extinct forms. Of the latter there is a long series from the Palæozoic, and it would seem probable that these animals have never been less numerous either in genera and species or in individuals than they are to-day. Thus the relatively deep-living Salenidæ had eighty-five species in the Cretaceous as compared with only twelve species to-day, but all the extinct forms were not deep-living.

The first animal here considered, *Bothriocidaris*, was formerly regarded as the ancestor of all sea-urchins, but more ancient forms are now known, and Mortensen evidently places it here to avoid making another phylum. He supposes that it must have ingested food through the mouth, probably the adoral spines and tube-feet helping as in the living spatangoids. Judging by the deposits where it occurs, it lived in shallow reef-pools, which, according to the indications furnished by its test, cannot have been exposed to strong wave-action. It is this thought of the fossil forms as once alive and playing their parts on the ocean floor which makes this monograph so illuminating, its animals far more than mere dates in a stratigraphical series and its living forms the few survivors of a long ancestry.

Only three divisions (Melonechinoida, Lepidocentroida and Stirodonta), besides Bothriocidaroida with its single genus, are monographed. They contain 22 recent and 116 fossil genera. All the genera are described, while in addition the 84 existing species are fully considered in respect to their anatomy, colour, occurrence and, so far as possible, their ecology; the text illustrations of the anatomy form a feature of great utility. The same technique is applied to the fossil genera, the anatomy of which is illustrated while their affinities are considered. Many of the species are referred to, but it is beyond the author's scope to consider all the described fossil forms. Added to the monograph is a volume of plates of high quality.

The whole is of great credit not only to Mortensen but also to Denmark and to the managers of the Carlsberg Fund, whose financial aid alone made possible the printing of this luxurious publication, which it is a joy to handle. J. S. G.

Negroes and Pygmies

My Pygmy and Negro Hosts

By Paul Schebesta. Translated from the German by Gerald Griffin. Pp. 287+31 plates. (London: Hutchinson and Co. (Publishers), Ltd., 1936.) 18*s*. net.

FATHER PAUL SCHEBESTA, whose intimate knowledge of the pygmy problem, acquired in the Far East as well as in Africa, transcends that of any living ethnologist, has now produced a sequel to "Among Congo Pigmies". In this he supplements his earlier work on the Congo pygmies by an account of the Batwa of Ruanda and the Bachwa of the Equatorial Province, who, if not all pygmies, at least merit the title of half-pygmies. More important, however, for his present purpose, are the tribes of full stature with whom he came into contact on his travels in 1929 and the two succeeding years.

Interesting for the ethnologist as must be the comparison of the material relating to the pygmy peoples given here with that of the previous book, it will probably appear to most readers that the author has displayed sound judgment in devoting the larger share of his attention to the tribes other than pygmy. For one thing, this material is essential for an understanding of the ethnological background, in view of the close relation, almost a symbiosis, between the pygmy and his taller neighbour, while in the second place, the culture of these peoples is both intrinsically interesting, and for the most part has not previously been described. Witchcraft, cannibalism and tribal history afford the author a rich field for description. It may be hoped that material for a fuller and more systematic analysis of the last named will be forthcoming later. Some further details, too, of the evidence upon which is based the suggestion of a surviving influence from Ancient Egypt will be welcomed.

The author was much impressed by his visit to the Royal Court of the intrusive Batutsi of the mandated territory of Ruanda, in which, as he points out, there are certain close resemblances to the court of Uganda. He was admitted to the presence of the Royal Mother—a privilege formerly denied to the foreigner, and evidently resented. Shortly after, the dynasty was deposed by the Belgian authorities.

The narrative offers innumerable tempting paths which would lead to discussion, such as, for example, the association of initiation ceremonial with a cannibalistic 'leopard' society among the Babali, where also initiation takes the place of circumcision, universal among the other tribes. The author himself was responsible for the discovery of a secret 'leopard men' society and its association with cannibalism among the Babali.

At the present moment, when African colonies and mandated territories are much under discussion, Father Schebesta's final chapter, in which he deals with the relations of black and white in the Congo, will be found to contain much that is pertinent. Belgium, he points out, is intensely proud of the possession of the Congo and has made immense sacrifices for its benefit. Since the Great War, a complete change has taken place in the spirit of the administration, and every effort has been directed towards the benefit of the natives. In the main these efforts have taken two directions —the building of roads and the formation of an administrative organization for the government of the natives in accordance with their own cultural ideas. As the author points out, the making of roads has conferred no benefit on the natives, while imposing on them a heavy burden of upkeep; and the system of headmen or *chefs de section* has been applied without discrimination. In certain instances it was applied to peoples to whom it was not adapted; in others the headman, as happened also at times in British mandated territory, was merely a figure-head, because the real native rulers, the spiritual chiefs, remained in the background and continued to receive the peoples' allegiance Apart from the author's criticisms, there is evidence here and there in his narrative that the administrative system lacks the necessary basis of a scientific study of native institutions, which has been recognized elsewhere as a necessary preliminary, however superficial it may have been in practice, owing to lack of time or other impeding conditions.

New Ornamental Trees and Shrubs

Trees and Shrubs hardy in the British Isles
By W. J. Bean. Vol. 3. Pp. xiv+517+64 plates. (London: John Murray, 1933.) 36*s*. net.

DURING the planting season, those of us who wish to make our gardens more attractive by the addition of flowering shrubs or trees, scanned nurserymen's catalogues for some of the more showy and less commonly seen species, so many of which have been introduced in recent years. The wanderings of Forrest, Kingdon Ward, Wilson, Farrer, Comber and Rock have greatly increased the possibilities for variety. Now that the new introductions have been tested as to adaptability to our climate, at Kew, Edinburgh, Wisley and elsewhere, seeds and plants of those which have proved satisfactory are becoming available for distribution, at a moderate price, to gardens with only limited space.

Those who are looking for new and interesting species would be well advised to study carefully the third volume of Bean's "Trees and Shrubs hardy in the British Isles". This is a supplementary volume to the first two, which were issued in 1914; it has been written with the same care and precision, and that unrivalled personal knowledge of the plants themselves and their requirements, which are so characteristic of all Mr. Bean's work. It comprises 517 pages and includes 64 full-page illustrations from photographs by such well-known lovers of trees as Lieut.-Colonel Stephenson-Clarke, Dr. Wilfred Fox and the late Dr. E. H. Wilson, and others by R. A. Malby and Co. These, in themselves, are a joy to look at; where all are beautiful and well-selected, it is almost invidious to mention any in particular, but perhaps *Magnolia sinensis; Pyrus* (*Sorbus*) *munda* var. *subarachnoidea* with its white fruits showing beautifully against a dark background; *Halesia monticola* with its bell-shaped flowers; and the charming habit photograph of *Cercidiphyllum japonicum* at Westonbirt, are worth especial mention.

Magnolia sinensis Stapf, from West Szechuen, China, where it occurs at 7,500–9,000 ft. altitude, is said to be perfectly hardy, forming a pleasant addition to the list of magnolias. It is described as a deciduous shrub or small tree, bearing saucer-shaped, fragrant white flowers 3–4 inches across, having rosy-crimson stamens; a useful feature is said to be its ability to thrive in a chalky soil. *Meliosma beaniana* Rehder and Wilson, from Hupeh and Szechuen, is said to grow "healthily" at Kew. Wilson described it as one of the most striking and handsome of Chinese trees, with leaves 6–12 inches long, and creamy-white panicles up to 8 inches long and 4 inches wide.

Of *Cornus kousa* var. *chinensis* Osborn, Mr. Bean says that this beautiful flowering tree should be in every garden, being perfectly hardy and blossoming at a season when most hardy trees and shrubs are out of flower. It is encouraging to read of a *Paulownia* (*P. fargesii* Franchet) which seems to be hardier at Kew than is *P. imperialis*.

Ceanothus cyaneus Eastwood, is described by Miss Eastwood, the veteran curator of the California Academy of Sciences herbarium, in Golden

Gate Park, San Francisco, as "certainly the loveliest of all the species of Ceanothus, with its large sprays" of flowers of a lovely bright blue, each about $\frac{1}{4}$ in. across. It is grown at Kew on a wall facing east, but suffered from frost in the spring of 1932, and Mr. Bean thinks it will probably be seen at its best nearer the south coast.

Of other genera represented in gardens by well-known species, many novelties are described, including 29 of *Berberis*, of which 3 are figured; *Betula* 7; *Buddleia* 11, *Ceanothus* 7, *Pyrus* 26, *Prunus* 16 and *Pittosporum* 11.

Of the New Zealand genus *Olearia* (daisy bush), of which the hardy *O. haastii* is the best known, twenty-four species are described, most of which, unfortunately, are hardy only in the mildest parts of Britain.

The genus *Rhododendron* comes in, of course, for the greatest attention, the account of it occupying 91 pages (out of the total 517), 173 species or hybrids being described and 14 figured.

The value of the book is indicated by the fact that a second edition has just been published.

Mathematics and Agriculture

Mathematical Treatment of the Results of Agricultural and other Experiments
By Prof. Dr. M. J. Van Uven. Pp. vi+310. (Groningen and Batavia: P. Noordhoff, N.V., 1935.) 9.50 f.

WE have become accustomed in Great Britain, mainly through the writings of Prof. R. A. Fisher, to the idea that accurate field experimentation in agriculture and cognate sciences is only possible through bringing certain principles of experimental design, mainly mathematical in character, to bear on the problem before the experiment is carried out, and then building up an arithmetical technique, based on the theory of statistics, for the working out of the data resulting from the experiment.

Dr. M. J. Van Uven, who is professor of mathematics in the Agricultural University of Wageningen, Holland, has been associated for many years with agricultural experimentation, and in this book he is concerned to place before readers a careful exposition of the mathematical and technical methods which are needed. He is not writing for the worker who merely desires a formula for the working out of a mean or a standard error. On the other hand, he wishes to be understood by a reader with only a modest equipment of mathematical knowledge. The result is a book, the first half of which is a carefully written and particularly full treatise on least squares. No appeal is made to other than straightforward algebra, but even so the book is by no means easy reading. The general subject is the adjustment of observations, direct and indirect, in one or more variables, including the choice of the representative value, the calculation of mean error of single observations, and of functions of these, and an elementary exposition of probability.

In the second part the author takes up the study of field experiments, beginning by showing how yields of plots can be adjusted when there is a regular fertility distribution. When this condition is not satisfied, he shows how to separate out the systematic and accidental causes of variation by means of an analysis of the variance of the yields. He considers the case of two treatments on alternate plots, and describes his method of working out the standard error of the difference between the treatment means. He recognizes, however, that such an arrangement is far from ideal, and proposes instead that the original plots should be divided to accommodate the number of treatments it is desired to test. This makes the trial one of a larger number of plots of smaller dimensions, but the author does not say how the treatments should be arranged within the plot, whether at random or systematically.

A long description follows of Fisher's methods of block trials, including as a special case the Latin square. There is much to interest the reader here in the exposition of the algebra of the method, and its various ramifications, but the author does not point out that one of the essential features of the methods is the random arrangement. Indeed his examples are systematically arranged, although he does point out, in the case of the Latin square, that some re-arrangement would be advisable to prevent the same treatment occurring down the diagonal.

The author returns to least squares in the last chapter, dealing with the adjustment of direct conditioned observations, and four appendixes are added dealing in detail with points arising in the text. The last, indeed, gives the complete technique of solution for normal equations.

The book is well and attractively printed, and there are few misprints. J. WISHART.

The Atom

By Prof. E. N. da C. Andrade. New edition, entirely revised, extended and reset. Pp. ix+129. (London and Edinburgh: Thomas Nelson and Sons, Ltd., 1936.) 1*s*. 6*d*. net.

PROF. ANDRADE dedicates this little book to two friends as a memorial to "a lively, learned, and humane luncheon table", and thereby sets the tone of what follows. Starting with an account of the meaning of the atomic theory, he takes the reader smoothly along, with many a well-chosen analogy and an occasional jest, dealing with the atom of electricity, the nature of light, the structure of the atom, the mechanism of radiation and, in the concluding chapter, with the relation between matter and energy.

We read of the positron, neutron, wave mechanics, quantum theory of spectra, transmutation of atoms and artificial radioactivity, all in a descriptive narrative using everyday illustrations to make difficult conceptions clear. A large ship, with engines stopped, rolling and pitching on the open sea, reveals by its motion to an observer in an aeroplane that the sea is rough even though he cannot see the waves; so the Brownian movement in a liquid reveals the motion of its molecules. Cigarettes of various sizes are sold, but we have to buy a whole number; similarly, the quantum of radiant energy varies with frequency, but we never find less than one quantum, whatever the frequency. A given kind of atom may be regarded as singing two characteristic songs in the bass (flame and spark spectra) and one in the high soprano (X-ray spectrum).

Prof. Andrade's hope that he will arouse a desire to pursue the subject further will surely be fulfilled. We may commend the book also to senior physics pupils in schools, who will obtain from it a broad and often novel view of recent developments in their subject.

The Identification of Trees and Shrubs:

how to name without previous Knowledge of Botany any Wild or Garden Tree or Shrub likely to be met with in the British Isles. By F. K. Makins. Pp. vii+326. (London: J. M. Dent and Sons, Ltd., 1936.) 15*s*. net.

THE appearance of a book that aims at supplying the means of identification of trees and shrubs that occur in Britain—wild or cultivated out of doors—should meet with a wide appeal. It is true that the indigenous woody species, which number only a few dozen, may be readily named from existing floras and handbooks, and that there are excellent works describing the legion of trees and shrubs now in cultivation; nevertheless, so far, there has been no attempt to provide a general key or other ready means of identification of the cultivated species, and the present work is a pioneer in this respect.

The book is easy of reference and assumes no previous botanical knowledge. Only those species that the author considers most likely to be met with are considered, rare or little-known plants being purposely omitted. In spite of this limitation, the number of woody plants dealt with is 1,732, or rather more than half those listed in the Kew "Handlist of Trees and Shrubs" (1934) which places the total number at about 3,000. Each species is represented by a small illustration or diagram, and is briefly described in the later part of the volume. A preliminary key on basic leaf characters serves to direct the user to the requisite group of diagrams to which any particular plant may belong.

The work should prove useful, particularly in naming the more generally cultivated trees and shrubs; but limitations of size must effect its usefulness in the case of the larger genera with numerous closely allied species, for example, *Rhododendron*, *Cotoneaster*, *Crataegus* and certain *Coniferae*.

Insect Pests of Glasshouse Crops

By Dr. Herbert W. Miles and Mary Miles. Edited by H. C. Long. Pp. 174+21 plates. (Surbiton: H. C. Long, The Birkins, Orchard Road, Hook, 1935.) 8*s*. 6*d*. net.

GLASS-HOUSE cultivation provides a type of environment which favours the spread and multiplication of a variety of insects and related creatures of injurious propensities. At the same time, these conditions afford facilities for pest control that are often exceptional. The growing extension of the glass-house industry has brought the cultivator up against the problem of pest elimination more realistically than in years gone by. New pests have come to light, species formerly regarded as innocuous have, after proper study, proved to be the reverse, and the list of known invaders has assumed considerable proportions.

Much valuable information is now available on the subject of glass-house pests, but it has mostly remained inaccessible to the amateur and to many professional growers. Dr. and Mrs. Miles have thus supplied a much-needed requirement in the book under notice. Their experience and qualifications have well fitted them for their task and they have produced a sound, up-to-date manual covering the whole range of pests likely to be met with. These are clearly described, along with their life-histories, and the most practical and efficacious methods of control. The book is well illustrated with a remarkably good series of clear photographs, almost all being hitherto unpublished. It can be recommended to all interested as one which is based upon practical experience and not merely compiled from the writings of others.

A. D. I.

Odyssey of the Islands

By Carl N. Taylor. Pp. xiv+284+31 plates. (New York and London: Charles Scribner's Sons, 1936.) 12*s*. 6*d*.

MR. TAYLOR describes himself as a 'vagabond', and entertaining as this record of a vagabond's wanderings may be, it does not call for extended notice here. It is, however, to be noted as giving a view of life among the wilder peoples of the Philippines, which includes an account of the too little known and often unapproachable pygmies. The book is illustrated by some excellent photographs.

The Total Solar Eclipse of June 19, 1936

Observations at Omsk

By Prof. J. A. Carroll, University of Aberdeen

THE expedition of the Joint Permanent Eclipse Committee of the Royal and Royal Astronomical Societies, and the University of Aberdeen, which was stationed at Omsk, had the good fortune to observe the total solar eclipse of June 19, 1936, under excellent conditions.

The expedition consisted of five members, namely, Prof. J. A. Carroll, professor of natural philosophy in the University of Aberdeen (leader); Mr. E. G. Williams, Solar Physics Observatory, Cambridge; Miss F. M. MacBain, Natural Philosophy Department, Aberdeen; and two volunteer observers, Mr. W. M. Alexander, Aberdeen; and Capt. S. I. Luck, London.

Our programme contained only three principal items, but as the instruments, methods and auxiliary equipment were in many respects quite novel, some detail of description will be of interest to readers of NATURE.

To deal first with the observing instruments themselves, and the results yielded by them:

(1) A very rapid objective prism spectrograph specially intended for exploratory work in the infra-red region of the coronal spectrum, but, of course, also used on the flash spectrum. Five 60° prisms were followed by an objective of two inches aperture and twenty inches focal length, giving a dispersion of about 100 A. per mm. at 9000 A., and covering the range from the *D*-lines of sodium to about 11,000 A. on several pieces of plate of different types. The plates used were (1) Ilford S.R. Panchromatic, (2) Agfa 800 Contrasty, (3) Agfa 950.

We were particularly concerned to detect the coronal radiation at about 9600 A. predicted by Rosenthal[1] on the supposition that the major coronal lines are due to excited helium atoms, and also to observe the line at 7896 A. observed by Curtis and Burns[2] in 1925 and recently observed by Lyot[3] at the Pic du Midi without eclipse.

Plates sensitive so far in the infra-red have in general poor keeping qualities, and the plates used were sent by air and by special messenger from Berlin as shortly before the eclipse as possible. We are much indebted to Messrs. Agfa for the prompt supply of fresh plates and to the British Embassy in Moscow and the Poulkovo Observatory for their rapid transit to Omsk, where we could keep them on ice. Thus our plates were in good condition, and thanks to the thermostatic control the instrument performed well.

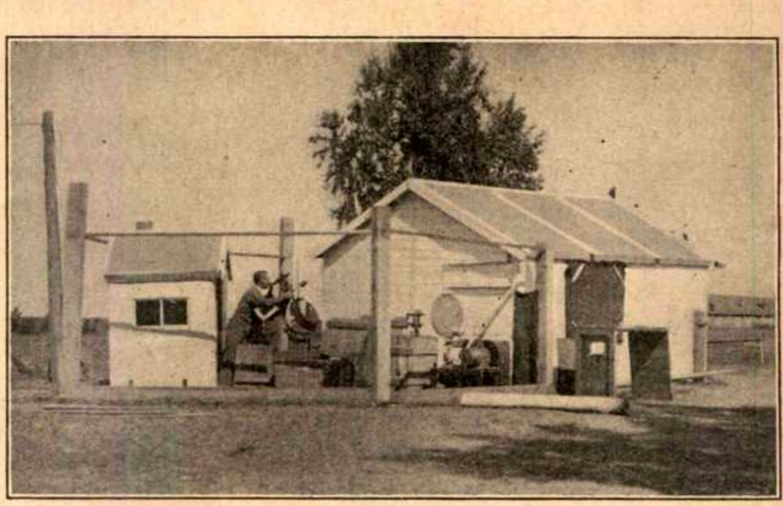

FIG. 1. Exterior of the cœlostat and experimental hut, looking east. The double-walled hut on wheels for sheltering the cœlostat is on the left. The larger hut is the double-walled, felt-lined hut for thermostatic sheltering of the instruments. At the nearest corner of the large hut can be seen the compressor for the refrigerator plant, and just above it the circular window to admit the horizontal beam from the cœlostat.

The plates show many flash lines and a number of coronal rings. Four exposures were given, (1) 5 sec. on the first flash, (2) 20 sec. on the corona, (3) 90 sec. on the corona, (4) 7 sec. on the second flash. Timing was good, and both flashes are satisfactory. In the flash spectrum, the Ca II triplet at 8500 A. is strong, the usual features show in the visible region and there are several strong lines in the region 9000 A.–10,000 A. not yet certainly identified, probably including a line due to helium. On the coronal exposures 6374 A. is strong and also the line near 7890 A. There is no strong radiation in the expected region near 9600 A., though later examination may reveal traces. The plates were good enough to show strong lines down to 10,000 A. It is interesting to note that at mid-totality prominences show, in $H\alpha$ and the *D*-lines, on both sides of the solar disk.

(2) An objective interferometer of 13 cm. aperture and 105 cm. focal length for the study

of the corona in its own monochromatic green radiation at 5303 A. The aim of this instrument is not, as some seem to have thought, to obtain accurate wave-lengths of the coronal green line. As this line is about 1 A. wide, the use of an interferometer for such a purpose is futile. The point is that by introducing a Fabry-Perot étalon into the optical train of a suitable objective spectrograph, one obtains a spectrograph working in all directions simultaneously as it were, and can obtain at all points of the corona the sort of information given by a powerful prism instrument, with a slit, over a small region only. Thus the variation in wave-length, strength, profile, and width of the line selected may be observed, and rotation and internal motion of the coronal material measured.

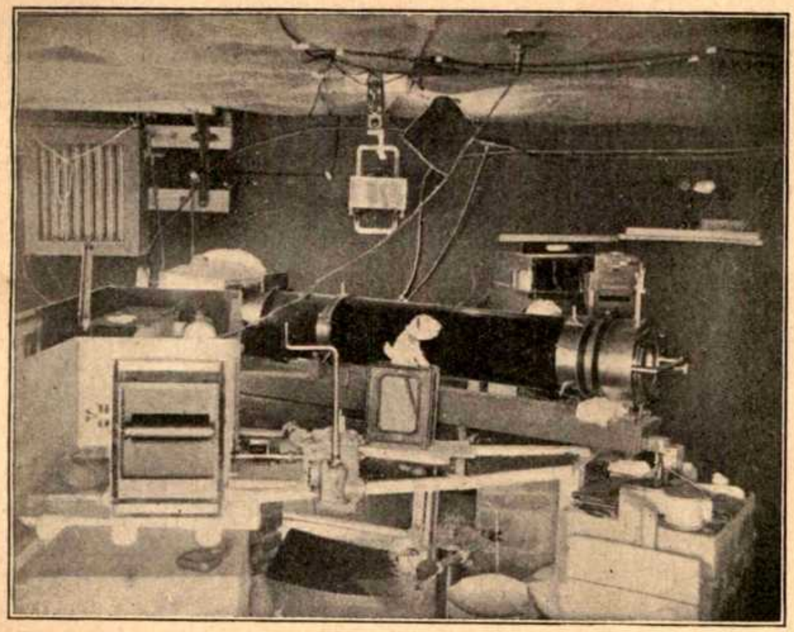

FIG. 2. Interior of experimental hut, showing echelon spectrograph, interferometer and infra-red objective prism spectrograph, with roof and sides of inner thermostatic chamber removed. One of the cooling coils of the refrigerator plant can be seen just above and to the left of the window admitting light from the cœlostat. In the opposite corner is one of the fans of the heating elements. In the centre of the ceiling are two thermostats controlling the cooling and heating elements for hut temperature. In the foreground is the heater element (surmounted by the Expedition's mascot) for fine control of instrument temperatures.

Two 6-inch 45° prisms dispersed the continuous spectrum sufficiently to allow the green ring to show by contrast, and the Ilford Astra VI plates were used, as these have a narrow maximum of sensitivity at 5300 A. with good resolving power and contrast. The plates of the étalon were separated by 1 mm. and were coated with aluminium *in vacuo* in an apparatus specially constructed in the Natural Philosophy Department at Aberdeen, so that the coating was uniform to a fraction of one per cent and the density could be exactly controlled. Thus the greatest resolving power obtainable for the loss of light allowance was secured.

The objective was a triplet of 6-inches aperture specially computed and made by Messrs. Adam Hilger, Ltd. The instrument worked excellently, and comparison fringes obtained during eclipse show exquisite definition at the full aperture.

Most unhappily, the light from the sun was cut off from this instrument during the total phase by a trivial accident, and only the comparison fringes remain to show the excellence of its performance. These are, however, not without interest in view of the remarks later on the need for, and benefits of, thermostatic control of eclipse instruments.

(3) An echelon spectrograph with automatic camera giving successive exposures of about 1·5 seconds for the study of the flash spectrum. It is of great interest to obtain accurate measures of the shapes of the chromospheric emission lines and of the changes in their shapes with height in the chromosphere. As these lines are only some 0·5 A. or so in width, very high resolution and dispersion are needed. An echelon spectroscope, crossed by, say, a pair of prisms, is almost the only instrument satisfying the necessary conditions for this type of observation, but so delicate an instrument is hard to use under eclipse conditions, and further, no echelons of large aperture exist.

The Natural Philosophy Department at Aberdeen possesses a very fine transmission echelon of 33 plates, each 1 cm. thick, height of step 1·1 mm., width 37 mm. This is still a very small aperture, but in view of the great interest of the observations and the great expense of a larger echelon, it was decided to attempt the observation of the flash spectrum with this instrument despite its small aperture. The information obtained would in any event be of vital importance in showing the practicability of the method and the size of instrument needed for accurate measurements, even if the flash spectrum turned out to be under-exposed.

As ordinarily used in air, the instrument had too small a separation between successive orders for use on the chromospheric lines, and the expedient of using the echelon immersed in oil of suitable refractive index was tried. Fortunately, the plates of the echelon turned out to be sufficiently homogeneous to permit this, and the main difficulty was due to the now abnormal sensitivity of the instrument to temperature changes. Liquids all have a temperature coefficient of refractive index some ten or more times that of glass, and to maintain homogeneity to a small fraction of a wave-length in a column of liquid 40 cm. long by some 8 cm. square proved a formidable task. Success was ultimately attained by careful thermostatic control, combined with the use of concentric thick-walled chambers of good conducting material (brass or copper) separated by air spaces or lagging, so that the echelon and its oil were surrounded by three such 'tunnels', and uniformity of temperature was satisfactorily obtained. The optical and mechanical details of the instrument are far too elaborate to describe in a short article. In essence, the appropriate portion of the chromospheric arc is picked out by a specially designed image rotator and achromatic collimator, and the light dispersed horizontally by two flint prisms and vertically by the echelon. The resulting spectrum is received on a film in a camera automatically operated to expose for about 1·5 sec., then move the film forward in about 0·2 sec. and expose again as often as desired.

The spectra obtained at eclipse proved too faint for useful measurement of flash lines, but the spectrum of the disappearing limb of the sun is well exposed for a study of darkening towards the limb in the last minute of arc over the region 4000–5000 A. It is of interest to note that the Fraunhofer lines seem to have almost completely disappeared by 10 seconds before second contact. The results given by this instrument suggest several possible avenues for exploration at future eclipses, and give accurate data enabling the design of a larger instrument to be undertaken with confidence in its adequacy and practicability.

Perhaps the most interesting and striking feature of our programme was the temperature control of the apparatus.

Modern eclipse observing requires the utmost of the optical performance of the instruments, and it is quite idle to set up spectrographs of any size with prisms and lenses, etc., figured to the last fraction of a wave-length, and expect any but mediocre results if they are subject to the ambient diurnal temperature changes. Still more is this so if interferometric apparatus is used. In Omsk the diurnal range of temperature was some 11° C., and this fluctuation was about a mean temperature that varied every few days from about 10° C. to 25° C. Ordinary lagging and screening by temporary shelters is hopelessly inadequate to deal with this, and it was decided to attempt complete and accurate temperature control as practised in the laboratory.

For this purpose the cœlostat mirror was of pyrex glass, and instead of the usual temporary canvas shelter a well-ventilated double-walled wooden hut, on wheels, was used to prevent undue fluctuation of mirror temperature. The performance of the mirror showed these precautions to be adequate so far as the cœlostat mirror is concerned, though a fused quartz mirror would be worth while. As the cœlostat must necessarily be uncovered in use, more accurate thermostatic control of it is impracticable.

The spectrographs themselves were very elaborately housed and controlled. Steady thermal conditions were obtained in two stages. First of all, a coarse control of the interior of the experimental hut. This hut was of wood, double-walled and felt-lined, with canvas screens (kindly supplied by the Willesden Paper & Canvas Works, Ltd.) for roof and walls. The mean temperature inside was maintained at about 15° ± 1° C. by means of a 1½ h.p. compressor and refrigerating coils (air conditioning units) lent by International Refrigerators, Ltd., and also by two 1 kw. low-temperature heating frames interlocked with the refrigeration control and regulated by a thermionic relay. Within the hut the instruments themselves, supported on masonry piers, were further enclosed in a lagged wooden chamber maintained at 1° C. ± 0·01 above mean hut temperature by thermostat and thermionic relay operating a low-temperature heater only. Tests of heat transfer in Aberdeen showed this system to be practicable and able to deal with the variation of external conditions expected in Omsk.

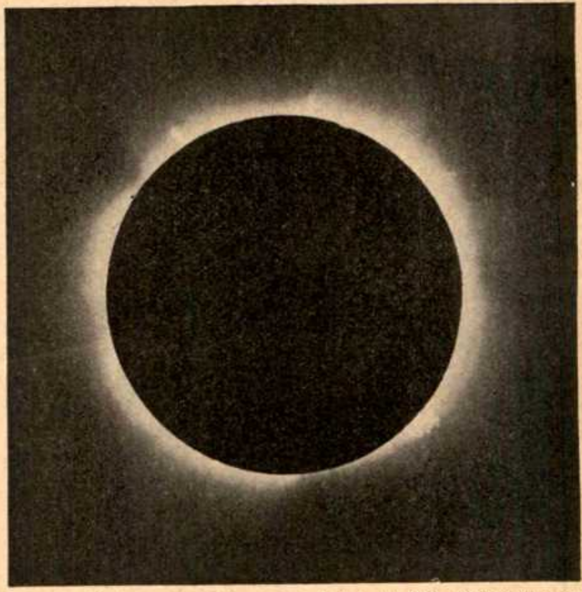

FIG. 3. Photograph of the corona taken by Mrs. Balanovsky, of Poulkovo Observatory, at Omsk. Lens, 5 m. focus; 10 cm. aperture; exposure, 1 sec. on Ilford Special Lantern Plate. By courtesy of Prof. B. P. Gerasimovic, director of Poulkovo Observatory.

It is very gratifying to be able to report that the installation, despite its elaboration, worked excellently. Some sixteen separately wired and fused circuits drawing currents of from ½ ampere to 20 amperes were needed and were required to operate smoothly for a fortnight or more before the eclipse ! Some troubles avoidable on a future occasion were experienced, but nothing disastrous, and the vagaries of electrical supply usual in remote districts were nobly reduced by the Omsk Electrical Supply Authorities despite our being some 8 km. from the generating station, on a line supplying heavy loads *en route*. Without the willing co-operation and special provisions of the supply authorities our efforts would have been nullified, and the way in which this unusual demand was met was typical of the treatment our Expedition received in the U.S.S.R.

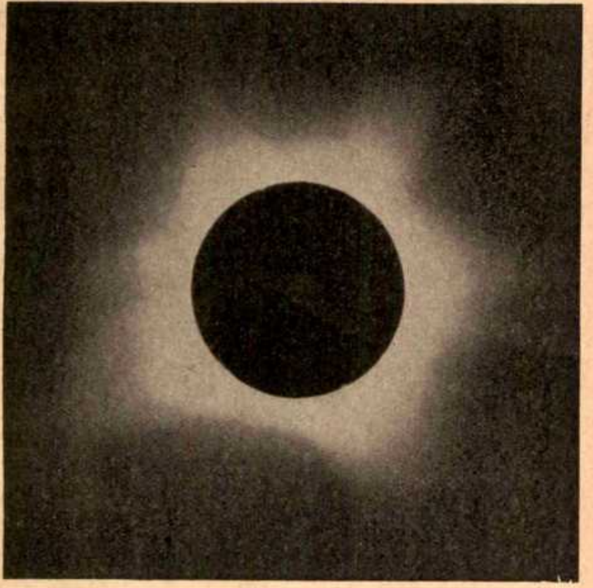

FIG. 4. Photograph of the corona in ultra-violet light taken by Dr. G. Tikoff, of Poulkovo Observatory, at Sara. Lens, 1·5 m. focus; 8 cm. aperture; exposure, 36 sec. on Ilford Special Rapid Plate. By courtesy of Prof. B. P. Gerasimovic, director of Poulkovo Observatory.

It would have been idle to take such elaborate precautions to ensure perfection of optical performance if the photographic materials had not been equally carefully prepared, tested and selected. The resolving power of many suitable emulsions, as well as their sensitivity, was carefully measured in Aberdeen, and the equipment so designed that the optical resolution attainable could be fully utilized. We are much indebted to the Research Department of Messrs. Ilford, Ltd., for the willing preparation of special materials and samples for this work and to Mr. Olaf Bloch for much time spent in valuable discussion.

One point of anxiety that was difficult to relieve by tests made in advance was the question of the correct temperature of stabilization for the instruments. Any desired temperature could be maintained, but clearly the desideratum is to have the instruments as near as possible to the actual temperature of the outside air at mid-totality. The expected temperature, based on mean diurnal records and calculations of temperature drop during the partial phase, was 15·5° C. The eclipse day itself was cooler than average, and the actual temperature was only 13·5° C. at mid-totality. The light was admitted to the instruments through a hole in one end of the hut, and a corresponding hole in the interior casing. These apertures were fully opened some five minutes before second contact and all temperature controls disconnected, the aperture into the hut being opened and the coarse controls suspended some 15 minutes earlier. The definition during totality proved excellent and the trouble feared from air currents did not arise.

The general 'seeing' was very good, and as the down-coming beam from the sun had to pass over the roof of the hut, this was covered for the greater part of the partial phase by a Willesden canvas sheet, removed shortly before totality and leaving the roof itself in good temperature equality with the surrounding air.

It is with great pleasure and gratitude that we can say in conclusion that no praise is too high for the arrangements made for us and facilities given for ourselves and our apparatus. On all sides we met with cordial co-operation, and a willingness to cut through routine procedure to expedite or to simplify our task. The special committee appointed by the All Union Academy of Sciences made excellent arrangements, which were well carried out, and the Government of the U.S.S.R. granted us exceptionally favourable rates for transport and housing, so that it was possible to take out sufficient equipment and personnel to execute this elaborate programme in the middle of Siberia. To Dr. B. P. Gerasimovic, director of Poulkovo Observatory, in particular, we are especially indebted for his personal attention to the hundred and one points of detail, as well as for the major planning of the arrangements made for us in the U.S.S.R. By his courtesy, two excellent photographs (Figs. 3 and 4) of the corona obtained by the Poulkovo expeditions at Omsk and at Sara are reproduced here. The main Poulkovo station was near us at Omsk, on State Farm No. 54, and its observers and the staff of the State Farm rendered us much assistance for which we are deeply grateful.

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[1] A. H. Rosenthal, *Z. Ast.*, **1**, 115 (1930).

[2] Curtis and Burns, *Pub. Alleg. Obs.*, **6**, 95.

[3] B. Lyot, *C.R.*, **202**, 1259 (1936). Lyot gives 7891·6 ± 0·2A. as a new line. The observations of Curtis and Burns in 1925 do not seem to be recorded in any of the more recent lists of coronal lines. I assume provisionally their line at 7896 is the same as Lyot's, allowing for the relative inaccuracies of the measurements made in 1925.

The Formosa Earthquake of April 21, 1935

WITHIN a year after its occurrence, the reports on this destructive earthquake have been issued in a special volume (Supplementary volume 3, 238 pages) of the *Bulletin of the Earthquake Research Institute*. The memoirs (eleven in number) are written in Japanese, each being followed by a summary in English. The five reports are also in Japanese, but only one of them contains an outline in a Western language. Few works on any earthquake have been so admirably illustrated, for half the volume consists of 29 maps and 119 plates, each of the latter containing reproductions of two or three photographs, with titles in English as well as in Japanese. They represent the damage to villages and buildings, the buckling of railway lines, the fissures in roads and fields, and various aspects of the remarkable earthquake faults.

The recent seismic activity of the northern half of the island is described by Prof. N. Miyabe (pp. 1–9), who notes that, since the beginning of 1934, the frequency of minor shocks felt at Ari-san (near the centre of the island) showed a continual increase up to the time of the great earthquake at 7.2 a.m. on April 21 (April 20, 10.2 p.m., G.M.T.). From seismographic records, the epicentre was found to be in lat. 24° 20′ N., long. 120° 38′ E., and the depth of its focus about 10 km. below the land-surface. The earthquake was very destructive to life and property; 3,279 persons were killed and 54,792 houses destroyed. In seven villages in the Taityu district, more than 70 per cent of the houses were ruined, but, as several of the authors notice, this was mainly due to their poor construction, the walls being formed of *dokaku* or blocks of hardened clay and straw, and very much weaker than those of the wooden houses in Japan. Mr. R. Takahasi (pp. 120–140) notes that the greatest intensity of the earthquake was reached in two regions that coincide with the north and south branches of the earthquake faults.

According to Mr. Y. Otuka (pp. 22–74), there were two main faults along which displacement of the crust occurred. The northern or Siko fault is about 15 km. long and runs in a direction about N. 30° E. from Gabi-syô to Taitôsei. Along this fault, the west side rose in two places about 3 metres relatively to the other side, the horizontal displacement being quite insignificant. The southern or Tonsikyaku fault is about 12 km. long and its general trend about N. 60° E. The north-west side of this fault was, relatively to the other side, shifted 1–1½ metres to the north east. Shortly before the earthquake, a fault was traced running from Gabi-syô to Taian, and the earthquake faults lie close to and parallel to this line. Mr. Otuka records the interesting fact that, at two places, the fault-movement took place after the houses in which the observers lived were destroyed.

From August until December 1935, the after-shocks were recorded at a network of four stations at which Ishimoto acceleration seismographs were installed. Most of the epicentres, according to Mr. N. Nasu (pp. 75–86), lay on the west side of the faults, and the focal depths were usually about 10 km. or less. In many of the shallow-focus earthquakes (depth 0–5 km.), the epicentres were close to the fault, especially in the upheaved region on its west side. Mr. Nasu notices that this was also the case with the after-shocks of the Tango earthquake of 1927 that he studied with so much care. At Byôritu (Taiwan), where the after-shocks were frequent, the level of the water in a well was measured from October 1935 (N. Miyabe and S. Kawasima, pp. 93–95). On the curve representing the changes of level from October 30 until January 10, dots are placed corresponding to the times of the after-shocks, and these occur at every point at which the level varies in direction.

The buckling of railway lines during a great earthquake is due, as a rule, to subsidence of the ground or to the destruction of the embankments on which the rails are laid. Such buckling occurs in both horizontal and vertical directions. Mr. R. Takahasi (pp. 148–153) describes and illustrates several cases of sinuous buckling. These are confined to a horizontal plane and lie along the fault-zone or its continuation. The buckling thus seems to be due to the movement of the surface layer of the ground on one or both sides of the fault.

Immediately after the earthquake, repetitions of first order triangulation and first order levelling were carried out in the central area by the Japanese Land Survey. The former, begun in August and finished in December 1935, included 14 points, three of which by comparison with the previous survey in 1917 had shifted by 26, 33 and 44 cm. The levelling was repeated along a route, 270 km. in length, from Kiirun and Musya, and was begun in October 1935 and completed in the following March. In the interval since the preceding survey, it appears that one point rose 23 cm., while another subsided 68 cm. C. D.

Obituary

Sir Arnold Theiler, K.C.M.G.

THE death of Sir Arnold Theiler on July 24 at the age of sixty-nine years has removed from our midst one of the greatest and most practical exponents of veterinary science of the century. There was no man more cosmopolitan in his principles, nor indeed was there a veterinary surgeon who was more universally welcomed in every country within whose borders he set foot, than Sir Arnold. His modest demeanour and his forceful personality, together with his untiring patience and plodding disposition, made him welcome everywhere. A Swiss by nationality and a veterinary graduate of the University of Berne, Great Britain was lucky in having him as a worker within its Colonial domains; and it was a great day for the British veterinary profession when Sir Arnold was offered—and accepted—the honorary associateship of the Royal College of Veterinary Surgeons. It was also a great honour for the Royal Veterinary College in London, when Sir Arnold made the request to Sir Frederick Hobday, its principal, that he might complete, within its walls, the summary of the great work which he had collected together on the osteo-dystrophic diseases of bone. This shortly followed his lectures (which were also given in the Royal Veterinary College, at the request of the University of London), and it was another fortunate circumstance that the editor of the *English Veterinary Journal* was able to secure the publication of these lectures in his journal.

Born in Switzerland in 1867, Theiler went to the Transvaal as a doctor of veterinary medicine in 1891. He found the Boer farmers very difficult; their narrow ideas, which led them to think that the diseases of their cattle and sheep were punishment inflicted upon them by the Almighty, were very difficult to overcome. It was only when a severe outbreak of glanders among the horses in Pretoria, and a disastrous outbreak of rinderpest in their cattle, enabled him to demonstrate the value of scientific veterinary knowledge in checking these respective outbreaks, that his consummate patience and skill triumphed to the extent that President Kruger, realizing the great value of Theiler's help, appointed him Veterinary Surgeon to the Republic. The South African War temporarily checked his work, and, as a burgher, Theiler was appointed veterinary surgeon to the Staats Artillery, a position which he filled with credit to himself—all the time with his brain working and learning points which stood him in good stead afterwards in his combat against disease.

Returning to Pretoria after the War, Theiler's reputation made him *persona grata* with the British Army staff, who were quick to recognize his knowledge and ability; and he was given laboratory facilities at Dasspoort and provided with an adequate staff. Whilst there, he came in contact with Lord Milner and Mr. F. B. Smith, the Director of Agriculture; and eventually he was given practically a free hand, the result being the foundation of the greatest experimental veterinary laboratory in the world—at Onderstepoort. The Botha and Smuts Government gave him staunch support and, on the formation of the Union in 1910, Arnold Theiler became the first Director of Veterinary Research. In 1920 he organized the Veterinary Faculty of the University of South Africa, being appointed its first dean, a post which he held until his retirement in 1927.

Theiler's honours were many. In 1907 he had been created a C.M.G., and in 1914 the knighthood of this order became his; then the fellowship of the Royal Society of South Africa and the first grant and medal awarded by the South African Association for the Advancement of Science. He was also the first recipient of the Scott Medal of the South African Biological Society. He was an honorary D.Sc. of the Universities of Cape Town and Syracuse, and D.Phil. of the University of Berne.

Theiler's married life—always very simple—was a happy one, and he leaves behind a widow, two sons and two daughters, all of whom are making names for themselves in the world of science. His death has left a gap which it will be very difficult to fill; but his name will ever remain not only as a pioneer, but also as a creator, in the world of veterinary science.

Dr. Bernard Smith, F.R.S.

BRITISH geology in general and the Geological Survey of Great Britain in particular have suffered a lamentable loss through the death on August 19 of Dr. Bernard Smith. Since October of last year he had served as director of the Geological Survey and Museum in succession to Sir John Flett. Smith was not only a brilliant geologist but also a scientific worker of exceptionally wide outlook, and, as he had served for thirty years on the Geological Survey in varied districts and capacities, his knowledge of the geology of Great Britain was most accurate and extensive. He had a very lovable personality, being genial and sympathetic by nature, and his sound judgment carried him successfully through many difficult situations. He died at the comparatively early age of fifty-five years, while it might have been anticipated that he had at least ten years of active work to look forward to in the Government service. Up to a few weeks ago, he was in regular attendance at his office.

Smith was born in Grantham and had his preliminary education at King Edward VI School there. He passed to Sydney Sussex College, Cambridge, as a scholar, and graduated in the first class of the Natural Science Tripos, Parts I and II. He won the

Harkness Scholarship in 1906, having been a demonstrator in geology since 1904, and in 1906 also he entered the Geological Survey by competitive examination. For a time he worked in the Midland coalfields districts under Lamplugh, but he surveyed also in North Wales. When the Great War broke out he devoted much time to the study of British iron ores, on which subject he ultimately became a recognized authority; but he also gave much assistance to the Ministry of Munitions on many other subjects connected with British resources of economic minerals.

In 1920 Smith was appointed district geologist, and shortly thereafter proceeded to Whitehaven where he superintended the revision of the geological maps of the Cumberland coalfield and adjacent districts. He had already produced a notable monograph on the Cumberland hæmatite iron ores which soon passed into a second and revised edition, and is the standard work on that subject. The Cumberland coalfield is very complex in structure and was not well understood before the revision undertaken by Bernard Smith and his staff; but it may be said that it is now one of the best known British coalfields, and the new maps and memoirs leave nothing to be desired. His work in that district was much appreciated by the local engineers and mine owners, and his personal relations with all connected with the industry, even though they might differ from him in opinion, were always excellent.

In 1931 Dr. Smith succeeded Mr. John Allen Howe as assistant to the Director in London and was placed in charge of all the field work in England. He also arranged the North Wales exhibits in the new Museum of Practical Geology. His time was now principally occupied in administrative work, and in answering inquiries sent in by Government departments and by the public. In this respect he was a great success, and in due course he succeeded to the directorship of the Survey and Museum in October, 1935.

Smith's natural bent to field geology was shown by his text-book of "Physical Geography" (A. and C. Black, Ltd.) now in its third edition. He also wrote on the glaciation of the Lake District and of the Isle of Man and on the history of Cumbrian rivers. His official work was very varied, but his principal contributions to Survey literature were his "Iron Ores of Cumberland" and the memoirs on the Whitehaven coalfield which he edited and in large part compiled. He was awarded the degree of Sc.D. (Cambridge) in 1924, and the Bigsby Medal of the Geological Society in 1927. The Royal Geological Society of Cornwall conferred on him the Bolitho Medal in 1933. In 1933 he was elected fellow of the Royal Society, and he served on the Council. In 1935 he delivered the Cantor Lectures on "Underground Water Supply" at the Royal Society of Arts; and he was actively engaged in the work of the Inland Water Resources Committee of the Ministry of Health. He served also on the National Committee of the Union of Geodetics and Geophysics and was a member of the Sub-Committee on Vulcanology and Hydrology.

Dr. H. A. D. Jowett

IN a characteristic appreciation of the late Sir Henry Wellcome, published in *The Times* of August 3, Prof. H. E. Armstrong points out that he chose his men with great shrewdness. It is with great regret that we have to record, so soon after the loss of Sir Henry Wellcome himself, the death of one of these chosen helpers, as the result of a motor accident on Monday, August 10. Dr. Jowett was born at Dorchester in 1870, but received his education at the Royal Grammar School, Lancaster, and remained in that town until 1891, when he gained a Bell Scholarship offered annually by the Pharmaceutical Society and became a student in the Society's College in Bloomsbury Square. He took his diploma in due time, along with most of the College prizes, and was awarded the Redwood Scholarship, which gave him entry to the Society's Research Laboratories, where he remained until 1896, working on aconitine and atisine, the latter being the subject of the thesis which he presented successfully for the London D.Sc.

In that year, Jowett became chief assistant in the newly-founded Wellcome Chemical Research Laboratories. There he spent ten busy and fruitful years, during which he made contributions of the first importance to our knowledge of the chemistry of the alkaloid pilocarpine, the hormone adrenaline and some of the naturally occurring glycosides and anthraquinone derivatives, chrysophanic acid, emodin and aloin. The work on pilocarpine and adrenaline was not only important in itself, but also it stimulated interest in the glyoxaline nucleus and in pressor amines, subjects which were to occupy both chemists and pharmacologists in the Wellcome Laboratories for some years to come. Jowett also began during this period those interesting investigations on the effect of change in structure in the tropeines on their mydriatic action.

In 1906 Jowett left London for Dartford to inaugurate the Experimental Department of the Wellcome Chemical Works, and a year later was appointed works manager, but was still able for some years to continue with collaborators the researches started in London. Having acquired a considerable reputation as an investigator, Jowett must have accepted his new post with some misgivings, but he soon justified his choice, and under his management the manufacture of fine pharmaceutical chemicals increased slowly but surely, and when War broke out in 1914 the works were ready to take a great part in the manufacture of those essential synthetic drugs which the nation had up to that time been content to import. In a very short time British equivalents for such complex drugs as 'salvarsan' and 'neosalvarsan' were being manufactured, and numerous other fine chemicals were added as required.

This development has continued steadily to the present time, and in this connexion it is only necessary to refer to the rapidity with which the manufacture of new products, such as insulin, ephedrine and ergometrine, has been undertaken and to the successful research work on cardiac glucosides and ergot alkaloids now in progress in the experimental laboratories at Dartford, to show that his inspiring personality was as vigorous as ever after forty years service to the Wellcome Foundation.

Dr. Jowett was not only skilled in chemistry, administration and the management of men: he became a motorist almost as soon as motor-cars were available; he was a keen golfer and an enthusiastic Wagnerian, and in recent years he developed a great interest in local government, becoming a member of the Dartford Borough Council, where as chairman of the Health Committee his administrative experience and scientific knowledge were of great service to his fellow citizens.

Dr. Jowett's friends are not likely to forget his achievements, but they will remember even more vividly his kindly and lovable personality.

WE regret to announce the following deaths:

Prof. F. Breinl, professor of hygiene in the German University of Prague, an authority on bacteriology, on July 29.

Prof. B. G. Cormack, emeritus professor of botany in the Anderson College of Medicine, Glasgow, on August 19, aged seventy years.

Dr. W. G. Plummer, assistant keeper in the Science Division (Physics and Geophysics) of the Science Museum, South Kensington, on August 2, aged thirty-eight years.

W. Rintoul, O.B.E., a director of research of Imperial Chemical Industries, Ltd., formerly manager of the Ardeer factory of Nobel's Explosives Co. Ltd., on August 24, aged sixty-six years.

News and Views

Synthesis of Vitamin B_1 (Antineurin)

SINCE the realization that the molecule of vitamin B_1 contains two heterocyclic rings, a substituted pyrimidine and a substituted thiazole, intensive research has been directed towards establishing the positions of the substituent groups and the method of combination of the two rings. According to a paper of which a brief abstract appears on p. 372 of this issue, Prof. Williams and his collaborators at Columbia University have now succeeded in isolating a compound which is chemically and physiologically identical with the natural vitamin. Several groups of workers in Great Britain and Germany have been working at the same problem, but they will doubtless be among the first to congratulate the American chemists concerned on a brilliant and important piece of organic synthesis. It may be noted that this achievement means that, with the syntheses of ascorbic acid, lactoflavin, vitamin D and vitamin B_1, four vitamins have now been produced from completely inactive organic reagents by purely chemical means.

New Fossil Anthropoid Skull from South Africa

A DISCOVERY is announced from South Africa which, if first impressions are confirmed by more detailed examination, may go far towards clearing up a point which has been a matter of acute anthropological controversy for more than a decade. Dr. Robert Broom, of the Transvaal Museum, and his colleagues, it is reported in a dispatch from the Johannesburg correspondent of *The Times* in the issue of August 26, have discovered in the Sterkfontein caves near Krugersdorp, a natural cast in limestone of the brain of an advanced type of ape and a number of fossilized bones of the skull, including jaws and teeth. It is anticipated that this new evidence will prove of importance in its bearing upon the status of the phylogeny of man and the great apes, and more especially on the position of the Taungs skull. It will be remembered that, when that fossil was found in 1924, some doubt was expressed as to how far the approximation to the human type in its characters stressed by Prof. Raymond Dart, by whom it was discovered, was due to its immaturity. The young of the chimpanzee, it was pointed out, is well known to exhibit pseudo-human characters, which disappear as maturity approaches; and it was agreed that the Taungs skull was that of an individual of not more than six years of age. As the Sterkfontein specimen, it would appear, is adult, a comparison with the Taungs skull may determine these uncertainties, and at the same time afford an indication of the relation of these fossil types to existing anthropoids as well as to early forms of man.

Roman Leicester—a National Asset

THE fate of Roman Leicester, which now hangs upon the decision of the City Council, is a problem in which the nation is no less deeply concerned, though from a slightly different point of view, than the city itself. A site in the heart of the city's oldest relics, purchased at a cost of £24,000 for the erection of public baths, has yielded on excavation remains of the Roman period, more particularly of the forum, the centre of municipal life, which in certain respects are unique (see NATURE of July 11, p. 69). While on one hand the local authority may allow due weight to the advantage to Leicester in the possession of this unique and irreplaceable monument of the past, yet local pride must inevitably be tempered by a sense of the duty of trustees of public funds; on the other hand the nation at large is a custodian of such treasures as this for the benefit not only of contemporary archæological studies, but also of posterity. The most meticulous records of excavation, however valuable for scientific study, cannot take the place of relics of antiquity which have been destroyed. Apart from the educational appeal of the buildings in their original relation, and so far as possible, in an appropriate setting, they will afford the scholar a constant inspiration to further research, as well as provide a source of evidence for correcting or reconstructing theory in the light of later knowledge, such as never can be derived from a written record, photograph or drawing. The excavations now in progress may reinforce the argument, or should the City's decision be adverse to preservation, justify a delay, which will then be urged, pending an appeal for funds from outside sources for the complete excavation of the site in the coming year. The conflict between duty to local economies and the preservation of antiquities, which are national in their interest, is one which is likely to arise with increasing frequency in view of the rapid development of urban and suburban properties now taking place. When such developments affect relics of wide historic and scientific interest, as at Leicester, it is a question whether national funds should not be called on to assist.

Potters of Lincoln

MUCH interest is attached to the discovery of a Roman potter's kiln at Lincoln, fully loaded with a light cream ware, and fired, but unopened. It affords evidence that an industry, which discoveries in 1932 have shown to have been in existence here in the Middle Ages, was also extensively practised in the Roman period. Quite possibly, as 'Pottergate Arch' nearby, and the occurrence of 'Pottergate' as a street name in the thirteenth century would suggest, the industry may have survived throughout the interval between medieval and Roman times with little or no interruption. The kiln was discovered, it is reported in *The Times* of August 21, on a site in Cathedral Street. It contained vessels of the mortaria type, the large shallow basins with a heavy rim, in which the Romans used to grind their food. The kiln was a hole in the ground four feet long and two feet wide, with a well-fired wall on two sides. It was roofed over with a whitish clay mixed with sand; and it contained four stacks of pottery, which had been considerably crushed. Curious short pipes, of which the use is obscure, were also found. Many of the vessels were stamped with the potter's mark, which, when deciphered, should afford a clue to the distribution of Lincoln pottery in Britain. The medieval pottery, which was found in this area, was attributed to the fourteenth century. No doubt the potters of that date drew their clay from the same source as their Roman predecessors. This in itself would be sufficient to account for the persistence of the industry in this area.

Minoan Influences in Ancient Syria

SIR ARTHUR EVANS, commenting on the results of Sir Leonard Woolley's recent archæological investigations in Syria (see NATURE of July 4, p. 20 and August 8, p. 235), pronounces the Minoan impact on inner Syria at so early a date, for which the ceramic relics from Tell-Atchana afford evidence, as "a new historic fact of far reaching importance and revolutionizing all previous ideas". It is, he points out in *The Times* of August 19, a step forward of at least two centuries; for although there are no actual imports from Minoan Crete, the starting point in repeated examples of pottery reflecting Cretan models must certainly touch 1700 B.C. Sir Arthur bases this conclusion on the chronological datum of remains of cups, of somewhat thin make, showing white rosettes on a black ground, recalling the "egg-shell ware" bowls of the great age of Minoan Crete of the Second Middle Minoan period, which goes back to the eighteenth and nineteenth centuries, but in Syria equating with the succeeding Third Middle Minoan style. At the same time, mixed influence is to be seen in the combination of arcaded zones, characteristically Minoan, with highly conventionalized ducks, which find a parallel in early Palestine, while one of the sherds depicts an uprearing goat charged by another, whereas animal designs were excluded from the vase painting of Cretan Palace art. In concluding with an analysis of motifs, which point to a fusion of Cretan and indigenous religious and symbolic ideas, relating to the cult of the double axe, and reference to tradition of a royal alliance with Cyprus, Sir Arthur holds out the alluring possibility that the spade may yet uncover a royal sepulchre at Tell-Atchana.

Special Exhibit at Ipswich Museum

IN 1917, Mr. Reid Moir announced the discovery of flint implements, mammalian and human bones, and fragments of rough pottery, in the lower of two superposed 'floors' in a brickfield of Messrs. Bolton & Co. at Ipswich. These occupation levels occurred in sand, and were overlain by a considerable thickness of hill-wash, while the excavations carried out showed that the now dry valley in which the discoveries were made has been deepened by erosion since the floors were occupied by man. Similar results were obtained, at a later date, by Mr. J. P. T. Burchell, in his researches at Ingress Vale in the lower Thames Valley. Here, at the base of an extensive section of sub-aerial loam, surmounted by a hill-wash containing rafts of Coombe Rock, was found a prolific floor, with flint implements, flakes, and fragments of primitive pottery. The third site, where a similar association of relics occurred, was discovered and investigated by Mr. and Mrs. MacAlpine Woods in a dry valley at Bovey Lane, Beer, Devon. In this case, a hill-wash, some 11 ft. in thickness, contained large numbers of flint artefacts, a few examples of bones and teeth of animals, and some pieces of rough pottery. Through the kindness of the discoverers, the Ipswich Museum now possesses representative series of the specimens mentioned, and is making a special exhibition of them. The matter is of considerable interest to archæologists as, in each case, the flint implements may be said to resemble, in their forms, those of Lower and Upper Aurignacian times, and are not associated with any microliths. Moreover, there seems good reason to believe that the widespread deposits in which the relics were embedded are of relatively considerable antiquity, and represent the results of geological activity, including an epoch of low temperature, in eastern and southern England.

Current Science

WITH the publication of its July issue, our Indian contemporary, *Current Science*, enters upon its fifth year. Founded to supply an obvious need in the scientific renaissance of India, *Current Science* is almost unique in that its editor is assisted by a board comprising the majority of the best-known Indian men of science. The July issue contains much of interest not only to India but also to the West. The leading article comments on the inauguration, by his Excellency the Viceroy, of a Nutrition Advisory Committee. The outstanding investigations of Sir Robert McCarrison in Coonoor have in recent years focused the attention of Indian public opinion upon the importance of adequate feeding for national efficiency. Inadequate nutrition, combined in many areas with endemic malaria, is known to be the cause of the poor physique of many classes. The Royal Society is now assisting in the investigation of the intricate problems of malaria control, and will doubtless co-operate with this new Advisory Committee. Another article in the July issue, of more than local interest, is the summary of a lecture given by Prof. Birbal Sahni on the Karewas of Kashmir, where the geology of the Karewas series in the Himalayas is discussed from the point of view of the botanist. We congratulate the editor of *Current Science* on the high standard of the journal, which, if maintained, ensures its continued success.

Philosophy and Quantum Theory

IF philosophy is, as Descartes claimed, the 'universal science', it should be able to assimilate all new discoveries in the special sciences. There was not much difficulty in dealing with classical physics. When the theory of relativity was put forward, it was soon found that philosophical ideas could be rearranged to find it a place, and even a welcome, but what is to be the attitude to a theory which denies continuity and determinism ? An attempt, admittedly incomplete, to answer these questions has been made by R. Dugas ("La méthode dans la mécanique des quanta". Actualités scientifiques et industrielles, 283. Paris : Hermann et Cie., 1936). Following Meyerson, complete indeterminism is rejected, and replaced by aggregates ruled by laws of probability. If there is no law, there is no science. Other difficulties arise when we try to discover the basis of Schrödinger's equation. Are we to say that our equations know more than we do, and that, without understanding them, we can rely upon them to furnish the correct results ? Are we to believe in *panmathesis*, and in a universe in which electrons and matter have no real existence, but are merely names for mathematical symbols ? The trouble with questions such as these is that all the available evidence appears to point to the conclusions that are repugnant to common sense.

Photomicrographic Reproduction of Scientific Papers

FOLLOWING on the formation of the Documentation Division of Science Service, a programme of testing mechanical methods of applying photomicrographic duplication of scientific literature is being developed, including a camera for copying upon 35 mm. film, supplementary apparatus such as a book holder for the camera, film container, etc., a reading machine, microfilm viewer, projection printer, and developing and processing apparatus for 35 mm. microfilm and paper projection points. Procedure has already been developed for the publication of scientific material otherwise unable to receive publication in full. Editors of journals or institutions deposit typescripts of those papers or portions of papers which they are unable to publish promptly or completely. With an abstract or summary, they publish a statement that additional matter, illustrations, tables, etc., are available on request from Science Service if the document number is stated and the price remitted. The document is assigned a number by Science Service and on receipt it is photographed on 35 mm. film master negative. The original document is then deposited elsewhere as a safeguard. The photomicrographic duplication is economical when up to twenty-five copies at a time are required and has the further advantage that the document is continuously in print as the negative can be used to supply a copy on demand at any time.

THE relation of microfilms or photo-copies prepared in this way to priority in scientific discoveries has been raised. Opinion is expressed in a note issued by Science Service that microfilm or photo-copy publication is a printed publication in the true sense, and that by considerably reducing the time between the submission of a paper to a journal and the date of publication of the discovery announced therein, this type of publication will be of great assistance in eliminating controversies such as have arisen in the past concerning individual claims for priority in making discoveries. If any doubt exists as to whether photomicrographic publication is a 'printed publication', it is urged that this doubt could be removed by scientific societies merely agreeing among themselves that, in so far as priority in their fields is concerned, photomicrographic publication should be accorded the same weight and effect as publication in a printed journal.

Wind Erosion in South Australia

WIND erosion is becoming an increasing danger in the semi-arid regions which form the world's chief granaries. In North America, the Argentine and to a less extent in Russia, the fertile prairie soils are rapidly being swept away as the result of destroying the original grass cover. A similar fate is overtaking vast pastoral regions in South Australia, due to overstocking. The gravity of the situation is revealed in a note by F. N. Ratcliffe, received from the Commonwealth Council for Scientific and Industrial Research. The worst erosion has been in the 'bush' country, where twelve drought years have so lowered the stocking capacity that overstocking on established farms is now almost unavoidable. Rabbits have added to the evil, the vegetation cannot recover after grazing, and natural regeneration of both shrubs and grasses has virtually ceased. Large areas have become barren deserts, and no measures are available for their reclamation. The evil might be checked by adopting a lower stocking policy; but the only hope for the already denuded areas is to introduce perennial exotic plants capable of stabilizing the large sand drifts, and withstanding rabbits and a very low and uncertain rainfall. The chance of discovering such plants is remote, and even if discovered, "there would remain the problem of their dissemination through vast areas with no regular growing season and an unimproved capital value rarely exceeding 2*s*. per acre".

Mining in Canada

WE have received the Report of the Department of Mines of the Dominion of Canada for the fiscal year ended March 31, 1935, and taken as a whole it may be said to be thoroughly satisfactory. The Report shows that the rise in the price of gold has caused renewed activity in that industry and states that "Canada's gold industry is contributing to the prosperity, not only of the communities in which operations are centred, but to the industrial life of the nation as a whole". Canada apparently is also reopening some of the silver camps for which it was famous a few years ago, but the "Department's work in fuels and non-metallics is becoming of increasing economic importance", and there has been a relatively small number of ore treatment investigations in connexion with base metal ores. There are full reports of the various divisions of the Department of Mines, commencing with a Bureau of Economic Geology, the National Museum of Canada and Mines Branches proper, together with an Explosives Division, an Editorial Division and an Accounting Division, which latter shows that something like a million dollars was available for the expenditure of the Department of Mines, and that nearly all of it was utilized. It is interesting to note that the Fuels and Fuel Testing Division was busily engaged throughout the year in question.

Cotton Research in India

INDIA is the second largest cotton growing country in the world, and the importance of the industry led the Indian Cotton Committee to set up a Technological Laboratory at Matunga some ten years ago. Research work and tests of direct importance to the cotton breeder, merchant and mill owner have been carried out in collaboration with the provincial agricultural departments, and a brochure has just been published by the Committee giving a full account of the activities of the Laboratory since its inception (Bombay: Indian Central Cotton Committee. 2 rupees). The two main objects of the work are to undertake spinning tests on improved varieties of cotton, and to establish relationships between the measurable fibre characteristics and the spinning quality. This second object aims at dispensing with the necessity of making spinning tests on large numbers of new strains, as it is hoped to be able to assess the performance of the cotton from a knowledge of its fibre properties. The development of the work may be judged from the fact that during 1933–34, 166 samples were tested in connexion with trade and technological problems, compared with only 28 in 1924–25, while as regards agricultural samples, 366 were tested in 1933–34, compared with 46 in the 1924–25 season. The problem of averting the possible danger of the introduction of the cotton boll-weevil through imported American bales has been successfully attacked. A satisfactory method of fumigation has been developed, and legislation enacted to ensure that all cottons imported from America are so treated. The brochure concludes with a complete list of publications issued from the Laboratory since 1925.

The Science Museum Library

ON entering a library for the purpose of obtaining information on a given subject, the first things the visitor wishes to know are what books or pamphlets the library possesses relating to the subject, and how is he to obtain them. There are usually card indexes available, but even with these at his disposal the reader may well be at sea unless he possesses a key to the system on which they are arranged. The publication of a new edition of the "Classification for Works on Pure and Applied Science in the Science Museum Library" (London: H.M. Stationery Office. 5*s*. net.) provides such a key to the finest science library in Great Britain. It should be studied by every one who uses the Library. It contains an explanation of the Universal Decimal Classification of the International Institute of Documentation in use at the Library, a list of about six thousand classes into which knowledge is divided for the purpose of indexing, and a copious alphabetical index comprising some five thousand entries. In the preface to the "Classification", Dr. S. C. Bradford says: "The titles on the cards in the Subject Catalogue are numbered and arranged in accordance with the Universal Decimal Classification. Under each number the titles are in chronological order. To ascertain what books the Library possesses on a given subject, readers are recommended to look first in the index, and then refer to the classification, before consulting the cards." By following this advice, those not already familiar with the system used in the Science Museum Library will undoubtedly save themselves both time and labour. It may be added that, in the last Report on the Science Museum, it was stated that the Library now possesses 252,515 volumes, the total of periodicals currently received is 9,468, while the Subject Matter Index contains 2,248,423 references.

Progress in France of Electricity Supply

AN account of electricity supply in France appears in *World Power* of July, as a translation of a paper in *La Journée Industrielle*. In 1923 the total installed capacity of electrical generating stations was 4½ million kilowatts. This increased to 10½ million in 1935. There are 15 thermal and 5 hydro-electric stations each having a capacity greater than 100,000 kw. The capacity has increased more rapidly than the output owing to the necessity of keeping a large reserve of power to meet sudden fluctuations in the consumption. In Paris, for example, the rate of consumption varies between 50,000 kw. at 3 a.m. and 340,000 kw. at 5 p.m. The rate of consumption of hydro-electric power is now greater than that of thermal power. It is noteworthy that the total length of the distributing lines is increasing more rapidly than the consumption of power. This is due to the increasing number of small consumers and to the fact that, as the supply service is extended to the more remote regions, longer lines are needed to reach new users. At present it is necessary to lay 46 metres of low tension line, on the average, to supply each new consumer, whereas in 1923 the length of line required was 13 metres. The large industries consume 7,100 million kwh. per annum and electrochemistry and electrometallurgy together take 2,200. Lighting and domestic supply take 1,800, small industries 1,000 and traction 900. There are now 35,369 communes supplied with electricity, and only about 2,600 not so provided.

Protection against Gas Attacks

THE Socialist Medical Association has issued a booklet entitled "Gas Attacks: Is there any Protection?" (London: Lawrence and Wishart, Ltd. 6*d*.). It is maintained that air-raiders are certain to penetrate our defences, and will not hesitate to employ a combination of high explosives, fire and gas in their attacks, against which the only efficient protections are respirators and gas- and bomb-proof self-contained dug-outs. The booklet issued by the Home Office, "Anti-Gas Precautions and First Aid for Air-Raid Casualties", is criticized, and is considered to give an incorrect impression of the dangers of war gases and possibilities of protection, and that the defences proposed, even if they could be generally adopted, would be inadequate. Dr. Sommerville Hastings contributes an introduction, the nature of the gases employed and their effects are described, and the available means of protection and the treatment of gas casualties are discussed.

Bulletin of the Metchnikoff Institute of the Ukraine

THE Metchnikoff Institute of the Ukraine has commenced the issue of a monthly bulletin (*Bulletin de l'Institut Metchnikoff*) devoted in the main to bacteriological and immunological papers from the Institute, written in French, English and German. In an editorial note to the first number (April 1936), it is remarked that until 1917 bacteriology had made slow progress in Russia, but that since that time many new institutes have been established and the active roll of bacteriologists and epidemiological experts has very greatly expanded. The nineteen extremely brief papers published in the first number are written in summary fashion without bibliographies, but any efforts that facilitate the introduction of Russian work to non-Russian readers are to be heartily welcomed.

The *Aquarist and Pond-Keeper*

THE *Aquarist and Pond-Keeper*, incorporating the *Reptilian Review*, in the March–April number, 1936, has various improvements, including a new cover design. Specially striking is a collection of photographs occupying two pages, which with the illustrations to the article on reptile hunting in Britain by A. E. H., depict the whole of our native species of reptiles and batrachians. Mr. E. Bridgstock-Choat, honorary curator of the Erith Museum, contributes an article entitled "The Pond Hunter", which will be continued, and papers from various other workers deal with fishes, fish-breeding, ponds and water gardening and various allied subjects.

Official Statistics

ATTENTION may be directed to the publication of the Guide to Current Official Statistics for 1935 (London: H.M. Stationery Office. Price 1*s*.). The arrangement is the same as in previous years. The greater part of the volume is occupied by an alphabetical range of subjects with reference to the appropriate publication. This is followed by a list of publications arranged under departments. The volume is invaluable for quick reference, and reveals the great range of matters on which statistical and other official information is available.

Post-graduate Medical Research

THE Medical Research Council has decided to institute a series of studentships and fellowships to encourage young British medical graduates towards becoming investigators in those branches of medical science which are concerned directly with disease as it occurs in human beings. Six post-graduate studentships are therefore offered for medical graduates who have already held house appointments and are strongly inclined to a career in clinical science or experimental pathology. Each selected student will receive an inclusive grant at the rate of £200 per annum, during a period not exceeding twelve months, while undertaking approved courses of study in Great Britain such as may be regarded as best calculated to advance the student's training in methods of research. Four research fellowships are also offered for candidates of similar qualifications who have already had some experience in research methods. Each fellowship will be tenable for one year at the value of £250 per annum, and will be renewable in approved instances at the rate of £300 per annum for a second year. Further information can be obtained from the Secretary, Medical Research Council, 38 Old Queen Street, London, S.W.1.

Fireball over Yorkshire

THE occurrence on August 18 at about 22^h 23^m (Summer Time) of a brilliant object, evidently a fireball or particularly bright meteor, has been referred to by several correspondents in the *Yorkshire Post*. The accurate observation of the apparent path of a meteor requires a trained observer, and it is to be expected that accounts supplied by casual eye-witnesses are often vague, conflicting, and quite unreliable for the data required to fix the real path above the earth. It seems, however, very probable that the fireball which lit up the countryside from which it was seen (including North Yorkshire, Derbyshire and Westmorland) was associated with the Perseid shower of meteors. This shower, which provides a high maximum frequency of meteors between August 10 and 12, is really operative from about mid-July until after mid-August; during this period the radiant point moves progressively from a position at about R.A. 1^h : Dec. +50° to R.A. 4^h : Dec. 65°, or from a position in the constellation Andromeda, through Perseus (which gives the shower its name) to Camelopardus.

The Night Sky in September

THE night sky of September offers a rich variety of objects for observation with slight optical aid. Some of the most attractive of the constellations are visible; there are star fields of the Milky Way, the Andromeda Nebula, the variable star, Algol, the Pleiades, some of the best known double stars and the largest two major planets. Between the first and last days of the month, the days shorten in the latitude of London by nearly two hours. On Sept. $23^d\ 5^h$ the sun enters, at the autumnal equinox, the sign Libra. Full moon occurs on Sept. $1^d\ 12\frac{1}{2}^h$ and again, as the Harvest Moon, on Sept. $30^d\ 21^h$. Of the planets to be observed, Venus still sets in the early twilight, but Jupiter is a bright object low in the south-west during the early evening. There is yet time, though very limited, for observing some interesting phenomena—transits, occultations and eclipses—associated with the four inner satellites. Particulars will be found on p. 615 of the *Nautical Almanac* for 1936. Saturn is above the horizon all night; on September 12 it is in opposition at a least distance from the earth of about 800 million miles. The rings appear nearly closed, the minor axis subtending an angle of only $1\frac{1}{2}$ seconds of arc. Mars is a morning star, and will be in conjunction with the bright star Regulus on September 24, when the angular distance between planet and star is less than 1°. Uranus is in Aries, and can be found near the 6th magnitude star ω Arietis, which the planet resembles when viewed with binoculars; but a 2- or 3-inch telescope will show the planet's disk of $3\frac{1}{2}''$ in diameter. The light variation of Algol (β Persei) may be observed near the following times of minima: Sept. $3^d\ 3^h$, $6^d\ 0^h$, $26^d\ 2^h$, $28^d\ 23^h$, Oct. $1^d\ 19^h$ (add 1^h to convert to Summer Time). The following double stars are suitably placed for observation during September: α Herculis (separation of components $4\frac{1}{2}''$), ε Lyræ ($3'$ separation for the wide components each of which is a double of $2\frac{1}{2}''$ and $3''$ separation respectively), β Cygni ($34''$) and γ Delphini ($11''$).

Announcements

PROF. MAX PLANCK, president of the Kaiser Wilhelm Society for the Advancement of Science, has been nominated doctor *honoris causa* by the Faculty of Philosophy of the University of Graz.

THE 1936 American Physical Education honorary award for achievement has been divided between the twin brothers, Dr. Edgar and Dr. Edwin Fauver, directors of physical education at Wesleyan University and Rochester University, respectively.

ON the occasion of the recent celebration of the twenty-fifth anniversary of the German Statistical Society the following were nominated honorary members: Prof. Sigmund Schott, director of the Mannheim Statistical Office; Dr. Friedrich Prinzing, of Ulm; Dr. Kovacs, president of the Hungarian Central Statistical Office, Budapest; and Dr. Savorgnan, president of the Italian Central Statistical Office, Rome.

DR. WILLIBALD SCHOLZ, professor of neurology and psychiatry at Munich, has succeeded the late Prof. Spielmeyer as director of the Department of Cerebral Pathology of the German Research Institute of Psychiatry, Kaiser Wilhelm Institute, Munich.

A NUMBER of public health courses have been instituted in Holland for training civilians in protecting themselves against attacks from enemy aeroplanes.

A SIX-year study of the role of diet in the last half of adult life will be undertaken at the New York State College of Agriculture at Cornell University. The Rockefeller Foundation has contributed 42,500 dollars to the support of the study.

THE second Italian Congress of Radiology will be held at Modena on September 20–21 under the presidency of Prof. Ruggero Balli, director of the Institute of Radiology. Further information can be obtained from the general secretary, Dr. Marco Lenzi, Istituto di Radiologia, Modena.

PROF. PAVLOV'S widow has presented the first batch of papers formerly belonging to her husband to the archives of the Academy of Sciences of Soviet Russia. They consist of about 2,500 letters from Russian and foreign men of science. Most of them relate to the years following the Revolution, while among the earlier ones are several from Metchnikoff and other famous men of science who corresponded regularly with Pavlov.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

An assistant (III) at the Ditton Laboratory, East Malling, Kent (refrigeration)—The Superintendent, Ditton Laboratory, East Malling, Kent (August 31).

Three inspectors (agricultural and live-stock) in the Department of Agriculture for Scotland—The Secretary (Establishment Branch), Department of Agriculture for Scotland, York Buildings, Queen Street, Edinburgh, 2 (September 1).

A civilian education officer in the Royal Air Force Educational Service—The Secretary (A.E.), Air Ministry, Adastral House, Kingsway, London, W.C.2 (September 14).

A visiting tutor for educational psychology in the Catholic Training College for Women, Cavendish Square, London, W.1—The Principal.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 369.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Structure-Factor Graphs for Crystal Analysis

WHEN unit cell and space group have been determined in crystal analysis by X-rays, the investigator tests various configurations of the atoms in the unit cell in order to obtain one which explains satisfactorily the observed strength of the diffracted beams with various index-triplets (*hkl*). For each configuration and each reflection (*hkl*), an appropriate 'structure-factor' can be calculated by the laws of optical interference. Large structure-factors correspond to strong reflections, and small structure-factors to weak reflections.

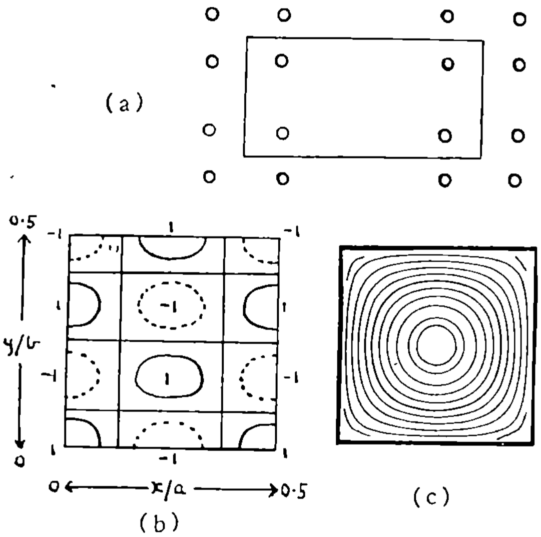

FIG. 1.

Once an approximation to the structure has been obtained, the fixation of the precise atomic positions is readily carried out by Fourier synthesis. The search for an approximate structure, however, is often extremely laborious, since in most cases a method of trial and error has to be used, and the structure-factor has to be computed for each tentative configuration. It is the purpose of this note to point out how greatly this labour is reduced by the use of *contoured graphs* of structure-factor.

It is usual to consider the projection of the structure on each face of the unit cell in turn, using the reflections around the corresponding zone in each case. 'General' reflections can then be used to test the structure so deduced. Although the number of space-groups is large, the number of symmetry types in the plane groups is restricted. A few formulæ for the structure-factor cover all cases.

As an example, the symmetry scheme shown in Fig. 1 (*a*) frequently appears in projections of monoclinic crystals on '*a*' or '*c*', and of orthorhombic crystals. An atom with co-ordinates x, y, along with the three other atoms to which it is related by the operation of the symmetry elements, gives a structure factor $4\cos(2\pi hx/a)\cos(2\pi ky/b)$ for the reflection ($hk0$). The function $\cos(2\pi hx/a)\cos(2\pi ky/b)$ is plotted in Fig. 1 (*b*) for the case $h = 2$, $k = 3$. In the graphs actually used in analysis contours are drawn for intervals of 0·1, but in this small-scale sketch only the zero lines and contours for 0·5 have been drawn. In the complete graph each small cell contains contours like those in Fig. 1 (*c*), suitably modified in horizontal and vertical scale. A set of graphs is prepared for all low values of h and k.

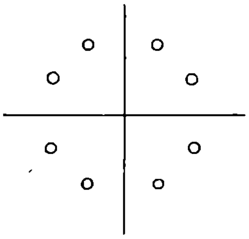

FIG. 2 *a*.

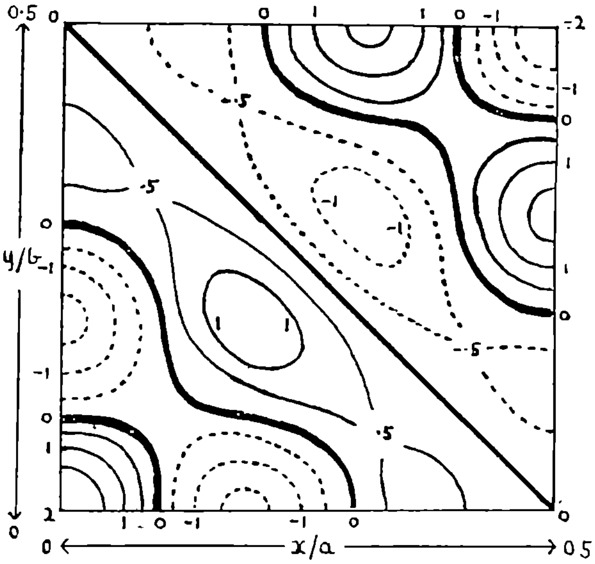

FIG. 2 *b*. Contours of the function $\{\cos(4\pi x/a)\cos(6\pi y/a) + \cos(6\pi x/a \cos(4\pi y/a)\}$.

When an atomic configuration is being tested, the x/a and y/b co-ordinates of its atoms are plotted on a transparent sheet which fits over the graphs. Structure-factors can be read by inspection to two figures, an amply sufficient accuracy. The principal merit of the graphs, however, is that the investigator can judge how the tentative configuration should be modified in order to make its structure-factor correspond to the observed value for each reflection, since the effect of moving an atom in a given direction and by a given distance is shown by the graph. The advantage of being able to do this will be appreciated by anyone accustomed to X-ray analysis.

By moving the origin from centre to corner of a small cell, the same graphs give values of $\sin(2\pi hx/a)\sin(2\pi ky/b)$. A single set of graphs, in fact, covers all cases of monoclinic and orthorhombic crystals for which the projection has a rectangular outline and a centre of inversion.

The advantage of the graphs is even greater in projections of tetragonal and hexagonal symmetry, when the atoms may be in groups of eight or twelve. The (230) graph for the tetragonal complex of Fig. 2 *a* is shown in Fig. 2 *b*. Such a graph considerably facilitates the adjustment of atomic positions. There are plateaux, for example, where the contribution of an atom varies very slowly, so that atoms in these regions give an approximately known contribution and attention may be concentrated on other atoms in 'sensitive' positions.

Trial has shown that analysis can be much more rapidly carried out with the graphs than by processes of calculation.

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July 27.

Molecular State of Proteins in Mixtures and Concentrated Solutions

BY means of the Svedberg high-speed ultracentrifuge it is possible to analyse mixtures of different molecular species, since the sedimentation involves a partial separation of the different sizes present. The concentration of the components may therefore be calculated from the sedimentation diagram. But during the study of protein mixtures in the ultracentrifuge it has often been observed that the concentration of the different sedimenting molecules thus calculated were not the same as those determined analytically. Generally the apparent concentration of the faster sedimenting molecule was smaller, when calculated from the sedimentation diagram, whereas it was higher for the slower sedimenting molecule. McFarlane[1], who first studied the problem on some artificial serum mixtures, thought that the effect was due to some specific interaction between the albumin and the globulin. Later, R. A. Kekwick and I studied some mixtures of serumalbumin and lactoglobulin. In this case serumalbumin, the faster sedimenting molecule, is found in too low concentration, and the lactoglobulin is found in too high concentration. From these experiments I concluded that the phenomenon was caused by some medium effect produced by the slower sedimenting protein molecules on the faster sedimenting ones, and that the effect was due to a real dissociation of the faster sedimenting molecules. If this is true, one would expect that it would be possible to produce the effect by means of lower molecular substances related to proteins, such as amino acids, polypeptides and protamines.

For the first two groups of these substances there was a measurable although very small effect. In the case of the protamine studied (clupein) the effect was very strong with serumalbumin, where it gave rise to new molecules with s_{20} (= sedimentation constant) of about 1×10^{-13} besides the ones with the normal $s_{20}(4 \cdot 5 \times 10^{-13})$. If we call the serumalbumin molecules with the normal s_{20}, *A*, and those of the dissociated serumalbumin, *B*, then the concentration ratio between these as calculated from the sedimentation diagram was: for a 5·3 per cent clupein solution $B/A = 1 \cdot 58$, for a 2·65 per cent solution $B/A = 0 \cdot 90$ and for a 1·1 per cent solution $B/A = 0 \cdot 36$. From these figures it is seen that the effect is by no means negligible since the dissociation product of serumalbumin in the more concentrated clupein solution is present in higher concentration than the undissociated serumalbumin. It is also very remarkable that all the sedimentation diagrams show only the presence of molecules with $s_{20} = 1 \times 10^{-13}$ and $s_{20} = 4 \cdot 5 \times 10^{-13}$ (besides a small amount of some association products); this probably indicates that the dissociation process always gives rise to molecules of the same size (perhaps one eighth of the original value). Some experiments with hæmoglobin show that this protein too is dissociated in the presence of other proteins and clupein, but here the sedimentation constant indicates that the dissociation at first gives molecules of half the original size, independent of whether lactoglobulin or clupein is used.

As the effect seems to be of a more general nature (whether it is a dielectric or chemical effect or a combined effect is at present impossible to decide) it is to be expected that it may also take place in a more concentrated solution of a uniform protein, and these solutions should therefore give a decreased molecular weight with increasing protein concentration. This may at least partly explain the fact that several investigations show that the proteins are behaving osmotically abnormally in that the ratio π/c (π = osmotic pressure, c = concentration of protein) increases with increasing protein concentration, as it should do if the molecular weight is not constant, but decreases with increasing concentration.

Information about this effect may be of value in explaining some of the biological processes, where we are dealing with more or less concentrated protein solutions.

Further details will be given in a forthcoming paper in the *Biochemical Journal*.

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July 26.

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[1] See, for example, A. S. McFarlane: *Biochem. J.*, **29**, 407 (1935).

Effect of Phenylacetic Acid on the Growth of Tomato Plants

MUCH interest has been taken in the action on the growth of plants of various organic substances which has been described by the workers at the Boyce Thompson Institute[1,2]. They apply these substances in lanolin preparations to plants, or as a water solution added to the soil or injected into the stem; the main responses of the treated plants being epinasty of the leaves, swellings and proliferations of the stems and petioles, and formation of roots on or near the treated part. In the course of some tests carried out at East Malling Research Station, using phenylacetic acid, I sprayed a batch of tomato plants with a 0·1 per cent solution in water, while control plants were sprayed with water containing a little alcohol. The solution was prepared as described by Hitchcock and Zimmerman[3]. By the spray method, the amount of growth substance applied can be fairly accurately controlled. Entry was very rapid; epinasty of the leaves being visible after one hour in a greenhouse at a temperature of about 20° C. The plants were treated in the morning, and by the next day the leaves had fully recovered; moreover, very little stem bending had occurred, showing that the distribution of the growth substance was uniform throughout the stem. The treatment was continued daily, and groups of plants were harvested weekly; the fresh and dry weights being determined. Fig. 1 shows a treated and a control plant at the end of two weeks.

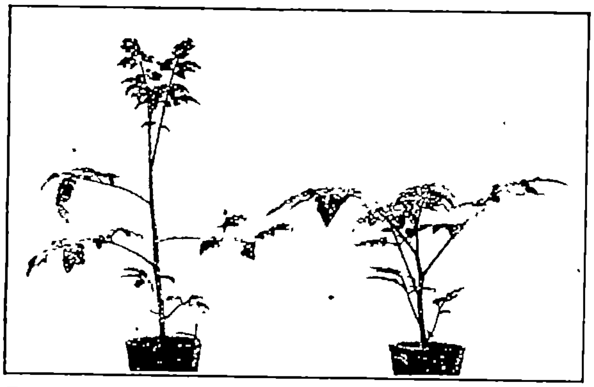

FIG. 1. The plant on the left has been sprayed daily for two weeks with 0·1 per cent phenylacetic acid Control on right sprayed with water.

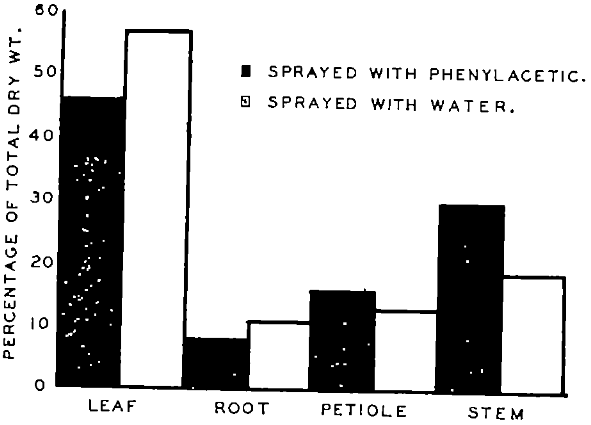

FIG. 2. Diagram showing the percentage of the dry weight present as stem, petiole, root and leaf after one week.

After one week the treated plants were more than thirty per cent taller than the controls, and the lengths of their petioles and internodes were also much greater. The diagram, Fig. 2, shows the percentage of the dry weight present as stem, petiole, root and leaf in the treated plants and the controls after one week.

From Fig. 2 it is seen that there are very significant alterations in the relative amounts of the various organs which make up the total dry weight of the plant. Thus the percentages of the total dry weight which are present as leaf and root have decreased, while the percentages present as stem and petiole have increased. These differences were maintained with little alteration after two and three weeks treatment. The water content of the treated plants had also increased indicating a more succulent type of growth. The total dry weight of the treated plants had not increased, however, and it would therefore appear that the growth substances may act not by increasing the growth of the plant as a whole, but by effecting the balance between stem, root and leaf.

If the treated plants were kept in a humid atmosphere, roots emerged from the stem after twelve to fourteen days. The spray method of applying the growth substance may therefore prove to be a convenient way of treating cuttings.

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July 29.

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[1] P. W. Zimmerman and Frank Wilcoxon, *Contrib Boyce Thompson Inst.*, 7, 209 (1935)

[2] A. E. Hitchcock and P. W. Zimmerman, *Contrib. Boyce Thompson Inst.*, 7, 447 (1935).

[3] A. E. Hitchcock and P. W. Zimmerman, *Contrib. Boyce Thompson Inst.*, 8, 63 (1936).

Structure of the Wall of *Valonia*

THE interesting röntgenographic studies of O. L. Sponsler[1] and of W. T. Astbury, T. C. Marwick and J. D. Bernal[2] on the cell-wall of the large one-celled alga of the genus *Valonia* have revived the interest in the older microscopic investigations by C. Correns[3] on the structure of the cell-walls of Algæ, including also *Valonia*.

Correns proved that the wall of *Valonia* and of some other Algæ consists of a large number of lamellæ, each containing numerous parallel cellulose fibrillæ, which are placed spirally around the axis of the cell, which is more or less of a cylindrical shape. The fibrillæ of the various odd-numbered lamellæ are practically parallel, as are those of the even-numbered lamellæ—there occur deviations of a few degrees—but the direction of the winding of the spiral in the odd lamellæ is opposite to that in the even lamellæ. In the case of *V. ventriculosa*, Astbury found that the angle made by the two directions may vary from 80° to 60°; for some *Cladophora* species this approaches 90°, according to Correns.

Up to now any explanation of the method by which this remarkable structure has been brought about is lacking.

H. J. Denham[4] has observed that the protoplasm stream in the cells of the pili on the stamens of *Tradescantia virginica* near the cell-wall often runs exactly parallel to the longitudinal or steeply spiral stripes of this wall. It follows from a remarkable study by P. Martens[5] that these stripes do not occur, as Denham thought, on the inner surface of the wall, but on the cuticula which covers the outer side of the wall; the inner side of the thin cellulose layer, situated under the cuticula, is completely smooth. By studying the double refraction of the cellulose layer, and by means of swelling experiments, I have been able to prove that the rod-shaped cellulose crystallites in this cellulose layer possess a 'statical preference' for the transverse direction. The layer has therefore a micellar structure which sometimes is called 'Röhrenstruktur'. The protoplasm courses approximately perpendicular to the direction which is most preferred by the crystallites in the cell-wall.

From a series of other important investigations of P. Martens[6,7] it follows that the markings on the cuticula very generally are indications of the tensions which occur therein by the active growth and the passive stretch of the cell-wall layer situated under the cuticula. The stripings on the cuticula of the pili of *Tradescantia* are really therefore the result of the fact that the cellulose layer lying underneath is most stretchable in the direction which is practically perpendicular to the one preferred by the crystallites. The relation referred to here between the direction of the greatest stretchability and the internal structure has been settled satisfactorily by R. Sonntag[8], P. Jaccard and A. Frey[9].

It may be assumed that the protoplasm lying directly against the inside of the cellulose layer, as a result of the stretching of that layer, is in a state of tension in the same sense as the cuticula, and that the protoplasm stream is *directed* by this tension along that layer. This explains the observation of Denham, which, through Martens' observations, had proved puzzling.

Various careful observations have been made by H. Crüger[10], L. Dippel[11] and E. Strasburger[12], from which it appears that the secondary thickenings which are often deposited on the inner side against the primary wall layer (not, however, in the case of the pili of *Tradescantia*, where the wall remains primary) are formed in the protoplasm streaming along the wall, and in such a way that it looks as if the protoplasm along the wall changes into wall substance. I directed attention in 1927[13] to the fact that the rod-shaped cellulose crystallites in such secondary thickenings are deposited in the direction of the protoplasm stream along the wall. The crystallites are probably arranged by the stream in the direction of the stream.

From the foregoing it will now be clear why, in numerous cell-walls, the direction of the crystallites in the secondary wall layer is more or less perpendicular to that in the primary layer. The direction of the crystallites in the secondary layer is hence determined by the direction of the greatest stretchability of the primary wall layer. In the case of a completely homogeneous wall structure the directions of the crystallites in the primary and in the secondary wall layer will therefore be *exactly* perpendicular to each other, but a priori deviations from this position may be expected.

The normal case appears to be that the secondary deposition begins after the stretchability of the primary wall has been greatly diminished, in such a way that after deposition has taken place, practically no stretch of the wall occurs. If one supposes, however, that after a secondary wall layer has been deposited the primary wall regains its stretchability by the intussusception of new cell-wall material, then the protoplasm near the wall will be subjected to a tension which is now perpendicular to the direction of the crystallites in the secondary layer. A tertiary layer will then be deposited, of which the crystallites are approximately perpendicular to those in the secondary. This process may repeat itself periodically, for example, by the strong passing increase each day of the turgor pressure in the cell, due to carbon dioxide assimilation in daylight. If one considers further that by the growing together of the rod-shaped cellulose crystallites placed next to, and end-on-end with each other, fibrillæ may be formed, then one may realize that the remarkable structure of the cell-walls of *Valonia* and other Algæ may be the result of the above mentioned process.

Applying the above train of thought, this structure should be effected by a periodic repetition of a process of wall thickening very generally found.

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July.

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[1] "Orientation of Cellulose Space Lattice in the Cell Wall", *Protoplasma*, 12, 241 (1931).

[2] "X-Ray Analysis of the Structure of the Wall of *Valonia ventriculosa*", *Proc. Roy. Soc. Lond.*, B, 109, 443 (1932).

[3] "Zur Kenntnis der inneren Struktur einiger Algenmembranen", Zimmerman's Beitr. Morph. Physiol. Pflanzenzelle, 1, 260 (1893).

[4] "The Structure of the Cotton Hair and its Botanical Aspects", *J. Text Inst.*, 14, 85 (1923).

[5] "Phénomènes cuticulaires et phénomènes osmotiques dans les poils staminaux de Tradescantia", *La Cellule*, 41, 17 (1932–33).

[6] "Recherches sur la cuticule" (3), *Protoplasma*, 20, 483 (1934).

[7] "Le relief cuticulaire et la différenciation épidermique des organes floraux", *La Cellule*, 43, 289 (1934).

[8] "Die duktilen Pflanzenfasern, der Bau ihrer mechanischen Zellen und die etwaigen Ursachen der Duktilität", *Flora*, 59, 203 (1909).

[9] P. Jaccard and A. Frey, "Einfluss von mechan. Beanspr. auf die Micellarstruktur u.s.w.", *Pringsh. Jahrb.*, 68, 844 (1928).

[10] "Zur Entwickelungsgeschichte der Zellwand", *Bot. Z.*, 13, 601, 617 (1855).

[11] "Die Entstehung der wandständigen Protoplasmaströmchen in den Pflanzenzellen", *Abh. Naturf. Ges. Halle*, 10, 45 (1868).

[12] "Ueber den Bau und das Wachstum der Zellhäute", Jena, 1882.

[13] "De wording van den plantaardigen celwand", *Chemisch Weekblad*, 24, 166 (1927).

Insect Coloration and Natural Selection

IN NATURE of August 8 there appear two letters on the subject of natural selection: one from my friend, Prof. H. E. Armstrong, and another from my friend, Prof. Hale Carpenter. Prof. Armstrong in his attack on "Natural Selection" quotes me. Prof Carpenter in his reply thinks that Prof. Armstrong's objections are easily answered. At the risk of appearing tedious, I desire to make one more effort to bring home to Prof. Carpenter the insuperable objections which exist to the explanation of "mimicry" or any other biological phenomenon whatever from "natural selection".

By mimicry Prof. Carpenter means the theory that superficial resemblances between different groups of butterflies and similar resemblances between flies and beetles, etc., resemblances in colour or shape or attitude, have the function of enabling the weaker of the two to escape its enemies. Every part of an animal has some relation to its life, which is a constant reaction to its environment, but whether these resemblances really act in the way in which Prof. Carpenter supposes is an open question. Certainly one is not convinced by his *obiter dicta*. Each case requires a renewed and critical examination, which so far it has not received. I need only say that two of the most distinguished entomologists living, Dr. McAtee, of the U.S. Biological Survey, and Dr. B. P. Uvarov, who first elucidated the problem of the migratory locust, repudiate the "natural selection" explanation of mimicry. Worse than all is the statement by Bergh in his "Nomogenesis", that the only case on record of a species of butterfly being seriously decimated by birds is that of a Danaid—a supposedly distasteful species—in Ceylon.

Even if Prof. Carpenter were proved to be right, however, and these "mimicking" resemblances really did function in the way he supposes, "natural selection" would be incompetent to explain them. "Natural selection" in a sense is a truism; it merely asserts that an organism exists and maintains itself, which is sufficiently obvious. But what the theory covertly assumes is that random inheritable variations in all directions are constantly taking place by *chance*—and that is simply not true. All the experimental evidence obtained by testing this point has given the same answer, and it is surely unsafe to base any biological theory on an assumption which has proved to be false. But it may be answered that 'mutations' are inheritable. Mutations have now been artificially produced, and always by similar experiments. If the eggs or young embryos are exposed to noxious conditions, then a large number are killed; some survive and develop normally whilst there is a border group of what we may term the 'half-killed' which develop into mutations. All mutants compared with the type are defective in vigour and viability. Mohr, the great authority on *Drosophila*, has constructed a scale of mutations: the slight mutations produce a slight effect on viability, the more obvious ones a greater effect, the most obvious a semi-lethal effect. Moreover, if mutants can be restored to normal conditions, after a certain number of generations they revert to normal development, and the mutant appearance which Johannsen defined as a "superficial disturbance of the chromosomes" passes off. No mutation has ever given rise to a natural race.

We have definite evidence that insects, like other animals, react to changes in the environment by changes in growth and appearance, and that when these changes in the environment are long continued, their effects become so engrained in the constitution that they are in ever-increasing measure inherited by the offspring. This has been proved by Heslop Harrison for the egg-laying habits of *Pontania salicis*, by Durkheim for the coloration of Pierid pupæ, for feeding habits by Miss Sladden and, *mirabile dicta*, for the colour of the imago of butterflies by Weismann himself.

When fully documented evidence for evolution as displayed by a minute study of species and races of living forms or by the study of lineage series in fossils is carefully studied, this dependence of evolutionary change on change in habit and function becomes apparent. It is useless to demand miracles in the shape of supposedly beneficial mutations to explain changes where the full evidence is not at hand. When and if it is available, I am convinced that apparently inexplicable cases will yield to the same explanation of inherited habit as those cited above.

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The External Forces Acting on Chromosomes

According to Darlington[1], in somatic mitosis or meiosis, "the equilibrium position reached at metaphase may . . . be described as the result of the combination of three kinds of repulsion acting on bodies in the confined space of the spindle", the repulsions being between chromosomes, between spindle attachments, and between poles and spindle attachments. If therefore at the first metaphase of meiosis there should exist two kinds of bivalents the different shapes or sizes of which cause the spindle attachments of the component chromosomes to be farther apart in one kind than in the other, we should expect the former type of bivalent to be pushed to the edge of the plate.

In the plant *Silene Otites* Wibel, the chiasmata at first metaphase are all terminal or nearly so, and a mixture of rod bivalents with one chiasma and ring bivalents with two chiasmata is found, the spindle attachments being farther apart in the rod bivalents. The latter tend regularly to be arranged on the edge of the plate, a minor, but none the less striking, verification of the theory.

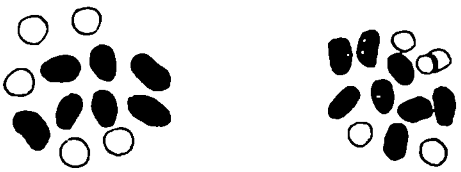

FIG. 1 Two polar views of the first metaphase of meiosis in pollen mother cells of *Silene Otites* Wibel For the purpose of illustration the bivalents with one chiasma are shown in outline. (×3000 approx.).

In the polar views represented in Fig. 1 the bivalents with one chiasma can be distinguished by their smaller and more circular cross-section. The illustrations represent an apparent contradiction of the general rule that the largest chromosomes are found on the outside of the metaphase plate, but actually, as can be seen more clearly in side views, the difference is one of shape rather than of size.

James L. Fyfe.

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July 16.

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[1] C D. Darlington, "Recent Advances in Cytology". J. & A. Churchill, London, 1932.

The different distribution of rod and ring bivalents found by Mr. Fyfe in *Silene* is a clear and hitherto unnoticed example of the principle of repulsion-equilibrium in the formation of the metaphase plate. This effect evidently depends on the numbers of chromosomes, on the equality of their sizes combined with the variation in the number of their chiasmata, and on a certain size-relationship of chromosomes and spindle. Less conclusive evidence of the same distribution is to be found in my figures of *Primula sinensis*[1], *Campanula persicifolia* and diploid *Tradescantia*. In the last case the body-repulsions assist in producing the differential effect. Where the chromosomes are more numerous, as in *Aesculus*[2], the differential distribution is not clear without statistical treatment.

The detailed study of the congression and distribution of the bivalents on the plate in relation to their size and chiasma structure makes it possible now to describe the forces at work with more precision than a few years ago, especially in showing that the repulsions are an inverse function of distance[3].

C. D. Darlington.

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[1] *J Genetics*, 24, 65 (1931)

[2] Upcott, *J. Genetics*; in the press.

[3] MS. in the custody of the Royal Society (1935)

Provisional Computation of the Plane Vibration Frequencies of Symmetrical Deuteroethylenes

SEVERAL workers[1,2] have developed the theory of the vibration spectrum of ethylene and have deduced from the experimental data values for some of the force constants occurring in the potential energy function of the molecule. A recent investigation by Bonner[3] has improved our knowledge of the vibration spectrum of ethylene.

The most general potential function for plane deformations which is compatible with the admitted symmetry of that molecule contains 15 constants. On the other hand, as there are 9 plane normal modes, it seems at first that only 9 constants of force can be determined from the present data. However, in order to reach a precision in accord with the accuracy of some data (1 cm.$^{-1}$), 11 constants are necessary, owing to reality conditions to be satisfied. Such a numerical potential function has been calculated for ethylene from Bonner's experimental data and checked by recomputation of the vibration frequencies with less than 0·15 per cent error.

Assuming that the potential function is not altered when 'heavy' hydrogens are present in the molecule, the vibration spectrum of C_2D_4 was readily obtained. The spectrum of each of the three isomers $C_2D_2H_2$ was calculated from two secular equations, one of the fifth degree, the other of the fourth. Each of them results from coupling together two families of normal modes of different symmetries in the completely symmetrical molecule C_2X_4, in such a way that a mode of the isomer of lower symmetry is produced. The coupling occurs through the kinetic energy function only, which has a lesser symmetry for the isomeres than for C_2X_4.

	C_2H_4	C_2D_4	HDC : CDH *cis*	HDC : CDH *trans*	$H_2C . CD_2$
1	S_1 1621 8	S_1 1428 8	π' 1516 5	S 1514 2	π 1555 3
2	3019 0	2283·9	3065 0	3049·2	3004 3
3	1343 9	1008 9	2304 2	2291·2	2221 0
4	A_1 2988 0	A_1 2152 5	1247·9	1240 2	1357 8
5	1444 0	1072·8	752 7	807·9	1043 1
6	S_2 3069 0	S_2 2308 0	σ' 3031·1	A 3053 2	σ 3088·1
7	950 0	758 3	2228·9	2233 4	2316 3
8	A_2 3107·0	A_2 2325·0	1295 4	1308 4	945·6
9	949·7	678 1	820 2	765 3	724 8

The horizontal lines separate the frequencies in different symmetry families. S and A, respectively, mean symmetric and antisymmetric with respect to the centre of the molecule. S frequencies are Raman active and infra-red inactive; the reverse is true for A frequencies. π and σ respectively mean symmetric and antisymmetric with respect to the carbon axis and π' and σ' the same with respect to the perpendicular axis in the plane of the molecule. They are all active in Raman effect and in infra-red absorption, but may be of widely different intensities. The π and π' frequencies are polarized and expected strong Raman lines, whereas the σ and σ' are depolarized and weaker. As is well known, for C_2H_4 and C_2D_4, S frequencies divide into two separate families $S_1(\pi\,\pi')$ and $S_2(\sigma\,\sigma')$ and also $A_1(\pi\,\sigma')$ and $A_2(\pi'\,\sigma)$. The π frequencies show a marked Q branch in the infra-red absorption. The four fundamental symmetry families of the totally symmetric molecule combine in the following way to form the normal modes of the three isomers: $\pi'(S_1A_2)$; $\sigma'(S_2A_1)$; $\pi(S_1A_1)$; $\sigma(S_2A_2)$; $S(S_1S_2)$; $A(A_1A_2)$.

Owing to the uncertainty resting upon some data and also the neglect of the anharmonicity, no too close fit with the experiment can be hoped. However, it is expected that the obvious qualitative relationships existing between the spectra of heavy ethylenes will hold.

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July 27.

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[1] Sutherland and Dennison, *Proc. Roy. Soc.*, A, 148, 250 (1935).
[2] Delfosse, *Ann. Soc. Sci. Bruxelles*, B, 45, 114 (1935).
[3] Bonner, *J. Amer. Chem. Soc.*, 58, 34 (1936).

Some Properties of Pentadeuterobenzoic Acid, C_6D_5COOH

THE acid was obtained by the reaction between pentadeuterophenyl magnesium bromide and carbon dioxide[1]. The following details enable a comparison to be made between this acid and benzoic acid:

	C_6H_5COOH	C_6D_5COOH
Melting point .	121·7° C.	120·9° C.
Solubility in 100 c.c. water at 18° C :	0·28 gm.	0·34 gm.
Molecular heat of combustion :	771400 cal.	761880 cal.
Dissociation constant at 25° C :	$6·6 \times 10^{-5}$	$6·6 \times 10^{-5}$

A detailed account of this work will shortly appear in *Helvetica Chimica Acta*.

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[1] Erlenmeyer, Lobeck und Epprecht, *Helv. Chim. Acta*, 19, 793 (1936).

Nuclear Reactions due to Neutrons of 2 m.e.v. Energy

MOST neutron workers hitherto have used Ra-Be, Ra-B or Ra-F as sources; these yield neutrons with continuous ranges of energies extending up to several m.e.v. The D – D nuclear reaction is considered to yield a homogeneous group of neutrons of about 2 m.e.v. energy. It is of interest, therefore, to know whether or not D – D neutrons can excite the nuclear reactions of the non-capture type reported by investigators using the radioactive sources.

We have been working in the Clarendon Laboratory with the neutrons obtained by bombarding heavy hydrogen with heavy hydrogen ions. The source of ions was a low-voltage arc of a modified Tuve and Dahl type. The total ion currents used have been of the order of 100 microamps. The accelerating voltage was 225 kv. Heavy phosphoric acid has proved to possess reasonably good lasting qualities as a target material. The yield of neutrons, as measured by the 2·3 min. induced activity of silver, has been checked at intervals over fifty hours' intermittent use, and has shown a constancy well within 10 per cent. Continuous runs of up to six hours' duration have been made.

With the exceptions of silicon and iron, the element under investigation was itself exposed to the 2 m.e.v. neutrons and then tested for induced radioactivity by means of a thin-walled Geiger-Muller counter. Silicon and iron were irradiated as SiO_2 and FeS respectively.

Silicon and phosphorus (half-periods, 2·5 min.) and phosphorus (half-period, 2·5 hr.) have been reported upon by Bjerge and Westcott[1]. They found a measurable activity only in the case of the 2·5 hr. period of phosphorus.

We have bombarded the following elements with our 2 m.e.v. neutrons for times up to twenty minutes in order to test for the shorter period activities: manganese and chromium (half-period, 3·75 min.), aluminium (10 min.), zinc (5 min.), silicon (2·3 min.). Any activity induced was certainly less than 1 per cent of the activity-value for phosphorus (2·5 hr.) irradiated to saturation under the same conditions.

Exposures for times up to three hours were carried out on zinc (half-period, 6 hr.), iron (2·5 hr.) and nickel (20 min.). No activities were found greater than 2 per cent of the saturation phosphorus value.

Calcium (16 hr.), magnesium and aluminium (15 hr.) were irradiated for periods up to six hours. Here again, our counter showed no activity as high as 2 per cent of that of phosphorus.

Naturally, any of these reactions might yield a positive result with a stronger source of neutrons or, in the case of the long-period ones, with a longer period of irradiation. We are making alterations which should greatly increase the number of neutrons available. Further investigations will be made on the above and other elements.

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[1] NATURE, 134, 177 (1934).

Ultra-Violet Absorption Spectrum of Hæmoglobin

IN a previous communication (Adams[1] *et al.*, 1934) it was shown that the ultra-violet band at 4100 A., which is characteristic of hæmoglobin and its immediate derivatives, is not found in unlaked blood. This observation has been extended to several species and confirmed in all cases.

It has been found that the difference in physical state is not responsible for the absence of the band when the hæmoglobin is in the corpuscle. The cell volume was varied by placing the cells in solutions of different osmotic strength, but not more than 5 per cent variation in light absorption was observed. Precipitation of the hæmoglobin with a protective colloid gave a suspension of hæmoglobin with a density about equal to that of a blood corpuscle suspension. This preparation, although similar in physical properties to a cell suspension, displayed the same ultra-violet absorption spectrum as hæmoglobin in solution.

The explanation for the non-appearance of the band in the corpuscle was next sought in the possible combination of hæmoglobin with some constituent of the red blood cell to give a compound with no specific absorption at 4100 A. Attempts to combine cholesterol, lecithin, glutathione and lipid extracts of the cells with hæmoglobin did not yield substances which lacked the band at 4100 A. 'Stromatin', or stroma protein, was prepared by Jorpes' method[2] (1932). The pure protein does not exhibit any selective absorption in the 4000 A. region. However, if a small percentage of hæmoglobin or methæmoglobin remained as an impurity in the preparation, the hæmoglobin band was absent.

This suggested a combination between hæmoglobin and stromatin to give a substance with no absorption at 4000 A. A small amount of pure stromatin was mixed with dilute hæmoglobin in alkaline solution. The spectrogram was taken at once, and at regular intervals for several hours afterwards. The mixture was kept at 37° C. The results show that, after heating at this temperature for 30 minutes, the ultra-violet band of hæmoglobin began to disappear, and at the end of one and a half hours there was no trace of selective absorption at 4100 A. The experiment was controlled by treating hæmoglobin with the same amount of alkali in a similar way.

The results of these experiments lead to the conclusion that neither the crude lipids of the red blood cell, cholesterol, lecithin, or glutathione react with hæmoglobin in such a way as to change the specific absorption of hæmoglobin in the region of 4100–4200 A. On the other hand, pure stromatin does react with hæmoglobin to cause the disappearance of its specific band at 4100–4200 A.; and it is suggested that this same combination exists in the red blood cell, and is responsible for the lack of the specific absorption band in corpuscle hæmoglobin. Such an entity is apparently quite labile, since hæmolysis by a wide variety of agents causes the breakdown of the substance.

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July 25.

[1] G. A. Adams, R. C. Bradley and A. B. Macallum, *Biochem. J.*, 28, No. 2, 482–485 (1934)

[2] E. Jorpes, *Biochem. J.*, 26, No. 2, 1488 (1932).

Potassium in the Brain in Vitamin B_1 Deficiency

IT has been stated that there is increased amount of potassium in the brains of pigeons suffering from vitamin B_1 deficiency. In view of the general interest attached to potassium salts and phenomena of excitation, I have re-examined this question. Unfortunately, I cannot find any significant difference between the amounts of potassium in the brains of normal and vitamin B_1 deficient pigeons, the values being 3·6 mgm. per gram of tissue in each case. The changes obtained by these authors[1] cannot, therefore, have been due to the avitaminosis.

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July 28.

[1] Balif and Gherscovici, *C. R. Biologie*, 115, 75 (1934).

Kinetics of an Inverse Diene Synthesis in the Pure Liquid State

THE decomposition of di*cyclo*pentadiene into *cyclo*pentadiene is an inverse diene synthesis. It was found previously[1] that in paraffin solution the reaction is monomolecular and that the rate constant is given by $k = 6 \cdot 0 \times 10^{12} e^{-34000/T}$ sec.$^{-1}$.

The rate of the decomposition has now been measured in the pure liquid state, using a method by which the *cyclo*pentadiene was continuously removed from the reaction mixture. Measurements have been carried out between 100° and 155°, and within this range the Arrhenius equation is obeyed. The value of the rate constant is $k = 3 \times 10^{13} e^{-35400/RT}$ sec.$^{-1}$, and the close agreement with the above figure shows that the mechanism of the inverse diene synthesis is the same both in solution and in the pure liquid state.

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[1] NATURE, 137, 496 (1936).

THE formation of di*cyclo*pentadiene from *cyclo*pentadiene is a diene synthesis and the reaction is bimolecular in benzene[1] and in paraffin solution.

If rate measurements in the pure liquid state are carried out it has to be considered that the 'solvent' originally present (*cyclo*pentadiene) is changed into a new solvent (mixture of *cyclo*pentadiene and di*cyclo*pentadiene). Hence it is not surprising that in each run a gradual change of the bimolecular rate constant (k) is observed. The constants characteristic of pure *cyclo*pentadiene are obtained if the observed k values are extrapolated to zero time. Both the extrapolated constants and those observed in benzene or paraffin solution obey the Arrhenius equation. The 'temperature independent factors' (Z) and the activation energies (E) are given in the accompanying table.

Reactants	Solvent	Z^1/gm.mol.sec. $\times 10^{-6}$	E kgm.cal.
*cyclo*Pentadiene	Benzene	1·2	16·4
*cyclo*Pentadiene	Paraffin	13	17·4
*cyclo*Pentadiene	*cyclo*Pentadiene	0·4[2]	16·1[2]

The accuracy of E is 5–10 per cent. It can be seen that the E's agree within the limits of experimental error. Further, the Z values and hence the collision numbers between solute-solute molecules and between solute-solvent molecules are of the same order of magnitude.

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[1] NATURE, loc. cit.; *J. Chem. Soc.*, 1028 (1936).

[2] These values were calculated using unpublished measurements and the data given by Stobbe and Reuss, *Annalen*, 391, 151 (1901), Barret and Burrage, *J. Phys. Chem.*, 37, 1029 (1933) and Kistiakowsky and Mears, *J. Amer. Chem. Soc.*, 58, 1060 (1936).

Points from Foregoing Letters

THE use of contoured graphs for determining the configuration of atoms in crystals, from X-ray data, is explained and illustrated diagrammatically by Prof. W. L. Bragg. The analysis of atomic positions, it is claimed, can be more rapidly carried out with the graphs than by calculation.

The addition to serumalbumin solution of a protein (clupein) changes the sedimentation constant. The effect, according to Dr. K. O. Pedersen, is probably due to dissociation into molecules of perhaps one eighth the original size. This, the author considers, may be a general phenomenon which occurs with increasing concentration, even in solutions of a single protein, and may account for the abnormal increase in osmotic pressure with increased concentration of protein solutions.

A method of applying organic growth substances to plants by spraying is described by Dr. H. L. Pearse. Tomato plants sprayed with a dilute solution of phenylacetic acid showed increased growth in stem and petiole, with decreased growth in leaf and root.

Algæ of the genus *Valonia* form very large bladder-shaped cells. By X-ray, microscopical and optical investigation of the wall, it may be shown that sub-microscopical rod-shaped cellulose crystals (crystallites) are present. The wall consists of about forty lamellæ; in the odd-numbered lamellæ all rods are parallel to each other, and in the even ones also, but in a direction which forms a large angle with the direction of the crystallites in the odd lamellæ. Prof. G. van Iterson, jun., gives an explanation of the way in which this structure is developed.

In connexion with the discussion on the origin of mimicry in insects, Prof. E. W. MacBride disagrees with the view that random inheritable variations in all directions constantly take place by chance. He considers that animals react to changes in environment and, when these are long continued, their effects are increasingly inherited by the offspring.

Diagrams showing the position of chromosomes during the metaphase stage of the reduction division (meiosis) in pollen mother-cells of *Silene Otites* are submitted by J. L. Fyfe; they agree with the view of Dr. C. D. Darlington, that the configuration is determined by repulsion forces. Commenting on this communication, Dr. Darlington refers to additional evidence in support of his theory and states that the repulsions are inversely proportional to the distance.

A table giving the vibration spectra of several ethylenes containing heavy hydrogen (C_2D_4 and each of the three isomers $C_2D_2H_2$) is given by Prof. C. Manneback and A. Verleysen. The values were calculated from the known vibration spectrum of ordinary ethylene, by assuming that the 'potential function' is not altered when heavy hydrogens are present in the molecule.

The melting point, solubility, heat of combustion and dissociation constant of benzoic acid containing five heavy hydrogen atoms in the molecule are reported by Prof. H. Erlenmeyer and A. Epprecht.

No appreciable radioactivity has been observed by E. T. Booth and C. Hurst after irradiating, for periods varying from twenty minutes to six hours, substances containing various elements with neutrons of two million electron volts energy; these were obtained by bombarding heavy hydrogen with heavy hydrogen ions, using total ionic currents of 100 microamp. and an accelerating voltage of 225 kv.

Hæmoglobin as found in blood corpuscles differs from the prepared 'laked' variety in that it does not show an absorption band in the ultra-violet at 4100 A. G. A. Adams, after investigating the effect of several substances, finds that the addition of stroma protein (stromatin) causes hæmoglobin to lose its absorption band at 4100 A., and concludes that hæmoglobin occurs in blood in combination with stromatin.

Research Items

Marriage among Serbian Gypsies

IN continuation of his studies of the Serbian gypsies, Dr. Alexander Petrović deals with marriage (*J. Gypsy Lore Soc.*, Ser. 3, 15, 3), drawing his material from Belgrade, Kragujevač and the neighbourhood of Arandjelovač, Rogatica, and Srebrnica. The gypsies from the two latter are Mahommedans, the remainder Orthodox. The marriage age is—Orthodox, boys, 13–18, girls, 12–16; Mahommedan, boys, 15–20, girls, 14–16. The later age among the Mahommedans is due to their custom of purchase, which involves a large sum. Neither bachelors nor old maids exist among the Christians, and to remain unwed is a disgrace. In olden times, marriages were celebrated at a much earlier age. The older generation used to betroth their children at 7–10 years and sometimes even before birth. In marriages in which the groom is very young, the bride usually being older by many years, it is customary for the father, or even grandfather, to be intimate with the bride in order to prevent her running away. These marriages secured a life-long bread-winner for the husband. Another reason given for early marriage is to ensure the descent in the male line and inheritance of the 'Slava' (patron saint) with the duty of celebrating his feast, as well as of burning candles in church for the parents after their death. The marriage is arranged by the father of the boy or the oldest man in the family. It is characteristic that when once a gypsy has decided on marriage, there is no delay. In marriage rites there is a tendency to imitate the customs of the neighbouring villages. Among some of the distinctive gypsy customs recorded is the pricking of a willow tree three times with a knife; while one of the chief marriage customs of all Serbian gypsies, but now no longer observed, was marriage around a tree. Even now, at Srebrnica, ties of marriage celebrated around a willow tree are considered more sacred than those celebrated by the 'Kadija'. In Mirijevo, the willow "symbolizes the woman". The rite of exposing evidence of virginity is widespread, as strict views are held on the subject of the virginity of the bride.

Tattooing in China

PROF. CHUNGSHEE H. LIU has initiated a historical survey of tattooing in China by a study of the practice as it still exists among the aboriginal Li people of the island of Hainan, southern China, which he contributes to the newly founded *Journal of Science*, published by the Sun Yatsen Institute for the Advancement of Culture and Education, Nanking. Tattooing is recorded under the Shang and Chou dynasties, when it was practised to avoid the trouble of dragons and snakes. No evidence for the custom can be traced among the 'Southern Barbarians' of the Middle Kingdom, where it might be expected. Among the Li, where it is called 'tatan' (cf. Polynesian 'tatu'), there are two traditions of its origin. According to one, it was a tradition of their ancestors that they might recognize their descendants easily; according to the other, when a mother and son were the only survivors of a great deluge, the former disguised herself by it from her son's recognition at God's bidding in order that the earth might be repeopled. Tattooing is practised only by the women. The instruments used are a rattan needle and bamboo rod, with black ash, or Chinese ink. The designs are first drawn. The technique is not of a high standard, and is known to most old women. The designs may be divided into four groups: (1) oblique lines in twenty-seven forms, mostly used on the face; (2) horizontal lines in seventeen forms, mostly on the legs, but partly on the arms; (3) circular lines, twenty-five forms, mostly on the chin; and (4) linguistic forms, recorded only among the Pai-sha Li, and unintelligible. The practice may be interpreted as a system of tribal marking, as related to marriage, or the totemic idea, as a magic symbol, or as purely decorative. The custom is dying out, and should be studied further before complete extinction.

Respiratory Dust Disease in the Cotton Industry

COTTON spinners do not suffer more than operatives in many other dusty occupations from respiratory tuberculosis, bronchitis and pneumonia; but cotton 'strippers' suffer a bronchitis mortality more than double that in other dusty trades. These operatives remove the dust from the carding machines, which comb out the cotton fibres, producing much dust in the process. The cause of this excessive mortality from bronchitis among these hands has been investigated by Prof. Carl Prausnitz (formerly of Breslau) in Prof. Maitland's Department at the University of Manchester, and his conclusions are published in a Report to the Medical Research Council (Special Rep. Series, No. 212. London: H.M. Stationery Office, 1936. 2*s*. 6*d*. net). Chemical examination showed that three fractions may be extracted from the dust, a lipoid or waxy fraction with petroleum ether, histamine with alcohol, and protein with saline solution. The lipoid is apparently quite harmless, the histamine has also a doubtful role as a disease-producing agent, but the protein is definitely toxic, causing irritant effects and inflammatory lesions in the deeper tissues. It also causes a condition of allergic hyper-sensitiveness; this was demonstrated by animal experiments, and was found to be present in all diseased cotton operatives examined. Various treatments for mitigating the disease are suggested, but the leading principle consists in prevention. This may necessitate the provision and use of adequate respirators, for even powerful and properly directed ventilation fails to carry away the lightest and smallest particles of dust.

Seals in Cornwall

COMPLAINTS by fishermen in Cornwall regarding the damage caused to fisheries of mullet and herring by seals have led to a careful survey of the seal population by G. A. Steven (*J. Mar. Biol. Assoc.*, 20, 493; 1936). The only seal observed by him on the Cornish coasts was the grey seal, *Halichoerus grypus*, and its habit was to frequent, during the rest of the year as well as during the breeding season, caves which were inaccessible from the land side. During the survey (August 7–20, 1935) the numbers counted indicate a seal population on the north coast of not less than 300 and probably not more than 500; on the south coast the number, not estimated, is very small. This differs very markedly from the estimate of 2,000 adhered to by the Cornwall Sea Fisheries Committee, and seems a much more trustworthy basis upon which to discuss any steps contemplated for the reduction of the seal population in the interests of the fishermen.

Larval Transplantation in Axolotl

KOLODZIEJSKI (*Bull. Internat. Acad. Polonaise*, Feb. 1936) reports the results of implanting axolotl larvæ upon hatching or within the first week or so in axolotls eight months old; all the implants were the offspring of the same parents. The skin of the back of the larvæ was cut, and they were inserted into holes in the dorsal fin of the host so that the tissues of the two animals could grow together. In some experiments the host skin grew over the implants, in others the implant fell off, but the majority fused successfully. The growth of the implants was fairly rapid at first, slowed down at four months and ceased altogether at six months, although some were kept alive for fifteen months. The internal organs of the implants developed more or less normally, but the external parts exhibited a wide range of abnormalities. Generally the body and tail were much reduced and the hind limbs entirely absent, while the fore limbs were often present and normally developed, and the head in some developed for several months. The reflexes and motility of the implant were independent of those of the host and were more developed where the body form more nearly approached the normal. Many implants had well-developed testes with motile spermatozoa, and while this condition was more common in those on male hosts it also occurred in those on female hosts. The lips of the cloaca were usually wide open, and in implants on male hosts the cloacal lips were markedly developed independently of the stage of maturity of their own gonads.

Morphology and Distribution of Penæids

MR. MARTIN D. BURKENROAD now concludes his preliminary review of the Penæidæ begun in two papers dealing chiefly with the littoral members of the family (1934 *a* and *b*) ("The Aristaeinae, Solenocerinae and Pelagic Penaeinae of the Bingham Oceanic Collection. Material for a Revision of the Oceanic Penaeidae". *Bull. Bingham Oceanographic Coll.*, Peabody Museum of Natural History, Yale University, 5, 1936). The members of these subfamilies are largely oceanic and of great interest in structure, habits and distribution. The question as to the relation between structural characters of penæids and their bathymetric habits is discussed and the distributional relations between the oceanic penæid faunas of the Atlantic and Pacific American regions. The larger part of the monograph of 151 pages is morphological, and the species are described and compared in great detail. The *Pawnee* third expedition collected a large number of species, four of which are new, but the descriptions are not confined to these, for there is also material from three co-operative cruises of the research ship *Atlantis*, sponsored jointly by Woods Hole Oceanographic Institution and by Yale University (Bingham Oceanographic Laboratory), and many more species are brought into the discussion dealing with the affinities of the various genera. Useful synopses of their main characters are given. All this very careful work is an important addition to our knowledge of this group of decapod crustaceans.

New Work on Cœlenterates

PROF. OSKAR CARLGREN has described a very interesting new Lucernariid from South Africa ("Ueber eine neue sudafrikanische Lucernariide., *Depastromorpha africana* n.gen. n.sp., nebst bemerkungen uber den bau und die systematik dieser tiergruppe". *Kungl. Svenska Vetenskapsakademiens Handlingar*, Tredje Serien. 15, No. 1; 1935). Besides the detailed anatomical description of *Depastromorpha*, the author has added a comparison of all known genera belonging to the Lucernariidæ with special reference to the musculature, and a table showing the relationships. This cœlenterate family occurs chiefly in northern and southern parts of the world, especially in the Arctic and Antarctic. Until 1933, only antarctic and sub-antarctic forms were known in the southern part of the Atlantic and Indian Oceans. In 1933, Dr. Carlgren described a *Lipkea* from the coast of South Africa, and in 1935 Prof. T. A. Stephenson discovered in Kapstadt the species which is the subject of the above paper. Mrs. L. M. I. Macfadyen (Miss L. M. I. Dean) has described the Stolonifera, Alcyonacea, Telestacea and Gorgonacea of the Great Barrier Reef Expedition 1928–29 (Scientific Reports, 5, No. 2, British Museum (Natural History), 1936). The collection is a fine one, 51 species being described, of which 6 are new. The order Stolonifera includes several genera whose systematic position has caused discussion. Although agreeing with Prof. Hickson as to most of these, the author is of the opinion that *Solenopodium*, placed by him in the Stolonifera, is really a Gorgonacean. The reasons given are that it appears to be impossible to separate *Briareum* from *Solenopodium* as the spiculation is almost indistinguishable, and *Solenopodium* approaches towards the *Briareum* type of growth. It does not always show a creeping form of growth, but hollow stems grow upwards which are sometimes solid at the tops, forming as it were the beginning of a solid axis.

Brittle Stars from Puerto Rica

MR. H. CLARK has described four new species of brittle stars from the Puerto Rican Deep out of the collections made by the First Johnson-Smithsonian Deep-Sea Expedition (*Smithson. Misc. Coll.*, 91, No. 24. Johnson Fund. 1936). Among the numerous species obtained there are three new species of the genus *Ophiomusium*, two of which are interesting in having the upper of the two arm spines transformed into a hook curving outwards from the arm. There are eighteen specimens of *Ophiomusium regulare* n.sp., but only one each of the other two, *O. rosaceum* n.sp. and *O. alecto* n.sp. There is also a new species of *Ophiocira*, a genus of the family Ophiolucidæ, known heretofore only from the Philippine and Lesser Sunda Islands, from 220 fathoms.

Molluscs and Blood Flukes

ONE of the most widespread of the blood flukes infesting man is *Schistosoma japonicum*. Millions of the inhabitants of China, large numbers in Japan and smaller numbers in Formosa and the Philippines suffer from it. The intermediate host of this, as of many flukes, is a fresh-water mollusc. In spite of the considerable amount of work on the parasite and its relation to the primary host, little has been done on the intermediate host. Bartsch (*Smithsonian Miscell. Coll.*, 95, No. 5; 1936) has performed a useful piece of work by reviewing very fully the known molluscan hosts. A number of them is fully described, and they are shown to belong to at least four distinct genera. A series of good keys is provided, which should be of assistance to future workers.

Self-Sterility in *Eruca sativa* Mill

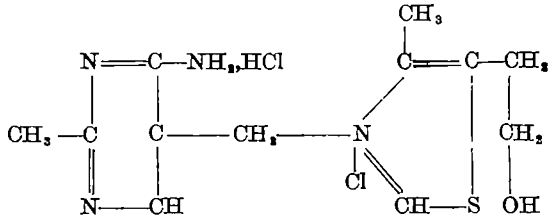
THIS crop plant of the Punjab is highly self-sterile and is normally cross-pollinated by insect visits to the recently opened flowers. Mr. Z. Alam (*J. Genetics*, **32**, No. 2) has made a genetical investigation of the self-sterility. Selfing reduces the length of pods by about one-third and the number of seeds to 2–3 per cent of that obtained from crossing. Plants raised from selfed seeds are weakly, shorter with fewer branches and pods, and give a lower yield of seed. Six plants were intercrossed in all possible ways. The results showed the existence of partially self-fertile as well as self-sterile plants. Some cross-matings were fairly sterile, and some compatible matings gave a much higher fertility than others. From bud pollinations it is concluded that a substance inhibiting pollen-tube growth is present in the style at anthesis, but is absent two days before and has gradually disappeared about two days after anthesis. Parthenocarpy and phenospermy were also observed in these experiments. The cause of different degrees of cross-fertility requires further investigation.

A Reagent for Structure Determination

IN the identification of organic compounds, those tests are especially valuable which can be carried out quickly on small amounts of material and show, by the formation of a colour or precipitate, the presence of a specific group or structure. R. Connor and J. H. Van Campen (*J. Amer. Chem. Soc.*, **58**, 1131 ; 1936) describe a test which, under specified conditions, is general for substances which contain hydrogen on a carbon atom bearing at least one acyl group or two other activating groups. The test consists in adding an alcoholic solution of mercuric chloride to a solution of the unknown in alcohol containing sodium ethoxide. The formation of a white (occasionally cream coloured) precipitate is a positive test. The negative test is the formation of a deep yellow precipitate similar to that obtained when the sodium ethoxide and mercuric chloride solutions are mixed in the absence of an additional reactant. More than two hundred organic compounds have been tested with the reagent, and it appears that it is desirable to limit its use to neutral compounds which do not contain elements other than carbon, hydrogen and oxygen. The classes of compounds with which the test will be concerned will include ketones, aldehydes, esters, hydrocarbons, ethers, acetals, alcohols, quinones and anhydrides. Of these, the last five types fail to give a positive test. Aldehydes and ketones with hydrogen on the carbon atom bearing the carbonyl group give a positive test. The only esters which give a positive test are those which have both hydrogen and a labilizing group on the carbon atom bearing the carboxyl group. Acetylenes appear to give a positive test, and are the only hydrocarbons to do so.

Synthesis of Vitamin B_1

IN June last (*J. Amer. Chem. Soc.*, **58**, 1063 ; 1936), Prof. Williams, of Columbia University, proposed a revised formula for vitamin B_1, in which 2.5-diethyl-6-aminopyrimidine is linked through the 5-methyl group to the nitrogen atom of 4-methyl-5-β-hydroxyethyltriazole. According to this view, the vitamin is the hydrochloride of a quaternary nitrogen base :



The Columbia University workers have now, according to a more recent communication from Prof. Williams to the same journal (loc. cit., **58**, 1504 ; 1936), isolated both the bromide and the chloride of a substance having the above formula, and have proved its chemical and physiological identity with the natural compound. The difficulties of their task may be imagined from the fact that the pyrimidine derivative was prepared by five stages from ethyl formate, acetamidine, $NH_2.C(CH_3):NH$, and γ-ethoxyethylacetate, $C_2H_5OCH_2.CH_2.COOC_2H_5$. This was then combined with the substituted thiazole, and the resultant bromide as well as the chloride prepared from it were compared with the corresponding substances from yeast. The thiazole compound appears to be prepared by six stages from ethyl aceto-acetate, β-bromethyl ether and thioformamide. Prof. Williams promises fuller details in forthcoming publications.

Dayload Peaks in Electrical Engineering Supply

IN the early days of electricity supply, it was soon realized that the machinery that had to be provided depended on the maximum (peak) load of the station. The higher the peak for a given load, the higher the price that had to be charged to the consumer. When direct current was used it was the custom to have a large battery of accumulators, which at times of light load were charged by the dynamos, and when the heavy load came they helped the dynamos by taking part of the load. Thus the load was equalized throughout the day. With alternating current supply it is more difficult to provide reserved power. In an article on "Dayload Peaks" published in the *Electrical Times* of August 13, it is stated that the time at which the peak load occurs is now in the process of changing from the evening to the morning. This is causing anxiety to those supply engineers who take a bulk supply, as their previous estimates will be upset and difficulties may arise. The following factors govern the times and nature of the daily peak load. One factor varies with the class of the load, which depends on the district, another on the time of the year, and a third on the weather. It has been noticed, for example, that the peak load occurs on a certain day at 5 p.m. A few days later, the weather being cold and foggy, it occurs at 9 a.m. This was due to the heating load from fires together with extra shop and domestic lighting. Except in large cities, there seems during the last two or three years to be a definite tendency for the maximum load to occur at breakfast time. If electric water heaters are used, and there is a large demand for hot water before breakfast, this in itself would be sufficient to cause a morning peak on the station load.

Twenty-five Years of Botanical Progress

THE Brooklyn Botanic Garden had the felicitous idea of marking the twenty-fifth anniversary of its foundation in part by the presentation and subsequent publication of a series of addresses dealing with progress in this period of time in different fields of botanical science. The series of addresses appears in vol. 4 of the *Memoirs* of the Garden (May 7, 1936), and will interest botanical readers everywhere.

The addresses were commendably brief, with the result that the most significant aspects in each field are usually thrown into prominent relief. Thus, Prof. C. E. Allen, dealing with cytology, after a brief reference to cytoplasmic structures, centrosomes and cell-wall, has a very penetrating analysis of the chief features of interest in chromosome studies in the twenty-five year period.

This pairs very well with Dr. Blakeslee's equally interesting review of the progress of genetics. Dr. Blakeslee finds that he is provided with about 0·7 seconds in which to discuss the twenty-five years work of each single geneticist, which produces the surmise that the so-called 'leaders of science' are rather 'pushed' than leading. "It is not the conspicuous spray which erodes the coastline of our continent but masses of water which surge forward with united front". Dr. Blakeslee regards us as passing, in 1910, from the Mendelism and 3 : 1 ratio period to that of "Brass Tacks—Genes and Chromosomes". The significance of three techniques are emphasized in this latter period; the aceto-carmine method which has enabled the rapid study of the nuclei of large numbers of specimens, the production of mutation by radiation treatment and the analysis of chromosomal structure permitted by the salivary glands of fly larvæ.

Dr. Blakeslee decides that the last twenty-five years have brought us again to the species problem, and appropriately enough a contribution follows by Dr. Elmer D. Merrill, director of the New York Botanical Garden, who deals most temperately and justly with the species problem as seen by the experienced taxonomist.

Many other points of view are discussed in this entertaining volume; virus diseases are passed in review, the progress of ecological investigation, of forest administration and research, etc. In short, it is made clear that in the last twenty-five years progress in botany has passed beyond the grasp of any one individual. Let us hope that the result will be to make us all as reasonable in our demands as specialists as Dr. Merrill, who concludes that it is neither necessary nor desirable that all botanists should master the field of systematic botany. "Yet it can be maintained as a general truth that the individual investigator, no matter what his field, who has a reasonable knowledge of the names and relationships of the organisms with which he deals, is a better equipped individual for productive work within his own field, and that the teacher of botany who has the same knowledge is a better teacher".

Geology in Great Britain

PART 1 of the "Summary of Progress of the Geological Survey of Great Britain" for 1933[1] contains the usual annual reports of the Geological Survey Board and of the director and gives particulars of routine work carried out during the year under review. As in the succeeding year, there was some slowing down of normal activities on account of the immense amount of additional work involved in preparation for the transfer of the collections to the new museum at South Kensington. Nevertheless, thirty-nine maps were issued, together with five memoirs, which, with one exception, have already been noticed in our columns (NATURE, 134, 782; 1934); the remaining one, the Merthyr Tydfil memoir[7], is reviewed below.

The old Museum of Practical Geology in Jermyn Street closed its doors to the public at the end of 1933. Sir John Flett contributes an interesting outline of its history from its opening in the year of the Great Exhibition of 1851 (see also NATURE, 134, 129; 1934).

Part 2[2] contains a series of papers on subjects of special interest. M. Macgregor and J. Pringle discuss the Scottish Millstone Grit in relation to that of the Pennines. The freshwater fauna of the Lower Coal Measures of Lancashire is described and the range of variation of its constituents demonstrated by W. B. Wright. The corresponding fauna in West Yorkshire is dealt with by D. A. Wray and A. E. Trueman. A valuable synopsis of Coal Measure plants and their stratigraphical distribution is provided by R. Crookall. The results of a study of the Carboniferous rocks of Innimore Bay, Morvern, on the Sound of Mull, are recorded by M. Macgregor and W. Manson. The fossils of certain pebbles in the Peel Sandstones of the Isle of Man are shown by H. P. Lewis to be of Salopian age. W. Manson describes the Carboniferous and Old Red Sandstone strata passed through by a boring for water (340 ft. deep) at Stonefold Farm, Berwickshire, with petrographical notes by J. Phemister. Sir John Flett continues his investigations of the teschenite-picrite sills of the Lothians with a study of a thomsonized inclusion from the Blackness sill.

Part 1 of the "Summary" for 1934[3], in addition to the usual information, records the transfer of offices, library and collections from Jermyn Street to South Kensington. The opening of the new Museum in July 1935 was recorded, with an account of the centenary celebrations, in NATURE (136, 75; 1935). Despite the strenuous activity necessitated by the change-over, and the employment of the equivalent of about one third of the field staff in the preparation of exhibits, all the normal departments of the Survey's work were carried on without serious interruption. Maps issued during 1934 number forty-one, and there were published two memoirs, both of which are reviewed below (Ardnamurchan model[5] and Fife Coalfields, Area II[8]). Certain features of the year's work deserve special notice. The colour-printed maps include twelve of the London area on the six-inch scale; fifteen further sheets of the same series were in the press by the end of the year. Among new maps in progress, mention may be made of a series of economic maps of England and Wales on the scale of 16 miles to the inch. Two of the sheets, devoted respectively to the coalfields (exposed and concealed) and iron ores have since appeared. These indicate that the series is likely to be of great educational value, and teachers, in particular, should not overlook this authoritative guide to mineral resources. The most important innovation of the year, however, was the preparation of a series of eighteen descriptive handbooks under the general title of "British Regional Geology". Eleven of the handbooks have now been published and a separate account dealing with them will appear shortly in these columns.

In Part 2[4], Prof. J. de Lapparent (Strasbourg) contributes a most important study of the Carboniferous bauxitic clays of Ayrshire. These deposits contain boehmite and diaspore and it is shown that the conditions of their formation involved the hydrolyzing action of a tropical climate followed by subsidence and burial. It is noted that bauxites which remained exposed during their formation contain gibbsite. W. Edwards describes the Pleistocene dreikanter of the Vale of York, and points out that conditions suitable for such wind-faceting were widespread in Britain and Europe towards the close of the Pleistocene. The strata encountered in a boring (810 ft.) in Northamptonshire are described by B. Smith, the special interest being the discovery of an old floor of presumably Pre-Cambrian quartz-felsite beneath the Keuper Marl. Another boring (980 ft.) at Bushey, Herts, reached Devonian rocks beneath the Gault. The strata are described by F. H. Edmunds; the Palæozoic fossils by C. J. Stubblefield; and the underground water by F. K. Sinclair. One of the most widespread of the fossil-bands of the North-West Province of the Lower Carboniferous is that characterized by *Cyrtina septosa*. It has now been discovered in the Midland Province of Derbyshire and is the subject of a paper by F. W. Cope. Palæontological contributions include a critical examination by K. P. Oakley of a Wenlock coral which has been referred to the Polyzoa by certain authors; a description of a Downtonian eurypterid from Lanarkshire by Dr. L. Størmer (Oslo); notes by C. J. Stubblefield on types and figured specimens acquired from the late S. S. Buckman by the Survey; and an account by W. B. Wright of the large species of *Carbonicola* which characterize the base of the Middle Coal Measures.

The "Guide to the Geological Model of Ardnamurchan"[5] refers to a model, originally constructed for exhibition in the Royal Scottish Museum, which displays the complicated solid geology of the worn-down and long extinct volcano of Ardnamurchan. The horizontal scale is four inches to a mile, but as the highest peak, Ben Hiant, reaches only 1,729 ft., heights have been slightly accentuated by adopting a vertical scale of six inches to a mile. The guide is very fully illustrated and forms a readable introduction to the remarkably interesting features of a Tertiary volcano which is justly famous for the perfection of its ring-structures and the variety and significance of its petrological phenomena. A detailed memoir on the area was published in 1930 (see NATURE, 128, 619; 1931).

The volume descriptive of the underground water supplies of Herefordshire[6] is one of a growing series which now covers the London area and twenty-eight counties. The usefulness and practical value of these memoirs has been especially emphasized by the droughts of recent years. As Herefordshire is a county that depends to a very considerable extent on underground resources for its potable water—whether as feeders of bores, wells and springs, or as contributors to the flow of rivers during dry periods—this latest issue should prove especially welcome. The main rivers are also discussed as sources of supply, and a selection of chemical analyses of the river- and well-waters suffices to show the principal types of water available.

The first edition of the memoir dealing with the Merthyr Tydfil district of the South Wales Coalfield was published in 1904 and has been out of print for many years. The progress of mining and geological research has made necessary a considerable amount of revision in the new edition[7], particularly as regards the zoning of the Carboniferous rocks and the underground structure and correlation of the coal seams. The district includes a large part of the magnificent mountain range of the Fforest Fawr, the highest peaks of which, the Brecknock Beacons, lie just north of the area described. Bare cliffs and numerous river channels clearly display the higher strata of the Old Red Sandstone, together with the Carboniferous Limestone and Millstone Grit formations. The southern part of the region is in Coal Measures and includes the industrial centres of Merthyr, Aberdare and the upper part of the Swansea valley. Special chapters are devoted to economic minerals and to palæobotany.

The second of the series of memoirs describing the economic geology of the Fife coalfields[8] deals with the central part of the county, comprising an area of about a hundred square miles, mainly occupied by strata of Lower Carboniferous age. The structure is complicated by numerous faults and intrusions of igneous rock, while the sequence in the southern part includes considerable thicknesses of lavas and ashes. The main structural feature is the Burntisland anticline, which separates the Cowdenbeath and Lochgelly coalfields on the west from the Kirkaldy coalfield on the east. More than 1,400 bore and shaft records have been collected to elucidate the relations of the formations. Much of the memoir is devoted to the coal-bearing strata of the Limestone Coal Group and the Productive Coal Measures.

The memoir describing the geology of the Orkneys[9] will be generally welcomed because the official survey has only recently been completed and is of special interest on account of the wealth of new information regarding the Old Red Sandstone now made available. The first four chapters deal with the history of geological research, the topography and scenery, and the general geology of the islands which make up the group. The intermediate chapters provide more detailed accounts of the individual districts and islands, while the last three chapters are respectively concerned with fossil fishes, fossil plants and petrography. With the exception of a small area in the neighbourhood of Stromness, where an ancient granite-schist complex occurs, most of the islands are mainly built of flagstones and sandstones belonging to the Middle division of the Old Red Sandstone. These beds were folded and heavily eroded before the deposition of those of the Upper division. The latter are restricted to Hoy and include ashy sediments and olivine-basalt. Five volcanic vents have also been detected in Hoy. The structure of the island-group is comparatively simple, consisting essentially of a central series of synclines passing over on the west into the broad and gentle West Mainland anticline and on the east into a series of minor anticlines. Faulting follows three directions, two of which are represented by the shores of Scapa Flow, where three important faults all throw down towards the sea. Numerous dykes of bostonite, camptonite and monchiquite traverse the Old-Red Sandstone, but their age, as elsewhere in Scotland where similar dykes occur, is still undetermined. The memoir is provided with a bibliography, a glossary of Orkney place-names, and an excellent geological map in colour on the scale of 4 miles to one inch.

[1] "Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1933". Part 1. Pp. viii+93. 1*s*. 6*d*. net.

[2] *ibid*., Part 2. Pp. viii+108+8 plates. 3*s*. net.

[3] *ibid*., for the year 1934. Part 1. Pp. viii+85. 1*s*. 6*d*. net.

[4] *ibid*. Part 2. Pp viii+65+4 plates. 1*s*. 6*d*. net.

[5] Guide to the Geological Model of Ardnamurchan. By J. E. Richey. Pp. 49+9 plates. 1*s*. net.

[6] Wells and Springs of Herefordshire. By L. Richardson. Pp. viii+136+2 plates. 3*s*. net.

[7] The Geology of the South Wales Coalfield. Part V. Merthyr Tydfil. By A. Strahan, W. Gibson and T. C. Cantrill. Second edition. By T. Robertson; with a Palaeobotanical Chapter by R. Crookall. Pp. xix+283+6 plates. 5*s*. 6*d*. net.

[8] Economic Geology of the Fife Coalfields. Area II. (Cowdenbeath and Central Fife). By J. K. Allan and J. Knox. Pp. xi+207+2 plates. 4*s*. net.

[9] The Geology of the Orkneys. By G. V. Wilson and W. Edwards, R. C. B. Jones, J. Knox and J. V. Stephens; with Chapters on Fossil Fishes by D. M. S. Watson; Fossil Plants by W. H. Lang; and Petrography by J. S. Flett. Pp. xii+205+8 plates+a Geological Map (4 miles to 1 inch) in folder. 5*s*. net.

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rship to L. G. Leaton (Southern

EGE, Newcastle-upon-Tyne, has a
for Research which distributed
mounting to £891. Its annual
lished, includes a series of in-
the recipients of these grants,
cases for purchase of apparatus
on's share (23 out of 25) went to
ral sciences. One, made in con-
t to the Massachusetts Institute
spectroscopic work, contributed to
of valuable personal contacts with
rs in the United States. The visit
included attendance at a conference on spectroscopy, an account of which was read before the British Association. Another grant was used largely in the purchase of Irish parliamentary reports for a study of "British Imperial Policy in the Twentieth Century", which provokes the question: is it not 'up to' Governments, seeing that they stand to benefit from the products of competent disinterested research in the social sciences, to encourage it to the extent, at least, of placing such material gratuitously at the disposal of an investigator of the standing of a university professor of history.

THE Department of Business Administration at the London School of Economics, established a few years ago on the initiative of a group of business men for university men who were resolved on a business career, has had another successful year. An Advisory Council has recently been established to assist in maintaining the closest possible touch between training and current practice. The chairman of the Council is Major-General Guy P. Dawnay, and its membership includes Sir Harold Bellman, Sir Kenneth Lee, Sir Felix Pole, Sir Frank Spickernell and others who are prominent in different fields of finance, industry and trade and who are united in the determination to develop the Department as a centre of business training for graduates of British universities. Interest in the post-graduate course of business training extends beyond those industries represented on the Council, and an American business man has recently given £200 for a studentship for 1936–37 in the fields of investment or finance. The Leverhulme studentship of £200 is also open to competition. Some business firms have from time to time used the Department as a kind of staff college, and others have offered appointments to graduates subject to their first attending satisfactorily the Department's course. Great care is taken to admit to the course only those likely to make good in a business career. There is now apparent a demand among managers themselves for lectures on current problems, and in the winter months of 1936–37 a series of twelve such public lectures will be delivered by six members of the academic staff on matters of administrative organization, business finance, industrial production, distribution developments, marketing and public relations, statistical and accounting service.

A STUDY of education in Czechoslovakia was undertaken by the United States Office of Education two years ago. A report prepared by a specialist in comparative education, S. K. Turosienski, on the basis of visits paid to a great number of types of schools as well as interviews with school authorities and examination of official documents, has been published as Bulletin No. 11 of 1935 (Washington: Government Printing Office, 25 cents). The establishment of a national system of public education was one of the first tasks confronting President Masaryk after the new Republic of Czechoslovakia was constituted in November 1918. The report indicates that the system is working well and contributing powerfully to the prosperity and well-being of the nation. Problems arising from multilingualism—Czechoslovak, Carpatho-Russian, German, Magyar, Polish, Rumanian, modern Hebrew and other tongues are used as languages of instruction—have been solved with remarkable success. Religion is a compulsory subject of study in all elementary, secondary and normal schools, the time allotted for it being, in general, two hours a week. Particular care is taken to exclude influences calculated to inflame racial or national animosity. In all secondary and elementary schools instruction is given in civics, under the headings : national culture, League of Nations, civilization of all nations, general progress of mankind, equality among the races and nationalities, the World Court, international treaties and guarantees, international pacifism, religious tolerance, history of labour and civilization, natural laws, man and the world, conditions of happy, peaceful life, etc. Parental co-operation with the school authorities is legally provided for by means of parents' councils. A noteworthy feature of the system is the clarity with which the objectives of education are set forth, not merely with reference to the educational process as a whole but also specifically for each course.

Science News a Century Ago

Death of Dr. William Henry, F.R.S.

ON September 2, 1836, Dr. William Henry, the eminent chemist, died at Manchester at the age of sixty-two years. The son of Thomas Henry (1734–1816), one of the founders and the first secretary of the Manchester Literary and Philosophical Society, he was born at Manchester on December 12, 1774, and attended the Manchester Grammar School. For several years he was secretary and assistant to Dr. Thomas Percival (1740–1804), the first president of the Literary and Philosophical Society, but, when twenty-one years of age, spent a session at the University of Edinburgh, where he was one of the last pupils of Black. On his return to Manchester, Henry assisted his father in his chemical business, wrote memoirs and lectured, and in 1801 published his "Epitome of Chemistry", which was enlarged and became "The Elements of Experimental Chemistry". It was said that this was the first English work on chemistry which with considerable literary merit combined scientific accuracy. It went through eleven editions. His experiments on the absorption of gases by water were made while he was writing these books. In 1805 he returned to Edinburgh, and two years later was granted the degree of M.D. The remainder of his life was spent in Manchester, where he counted among his friends Dalton.

Henry was elected fellow of the Royal Society in 1808, and in the same year received the Copley Medal. His original contributions to science included papers on medical subjects such as diabetes and cholera, and biographical sketches of Priestley, Davy and Wollaston. At intervals during his life he suffered severely from an accident received when a child, and his death on September 2, 1836, was due to nervous irritation and insomnia. He was a refined, eloquent and accomplished man, and his bust and portrait are preserved by the Manchester Literary and Philosophical Society of which he was an ardent supporter. His life was written by his son, Dr. W. C. Henry.

The British Association at Bristol

SUMMARIZING the results of the Bristol meeting of the British Association, the *Athenæum* of September 3, 1836, said : "Having now read the Reports ; and calmly and dispassionately surveyed the entire proceedings, we are of opinion, that the results of the Bristol Meeting are most satisfactory : rather more than 1,300 members were present, many of the papers read were very valuable, many important questions were discussed, and the Committee have been enabled to devote no less than £2,700, in further aid of science and scientific research. These are beneficial effects not to be questioned. It appears, however, that the Association does not work to the entire satisfaction of some influential members . . . who . . . are of opinion, that some proceedings in particular Sections had a taint of quackery . . . and they are in consequence disposed to limit the sphere of inquiry, or restrict the numbers. Now, we concur generally as to the possible tendency of the Association ; such an opportunity for personal display and cheap advertisement will not be lost by the far-seeing ; but the remedy suggested would be, in our opinion, a still more mischievous error. There can be no such thing as an oligarchy of science, which these restrictions would tend to create. We take leave to suggest the most scrupulous care in the election of Chairmen to the several Sections . . . and a great deal more energy and resolution on the part of the Sectional Committee ; the one (the Committee) should be foreseeing and directing, and the other (the Chairman) the controlling mind of the Association. . . ."

Botanical Society of London

ON September 3, 1836, the *Mechanics' Magazine* said : "A number of botanists, amateurs, etc., have recently held several meetings at the Crown and Anchor Tavern, Strand, for the purpose of forming themselves into a society bearing the above name. . . . Among the leading objects the Society propose are, the advancement of botanical science in general ; the particular cultivation of descriptive and systematic botany ; the formation of a library, herbarium and museum ; the reading of original pa
and translations ; the exchange of sp
other societies or individual collector
other available means that may prom
of the Society". Commenting on th
said : "We are glad to find, among t
of bricks and mortar, ladies and gentl
devoted to so healthy and so endu
botany".

The Flora of Ireland

IN 1836 appeared the "Flora
prising the Flowering Plants, Fern
arranged according to the Natura
Mackay, who from 1806 until 1
the Botanical Garden, Trinity C
a notice of the book in the *Athen*
1836, a reviewer said : "We co
friends upon the publication of t
creditable to the naturalists of I
general account of the plants
appear in a form corresponding
science elsewhere. . . ."

"The character of the classes a
chiefly from the writings of De Ca
and the arrangement employed b
botanist, in his 'Synopsis of th
followed, with few exceptions. T
genera and species are chiefly from
Flora' ; for the matter relating to M
and Lichens, the author is indebt
and for the arrangement of the
Harvey, both of whom are na
for their acquaintance with th

Societies and Academies

Paris

Academy of Sciences, July 6 (*C.R.*, 203, pp. 1–136)*.

Jacques Errera, Pol Mollet and Mlle. Mary L. Sherrill: Tetramethylethylene and the influence of the double bond. Study of the infra-red spectrum.

Victor Henri: The electronic state of the radicals in polyatomic molecules. The radicals discussed are SO, CN, $C=C$, NN, and NO. The results relating to the electronic states of the radicals, based on infra-red and Raman spectra, and on the determination of the distance between the atoms of the radicals measured by X-rays or electron rays, can serve as a basis for the analysis of the mechanism of chemical reactions between these molecules. They lead to a new interpretation of the laws of chemical kinetics.

Maurice Bachelet: The extraction of uranium X by precipitation of ferric hydroxide. The exact working conditions are given: the yields vary from 85 to 95 per cent.

Maurice E. Nahmias and Robert J. Walen: Some artificial radio-elements. Results of the bombardment of fluorine and sodium by neutrons.

Hans von Halban, jun. and Pierre Preiswerk: Experimental proof of the diffraction of neutrons.

Georges Carpéni: The dissociation constants of ascorbic acid and of its product of oxidation by iodine.

Alexandre Krassilchik: The use of the uranyl-magnesium reagent in dilute alcohol. Discussion of the errors inherent in this method of determining sodium, and suggestions for their elimination.

Mlle. Jeanne Foret: The synthesis of hydrated mono-calcium silicates under pressure.

Tryphon Karantassis and Léandre Capatos: The hexa-iodotellurates of the aromatic amines and of the heterocyclic bases.

Adrien Perret and Joseph Biechler: Researches on some chlorocarbonates.

Mlle. Jeanne Boulanger: Study of the systems zirconyl oxalate, alkaline oxalates and water.

Pierre Sue: The thermal equilibrium between Nb_2O_5, Na_2CO_3, CO_2.

Georges Dupont and Raymond Dulou: The oxidation of cyclohexene by hydrogen peroxide.

Jules Garrido: The dehydration of brucite.

Jean Wyart and Yeu Ki-Heng: The crystallographic study of some derivatives of tartaric acid. X-ray studies of tartramide, tartramic acid, methyl tartrate and potassium borotartrate.

Pierre Marie: The Cretaceous micro-fauna of the south-east of the Paris basin.

Marcel Roubault: The radioactivity of some natural springs of the Kahylie de Collo (Department of Constantine, Algeria).

Charles Bois: Earthquakes with abnormally deep focus. A table showing focal depth obtained by various authors by different methods.

Paul Corsin: The phylogeny of the Inversicatenales.

Paul Bertrand: Some fundamental observations for the comprehension of the organization of vascular plants.

Roger Heim: The phylogeny of the Lactario-Russula.

Mlle. Jane Manuel: The sexuality of *Hansenula Saturnus* and of some species of the genus *Saccharomyces*.

Marcell Masoré and René Raymond-Paris: The comparative action of acrolein vapour on the cellular structure and glucidic composition of some plant tissues.

Antoine de Cugnac: The experimental production of inter-specific hybrids in the genus *Bromus*, and some related systematic considerations.

Désiré Leroux: The influence of the trituration of cultivated soils on the amount of essential fertilizing principles in their aqueous extract.

Robert Castagné: The improvement of technique [historadiography]. Substitution of a window of lithium for one of aluminium. Lower voltages can be used and exposures shortened.

Emile Haas: Comparison between the energy of a simple radiation and that of a mixture of radiations of the same visual appearance.

Charles Lapicque: The optical structure of the vitreous body.

R. Jonnard: The interferential study of the refraction of blood serum as a function of the concentration.

Stig Veibel and Erik Nielsen: A case of a non-hydrolyzable β-glucoside.

Jean Roche and Mlle. Marie Thérèse Bénevent: The hæmatins of the α-cytochromes.

Théophile Cahn and Jacques Houget: The utilization of glucides in experimental diabetes.

Gaston Ramon and André Staub: A new method of anthrax vaccination.

Moscow

Academy of Sciences (*C.R.*, 2, No. 1, 1936).

S. Michlin: Composition of double integrals.

L. Kantorovich: Some theorems on semi-regular spaces of general type.

B. Demidovich: Existence of an integral invariant in a complex of periodic points.

P. A. Walther and V. A. Stefanovskij: Action of centrifugal forces inside the axial pump.

A. A. Grünberg and B. V. Ptioyn: Titration of bivalent platinum and trivalent iridium at different temperatures.

J. G. Ryss and N. P. Bakina: Complex fluorides. (1) Hydrolysis of the silicofluoride ion.

W. A. Silberminz and A. K. Rusanov: Occurrence of beryllium in fossil coals.

G. M. Smirnov and G. M. Zaridze: Neo-intrusions of the Dzyrul crystalline massif.

A. M. Lebedev and L. I. Sergejev: Regeneration of vernalized plants after injury of the growing points.

I. N. Konovalov: The effect of the vernalization of plants upon the accumulation of organic substance.

S. V. Dorofejev: Observations on the reproduction period of Greenland seals (*Histriophoca*) (*groenlandica oceanica* Lepechin).

A. S. Serebrovskij: An attempt at a new method of genetical analysis of quantitative characters.

(*C.R.*, 2, No. 2, 1936).

P. S. Alexandroff: Contribution to the theory of topological space.

B. Z. Vulich: Some remarks to the theory of K-normed space.

V. Rasumuvskij: Latent polarity and explicit polarity of molecules.

L. W. Nikitin: Acoustico-electrochemical phenomena (2).

I. N. Nazarov: Metal-ketyls of the fatty series. (4) Action of metallic sodium on *tert.*-butyl-*tert.*-amyl and *tert.*-butyl-*tert.*-hexyl ketones.

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* *Continued from p.* 338.

T. N. Godnev and **S. V. Kalishevich**: Quantitative determination of chlorophyll with the aid of the light of a Lange electrical colorimeter.

P. G. Danilchenko: Ecology of the spawning migrations of the salmon.

Washington, D.C.

National Academy of Sciences (*Proc.*, 22, 327–434, June 15).

Frederick H. Seares: Selective absorption of starlight by interstellar clouds. Measures of the colours of certain stars in luminous or dark nebulosities show them to be redder than would be expected from their spectral types. This seems to be due to selective absorption of light, and quantitatively it is sufficient to require a radical change in the estimated dimensions of the stellar system.

Cecilia Payne Gaposchkin: On the physical condition of the super-novæ. Their spectra are similar to those of ordinary novæ, but with wider bright lines. It is concluded that they differ from novæ mainly in size, having possibly developed from giant stars.

E. S. Castle: A model imitating the origin of spiral wall structure in certain plant cells. Six wooden dowels are fixed in a wooden base and their free ends separated by a small wooden spool. A ring pushed down over the dowels produces a spirally twisted formation, which seems to be similar to that of the wall of the spore-bearing cells of Phycomyces.

Nathaniel Lyon Gardner: A new red alga from New Zealand. It is parasitic on *Zostera* and has two forms, one having erect filaments (*Erythrocladia Hunteriæ*).

N. L. Bowen and **J. F. Schairer**: The system albite – fayalite. The mixture is heated in a crucible suspended in a platinum resistance furnace, and the temperature of appearance of a phase is determined by quenching the charge in mercury and examining it under the petrographic microscope to determine the phases present. The diagram for albite – fayalite is of simple eutectic type. It is hoped to use the marked fluxing action of albite to examine the equilibrium relations of other silicate mixtures.

M. Demerec: Frequency of 'cell-lethals' among lethals obtained at random in the *X*-chromosome of *Drosophila melanogaster*.

Aleš Hrdlička: Puberty in Eskimo girls. The age of onset for 16 full-blooded Kuskokwim Eskimos (Alaska) and also of 6 mixed-bloods is 13½ years, which is unexpectedly low for so far north.

Froelich G. Rainey: Eskimo chronology. A test cut to a depth of fourteen feet through a stratified midden deposit at Kukulik, St. Lawrence Island, Alaska, has revealed six cultural horizons, most of which have been recognized at widespread Eskimo sites in the Arctic.

William Hovgaard: Torsion of rectangular tubes. Current theory, based on a hydrodynamical analogy, represents the angle of torsion correctly up to the point of breakdown, but gives an incorrect picture of the stress distribution.

R. Courant: (1) On the problem of Plateau. (2) On the theory of conformal mapping.

G. A. Miller: Regular subgroups of a transitive substitution group.

Hans Lewy: Generalized integrals and differential equations.

J. W. Alexander: On the connectivity ring of a bicompact space (2).

(*To be continued.*)

Forthcoming Even

NORTH OF ENGLAND INSTITUTE OF M
CHANICAL ENGINEERS, August 29.—
Meeting to be held at Newcastle-upon

Official Publications R

Great Britain and Irela

Survey of Thunderstorms in the British Islan
storms, continuing Summer Thunderstorms. F
1934. (Vol 2, Part 1.) By S. Morris Bower and
plates (Huddersfield: Thunderstorm Census Org

The Kent Incorporated Society for Promo
Horticulture. Annual Report (Twenty-third Ye
Research Station, East Malling, Kent, 1st Ja
December 1935. (A. 19.) Pp. 242+10 plates
Members; to non-Members, 4*s*. Supplement
(Twenty-third Year). General Development a
Malling Research Station, East Malling, Kent, 1s
31st December 1935 (Miscellaneous Publication H. 2
Malling: East Malling Research Station.)

Prospectus of the University College of Wales, Abe
fifth Session, 1936–1937. Pp. 128. (Aberystwy
College of Wales.)

Other Countries

Annales de l'Institut de Physique du Globe de l'Univ
et du Bureau Central de Magnétisme Terrestre. Publiée
de Prof Ch. Mauram. Tome 14. (Pp. ii+102. (Paris: Les Press
universitaires de France.) [78

Publications of the Dominion Observatory, Ottawa. Vol. 12: Bibliography of Seismology. No. 8 (Items 2842–2941): October, November, December, 1935. By Ernest A. Hodgson. Pp. 157–178. 25 cents No 9 (Items 2942–3041): January, February, March, 1936. By Ernest A. Hodgson. Pp. 179–194 25 cents. (Ottawa: King's Printer.) [78

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 140. The Nature of the Deflection-Aileron Flutter of a Wing as revealed through its Vibrational Frequencies. By Katsutada Sezawa and Satosi Kubo Pp. 301–338+plates 4–7. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 50 sen. [108

Koninklijk Nederlandsch Meteorologisch Instituut No 102, Mededeelingen en Verhandelingen, 38. De gemiddelde hoogtewind boven De Bilt volgens loodsballonwaarnemingen. Door W. Bleeker. Pp. v+126. ('s-Gravenhage: Rijksuitgeverij.) 1.10 fl. [108

Proceedings of the First Meeting of the Crops and Soils Wing of the Board of Agriculture and Animal Husbandry in India, held at Delhi from the 25th February to the 2nd March 1935; with Appendices. Pp. v+377. (Delhi: Manager of Publications) 6 rupees; 9*s*. 9*d*. [108

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 87, 1935. Pp. iii+572+17 plates. (Philadelphia: Academy of Natural Sciences) 6 25 dollars. [108

The Indian Central Cotton Committee. Spotted Boll-Worms in South Gujarat. Pp. 24. (Bombay: Indian Central Cotton Committee.) [108

Indian Forest Records (New Series). Vol. 1, No. 3: Results obtained with a Timber Drying Kiln heated directly by Furnace Gases (Heimpel and Besler's Double Firing Generator Kiln) By Dr. S. N. Kapur Pp iii+77–92+2 plates. 10 annas, 1*s*. Vol. 2, No. 2: Standard and Commercial Volume Tables for *Dalbergia sissoo*. By M A. Kakazai. Pp iv+47–58+3 plates. 8 annas; 10*d* (Delhi: Manager of Publications.) [108

Memoirs of the India Meteorological Department. Vol 26, Part 5. Soundings of Temperature and Humidity in the Field of a Tropical Cyclone and a Discussion of its Structure. By Dr. K. R. Ramanathan. Pp. 79–92+8 plates. (Delhi: Manager of Publications.) 1.6 rupees; 2*s*. 3*d* [108

Jahresbericht der Hamburger Sternwarte in Bergedorf fur das Jahr 1935. Erstattet von dem Direktor Dr. R. Schorr. Pp 25+4 plates. Astronomische Abhandlungen der Hamburger Sternwarte in Bergedorf. Band 4, Nr. 8. Untersuchungen uber die Methode der effektiven Wellenlängen Von Marius Lobsien. Pp 201–212. (Bergedorf: Hamburger Sternwarte.) [108

U S. Treasury Department: Public Health Service. Variations in Physique and Growth of Children in Different Geographic Regions of the United States. Physical Measurement Studies, No. 2. By Carroll E. Palmer and Selwyn D. Collins. (Reprint No. 1677 from the Public Health Reports.) Pp. 13. 5 cents. Height and Weight of Children of the Depression Poor. Health and Depression Studies, No. 2 By Dr. Carroll E. Palmer (Reprint No. 1701 from the Public Health Reports.) Pp 7. 5 cents. Changes in the Incidence and Fatality of Smallpox in Recent Decades. By Dr. A W. Hedrich. (Reprint No 1738 from the Public Health Reports.) Pp 30. 5 cents. (Washington, D C.: Government Printing Office) [108

Hamburger Sternwarte in Bergedorf. Bergedorfer Eigenbewegungs-Lexikon fur die in der Bonner Durchmusterung, der Cordoba Durchmusterung und der Cape Photographic Durchmusterung, enthaltenen Sterne des nordlichen und sudlichen Himmels. 2 Ausgabe. Unter Mitwirkung von Dr W. Kruse und B Imgart Herausgegeben von Prof. Dr Richard Schorr. Band 1: Nordlicher Sternhimmel. Pp viii+410 Band 2 Sudlicher Sternhimmel Pp. viii+232. (Bergedorf: Hamburger Sternwarte) [108

The Academy of Natural Sciences of Philadelphia. Annual Review, 124th Year, 1935 Pp. 16 (Philadelphia: Academy of Natural Sciences of Philadelphia.) [118

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No. 3488 SATURDAY, SEPTEMBER 5, 1936 Vol. 138

Food Requirements in the Modern State

THE Health Committee of the League of Nations has given abundant evidence during the past few years of its interest in human nutrition. The health experts who were asked last year to formulate guiding principles for the construction of adequate human diets emphasized the importance of the provision of ample supplies of protective foods, especially dairy produce, fresh vegetables and fruit, for the purpose of securing an optimum state of nutrition. The problem of securing such supplies for the masses of the populations of modern States must involve in most instances far-reaching changes in economic and agricultural policies. A mixed committee was accordingly set up, composed of economic and agricultural experts, in addition to health experts, under the chairmanship of the Viscount Astor, to report on the whole position regarding the relation of nutrition to health, from the point of view of practical politics. The Committee has now issued the first volume of its report[*], which provides a general survey of the problem.

In the light of the established principles of nutrition, it can be shown that in no country does the whole population attain the scientifically desirable standard of physical development or resistance to disease. To remedy this serious defect, the greatest emphasis ought to be laid on the proper feeding of pregnant women and of children, for many individuals bear throughout life the stigmata of defective feeding in childhood. This would involve a campaign of education in which public health officials, practitioners of medicine, health nurses, school teachers and social workers should co-operate. Economic and agricultural policies would have to be framed by the Governments concerned, to enable the necessary food to be produced and distributed. The campaign for better nutrition should take its place as an integral part of national policy. Such a policy would require for its effective working the supervision of a central authority which would secure the co-operation of bodies engaged in nutritional research, of those engaged in popular instruction and of those responsible for directing economic and agricultural policies.

The main body of the report deals in simple language with the dietary requirements of human beings of different classes and age-groups, and gives illustrations of some of the observed effects of improper feeding on the physique and health of individuals and communities. This section is followed by chapters dealing with some of the economic and agricultural aspects of the problem of nutrition. These chapters are short, for the reason that later volumes of the report will deal more fully with these particular aspects.

In the last section of the present volume, the Committee formulates recommendations which it invites the Assembly of the League of Nations to approve, in the hope that they may be accepted by Governments and may make an immediate contribution towards the improvement of nutrition among the peoples concerned. These recommendations urge the policy of encouraging the scientific study of nutritional problems and of furthering the dissemination of knowledge so gained. International co-operation is invited to facilitate the exchange of relevant information. Governments are also urged to consider what steps might be taken to meet the nutritional requirements of those sections of their communities with the lower ranges of income, and particularly to ensure an adequate supply of safe milk for expectant and nursing mothers, infants, children and adolescents. Further recommendations include the examination of schemes to make supplies of the protective foods available at prices within the reach of all classes without prejudicing the interests of producers. If necessary, the question of the re-orientation of agricultural production, with the view of satisfying the requirements of sound nutrition, should be seriously considered.

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[*] The Problem of Nutrition. Vol. 1. Interim Report of the Mixed Committee on the Problem of Nutrition. (London: Allen and Unwin (League of Nations Publications Dept.), 1936) 2s.

Malaria and Nutrition

THE Royal Society, more than thirty-five years ago, followed up Ross's discovery of the mosquito-cycle of the malaria parasite by sending specially qualified research workers to Africa and India to study the endemiology and epidemiology of the disease and the life-history and habits of the mosquitoes which transmit it. Judged by the results of those investigations, which were published as Reports to the Malaria Committee of the Society between 1899 and 1903, the action was one of the most important steps ever taken for the advancement of knowledge of the subject. The Society has recently taken a second step which everyone will hope may have an equally important outcome. At a meeting held in July this year, the Council decided that the whole income, together with the invested income, of its Medical Research (Anonymous) Fund should be employed for a period of five years on a scheme of laboratory research on malaria to be conducted in England, and a field inquiry into malnutrition to be conducted in India. The two subjects are more closely related than may be apparent, for it has been shown repeatedly in Italy and elsewhere that measures designed to improve the nourishment and general welfare of the people have a great effect in lessening the mortality, disability, and other evils due to acute or chronic malarial infection.

The scheme as a whole is estimated to cost about £8,500 for the period mentioned, and has been worked out and arranged for in detail. The malaria programme is in two parts, of which the first is concerned with the parasites and their relationship with human, animal and insect hosts, the second with the ecology of one or more of the species of anopheline mosquitoes chiefly responsible for spreading malaria in the tropics. On both subjects an advanced type of scientific 'long-range' research by modern experimental methods is contemplated. It is believed that in the present state of knowledge this highly specialized type of work offers the best hope of improving existing methods of dealing with malaria, and it is recognized that its pursuit has been facilitated during recent years by several outstanding events such as the application of the practice of malariatherapy to the study of malaria itself, as well as for its original purpose, and the discovery that monkeys, as well as canaries and other birds, can be utilized for studying immunological and other problems. It is intended, too, to give increased attention to the chemotherapy of malaria, which has become of paramount importance since the discovery of effective synthetic anti-malarial remedies, and is a subject on which, up to the present, little has been done in Great Britain (see NATURE, Nov. 9, 1935, p. 743).

The practical object of the proposed research into the ecology of a particular species of anopheline mosquito is to improve the antimalarial method called 'species sanitation', which aims at the elimination from an area of the species that has been found to be most concerned in transmitting the disease. Success in this task would be greatly facilitated if complete knowledge were available of the biology, habits and behaviour of the insect concerned, and particularly if the physical, chemical and other factors governing its choice of breeding places, food supply, shelter and other items of behaviour were precisely known. Thanks to new methods devised by insect physiologists, these problems can now be studied experimentally in the laboratory and applied to observations made in the field.

Lieut.-Col. J. A. Sinton, I.M.S., lately director of the Malaria Survey of India, has been appointed to conduct the first part of the malaria programme, and it has been arranged that he will work in the laboratories of the Malariatherapy Centre at Horton where, in addition to the intensive study of particular problems, he will have an opportunity of continuing and extending the observations on induced malaria which it was feared might have to be given up when Colonel S. P. James retires this year.

The second part of the programme is to be commenced in the Entomological Department of the London School of Hygiene and Tropical Medicine by the appointment of a young worker with experience in modern experimental zoology. For a period of 12–18 months he will study the physiology and behaviour of the several species of anopheline mosquitoes which can be made available in England, and will then proceed to an appropriate centre in India for the special research proposed. It is understood that the London School has undertaken to meet part of the cost of this research.

Dr. Curjel Wilson has been appointed to conduct the nutritional survey in India in collaboration with Dr. Aykroyd, director of nutrition research to the Indian Research Fund Association. The survey will be concerned chiefly with the incidence of malnutrition among school children, and the dietary habits of groups of families in the districts where the children live. An important object of the investigation will be to train workers who will continue and extend the survey.

It may confidently be expected that the expenditure from its trust funds by the Royal Society which this programme involves will be fully justified by the additions it will make to our knowledge of malaria, which, despite all that has been done during the last three decades, still remains the greatest single destroyer of the human race.

Nature and Purpose of Science

The Scientist in Action:

a Scientific Study of his Methods. By Dr. William H. George. Pp. 355. (London: Williams and [illegible] Ltd., 1936.) 10*s*. 6*d*. net.

THE reviewer's first task is to state the nature of the book and the purpose of its author. Here this task is very difficult. "Action" is the key-word of the title; and on his first page, Dr. George tells us that he takes it "as basic that scientific research is a form of human action". But he has just said that "by definition speaking, writing or manipulation . . . are forms of action but thinking, believing or feeling are not." Research then, for Dr. George, is an activity in which thought and belief play no part. This is sufficiently puzzling; but it becomes more puzzling when most of the book is found to be concerned with things that are indubitably thought or believed and not *done*—laws, theories, propositions in general, and so forth.

This inconsistency pervades the book. A possible (but of course speculative) explanation is suggested by hints in the final section. It is that Dr. George started to "clarify his mind on the relation between experiment and theory, and more especially on the relation between experimental and mathematical physics"—in other words, to solve the central problem of the philosophy of science. Reading the works of his forerunners, he was repelled (as many others have been) by the folly of those to seek to interpret science as a set of formal propositions out of any relation to the scientists who produce them. He therefore rushed to the other extreme and, "to his own surprise", arrived at the conclusion that science, though "inseparable from scientists, is quite separate from philosophy". In order to understand science, all that is necessary is to study the scientist reacting, like any other organism, to its environment; his problem turned out to be purely biological.

Of course, Dr. George could not act consistently on such a belief. Mental activity is even more difficult than physical activity to describe without some preconceived scheme to which it is supposed to conform; and even if a perfectly neutral description of the mental activity of a scientist could be given, it would not explain that activity or clarify anyone's mind concerning it. For that task it is necessary to show that the activity does conform to some logical scheme that is equally valid for all kinds of thought; the ordering of different kinds of thought into a single coherent whole is not merely inseparable from philosophy; it actually is philosophy. Accordingly, Dr. George found himself alternating between his new desire to ignore all forms of activity that cannot be merely described, and his old desire to clarify his mind; his book is a queer medley of his two moods.

Dr. George's work in his old mood does not appear to me very valuable. He has made the common mistake of being so preoccupied with those at the opposite extreme of thought as to ignore altogether those who stand very near to his own point of view. Thus, he might have been expected to find Bridgman's "operational" doctrines sympathetic; he makes no reference, explicit or implicit, to Bridgman, but expresses approval of Hobson, who really agrees with him in nothing but a common dislike of transcendental metaphysics.

The book is divided into three main sections: the scientific outlook, getting scientific facts, arranging scientific facts. What Dr. George has to say on the topics to be expected under these headings is neither very original nor very profound; it is difficult to summarize, because so much of it is merely negative. Science is *not* based upon measurement; the "coincidence observations", constituting the facts on which it is based, are *not* merely temporal or spatial; the observables of quantum theory are *not* what is actually observed; mathematical probability is *not* a measure of rational belief. But the positive assertions that might be expected to supplement these negations are lacking; after the last of them "the reader is left to decide" what, if any, is the connexion between probability and belief—surely a matter vital to any understanding of science!

In his new mood, however, Dr. George is a very different person. His description of scientific activities is always accurate and, though there are many commonplaces, often acute. He does not, of course, profess to instruct researchers in their art, but few of them could read the book without gaining some useful hints; at any rate they will be soothed and entertained by finding all their instinctive prejudices set forth so sympathetically.

However—this may possibly shock Dr. George—the persons who will gain most from his work are precisely the philosophers whom he treats with such contempt. For many of them accept fully Dr. George's main thesis that science is incomprehensible apart from scientists. But they find it difficult to discover how scientists really think. Lack of technical knowledge forbids them to study the original literature of science; while those distinguished men who undertake to explain science to the unlearned are notoriously untypical; indeed their success as popularizers is largely due to their sympathy with views that most scientists reject emphatically. Their difficulty is now completely solved. Dr. George is a thoroughly typical scientist—typical, not of all scientists (that is impossible, because scientists differ), but of those to whose mental idiosyncrasy the distinctive character of science is due; and he has been marvellously successful in portraying their method of thought.

Accordingly, if anyone in the future writes about the nature and purpose of science, meaning thereby that which scientists produce, without careful study of Dr. George's book, he will be wasting his own and his reader's time. But of course he will find himself in a difficulty. For what distinguishes the true scientist is a hatred of abstract thought and of the shackles of logic. The discovery of an intellectual difficulty delights the philosopher; it makes Dr. George and the rest of us go all hot and bothered. If this dislike of logical precision is a necessary element of the scientific outlook, there can be no philosophy of science; if a scientist who was willing and able to untie the intellectual knots in which he is constantly entangling himself, would thereby [illegible] be a scientist, then there can be no place fo[illegible] in any scheme of ordered thought. If, on the other hand, this attitude is unnecessary and inessential, if science is really subject to a logic which alone can make it intelligible, how do scientists manage to produce science? The great merit of Dr. George's book lies in its raising this problem so clearly; it is for others to solve it.

NORMAN R. CAMPBELL.

The People of Pitcairn Island

The Heritage of the Bounty:
the Story of Pitcairn through Six Generations. By Harry L. Shapiro. Pp. xv + 330 + 8 plates. (New York: Simon and Schuster, Inc.; London: Victor Gollancz, Ltd., 1936.) 3 dollars; 10*s.* 6*d.* net.

PERENNIAL interest in the story of Bligh and the mutineers of the *Bounty* has been enhanced recently by the cinematograph; but Dr. Shapiro, though fully alive to the drama of the story, of which he recalls the main outlines, is more immediately concerned with the opportunity afforded science by the consequences of this tragedy of the sea. While still *in statu pupillari*, he was inspired by Prof. E. A. Hooton of Harvard with an overwhelming urge to biological and sociological investigation among the descendants of the mutineers and Tahitian women living on Pitcairn Island. He had to wait twelve years before his desire was satisfied. Although he visited Norfolk Island in 1923, and spent five months examining the Pitcairn Islanders and their descendants who had been transported there in 1856 —the results were published in 1929—it was not until 1934 that he was able to land on Pitcairn.

Pitcairn Island, it will be realized, offers exceptional opportunity for the study of miscegenation and the effects of culture contact. The islanders are the descendants of six mutineers and thirteen Tahitian women. The six Tahitian males left no offspring. Although the descendants of the migrants to Norfolk Island are the more numerous, conditions on Pitcairn are more favourable to scientific investigation, as the accessions of new blood there have been few and are known—eight Europeans and one Polynesian female. The records of birth, marriage and death have been kept with care, while genealogical data are remembered with pride—and no less well remembered when calling for a veil of reticence. Another advantage from the point of view of the observer is that the material is entirely unaffected by the social disabilities which usually depress the products of racial crossing elsewhere and vitiate observation.

It is a remarkable fact, perhaps the most striking fact in the vital statistics of the island, that the increase in population has been extraordinarily rapid. In one hundred and forty-five years from the original matings, the living descendants of the mutineers now pass the eight hundred mark. There are more than six hundred living on Norfolk Island and some two hundred on Pitcairn; and if absentees were taken into account, the figure might well fall not far short of a thousand. The [redacted]erations seem to have been extraordinarily A calculation by Dr. Shapiro gives in his group of women, listed according to years in the period 1815–39, an average family of 11·2. It was owing to this rapid increase in numbers, which threatened over-population, that the Pitcairn Islanders were transported to Norfolk Island in 1856. Of those transported, forty-two had returned to Pitcairn by 1864; and from them the present population is descended. The continued rapid increase in numbers during the last seventy years is thought by the islanders again to threaten over-population; but Dr. Shapiro is of the opinion that the danger is not imminent. His analysis shows that the rate of increase is falling with a falling birth-rate.

Although inbreeding naturally is intense, no ill effect is perceptible, except possibly deterioration in the teeth. It may be responsible for a degree of homogeneity in physical character unusual in such a population of mixed origin.

The evidence of cross strains in physical character is interesting. The two stocks were markedly differentiated, and the strains on both sides certainly not inferior. The English probably were picked men. While the men of the present day incline to favour their European ancestry, as, for example, in the tendency to a lighter coloured eye, the women favour the Tahitian. In them the dominant in eye colour is brown. In skin colour there is an overlap with both English and Tahitian. While none is as dark as the darker Tahitian, few individuals are as fair as the fairest English. In stature the men are taller than either the Tahitian or their European ancestors, of whom the height is recorded at the Admiralty. The head-length is almost identical with that of the Tahitian, being less than that of the English head; but in breadth they follow the English measurement and are narrower than the Tahitian. The cephalic index is intermediate between the two. It is interesting to note that the characteristic disproportion between the frontal diameter and broad face found in the Tahitian appears also in Pitcairn, although the facial breadth is low as in the English. Consequently in the Pitcairn islander the frontal diameter is lower than in the Tahitian, and still more so than in the European.

Dr. Shapiro sums up his results as showing that in their heredity the Pitcairn Islanders bear testimony to both their English and their Tahitian ancestry; and while some are more influenced by the Tahitian strain, some by the English, others appear to be intermediate. Each one is a varying mixture of characters, of which some follow the Tahitian, others the English character. On the whole, the features of the islanders are definitely English. This preponderance is only natural, the author concludes, as all new additions to the colony have been of English stock. Fortunately, the researches in the Pitcairn records made by Dr. Shapiro, which are here embodied with material from outside sources in a history of the islanders from the time of the first settlement, enable all such additions to the original strains to be traced and checked.

It is interesting to note that the author is decidedly of the opinion that the results of his investigation support the view that an early result of miscegenation is an increase of vigour transcending that of either of the original stocks.

Dr. Shapiro has recorded a number of phrases of the Pitcairn language, which he regards as a hybrid dialect. His evidence scarcely bears this out; and a closer knowledge of colloquial English tradition might have convinced him that it does not attain even the dignity of a dialect. It seems to be a mispronounced and degenerate English with a few Tahitian words and mannerisms.

The present-day culture is a blend which shows evidences of development, when compared with that recorded by early visitors to the island. The absence of European materials and appliances in the beginning naturally has affected the balance between English and Tahitian.

Dr. Shapiro is to be congratulated on the opportunity for this first scientific study of unique material, and on the use of it which he has made.

Some British Cœlomycetes

British Stem- and Leaf-Fungi (Coelomycetes): a Contribution to our Knowledge of the Fungi Imperfecti belonging to the Sphaeropsidales and the Melanconiales. By W. B. Grove. Vol. 1: Sphaeropsidales, to the end of the Sphaerioideae which have Colourless or nearly Colourless Spores. Pp. xx+488. (Cambridge: At the University Press, 1935.) 21*s*. net.

IN this handbook, Mr. Grove monographs the recorded British species of this most obscure group of the fungi, a task that has not been attempted in Great Britain since 1871. His Cœlomycetes comprise the Sphaeropsidales and Melanconiales sections of the Fungi Imperfecti, most, if not nearly all, of which are no doubt Ascomycetes classified in their imperfect as opposed to their perfect condition.

The modern systematic mycology of this group really dates from vol. 3 of Saccardo's "Sylloge Fungorum", which appeared in 1884. It is perhaps impossible for us at this date to envisage the state of affairs before Saccardo collected together all the recorded nominal species and put them upon his mycological map, but we may properly recall the cheer with which Mr. Grove greeted the appearance of this volume. In the *Midland Naturalist*, 9, 127 (1886), he tells us how, as about to vault a fence, he observed myriads of black specks on the bark of the top pole; how he deduced in the field that the pole must be mountain ash; how at home the black specks resolved themselves into the pycnidia of *Rhabdospora* as judged by their spores and habitat; and how he turned "to that monument of Herculean labour, the Sylloge Fungorum omnium of Professor Saccardo . . . who stands head and shoulders above all the other mycologists of the age". *Rhabdospora inaequalis*, Sacc., it was, for it agreed in the characteristic pycnidia, the spores and the habitat, and as further evidence there was Saccardo's excellent representation. "Now my task is smoothly done. No link in the chain is wanting. We have determined our fungus with a degree of certainty that cannot always be attained, and are still further rewarded by finding that it is a species new to Britain".

Some forty-eight years have passed, and Mr. Grove presents us with the first half of his monograph of British Cœlomycetes; and—as a monograph must of course—it contains numerous species that cannot be determined with the same certainty that marked the recognition of *Rhabdospora inaequalis*. In Cooke's "Handbook", two hundred species were recorded as British; in this and the second volume which is shortly to follow, more than two thousand nominal species are listed. All the included species have been examined microscopically unless the contrary is specified, the material, on which this work is based, being represented by the collections at Kew and the British Museum, and by more than three thousand collections in the author's private herbarium. At long last, we have a good general idea of what has been found in Great Britain, together with what a most experienced naturalist has made of it.

Mycology is a term that is now held to cover many pursuits, but, broadly speaking, fungi can be studied in the field, in herbaria, in laboratories and in books. The work under notice is the result of some fifty years' ardent collecting and examining at home, checking determinations with authentic material, and a wide knowledge of the systematic literature. The laboratory side of the science, which has developed so strongly of late—especially since the Great War—is left to others.

Saccardo's ground plan, laid down in vol [illegible] "Sylloge", is accepted absolutely, the most [illegible]ant change following on the general recog[illegible] the genus *Phomopsis*, to which a large nu[illegible] nominal species have in recent years bee[illegible]ferred. It does not appear that any othe[illegible] was open to anyone who intended to pr[illegible] orderly account of British Cœlomycetes, and surely it is high time that such an account should be presented. This classification—and it is the only one yet devised—is largely a habitat classification; that is to say, Cœlomycetes which fruit on leaves are apt to find themselves in another genus from those that fruit on stems; pycnidia formed on the surface of wood are not normally classified in the same genus as those that develop just beneath the periderm. As is well known, fungi in pure culture are apt to present little resemblance to their appearance in their natural habitat—the appearance under which they have been discerned, collected, described, classified and preserved in herbaria. It is, therefore, much safer to attempt the identification of a Cœlomycete, in the first instance, before, rather than after, isolation. If this elementary precaution is not taken, there is no known method of ensuring that any systematic data that may be acquired will be comparable to the data preserved in the existing diagnoses of fungi. Such, at any rate, is Mr. Grove's message to the culture men, whom, after a characteristic implement of their craft, he dubs the "petri-petallists".

Together with the ground plan, the author accepts Saccardo's usage of generic names, and will have no nomenclatorial grit thrown into the works, especially by the new type species method of fixing genera (he gives no type species for the genera). As examples, see his citation of the genus *Phoma*, and his inclusion of *Hendersonia elegans* Berk., the type species of *Hendersonia*, in the genus *Stagonospora*, with a footnote that it will probably prove to be neither a *Hendersonia* nor a *Stagonospora*.

As with genera, so with the view of specific values, current for so many years after the appearance of the "Sylloge", but in this case with a note of hesitation. "Generally, in these pages, the host will be made the supreme test" but "in the genera *Cytospora*, *Phomopsis*, *Septoria* and the like, the list of presumed species cannot be considered as anything but an interim catalogue of the known and described forms". It is probably on this question of specific distinction that systematically directed culture work could be of the most immediate use to a study of the Cœlomycetes. For example, a *Phomopsis* is usually, if not always, the pycnidial condition of a species of the ascomycete genus *Diaporthe*. Mr. Grove lists about 158 nominal British species of *Phomopsis*. In a recent world monograph of *Diaporthe*, Wehmeyer has suggested that the type species, *D. eres*, which was first described on *Ulmus*, really occurs upon nearly all woody plants, and has (ominously enough) acquired about 160 synonyms. The question as to the number of good British species of *Phomopsis* is obviously open for research by anyone who cares to collect, determine and isolate these common and easily grown fungi. Pending any such study, Mr. Grove will probably agree that we are still very much in the position so graphically described by Saccardo, when he was roughing out the classification of the Fungi Imperfecti. "Et in Mycologia fere omnes tyrones sumus."

The citation of literature is terse. The standard floras appear as "All.", "Died." and "Mig.". B. & Br. stands for Berkeley and Broome and B. & V. for Berlese and Voglino. The original place of publication is often not given, especially with Saccardo's own species which later became incorporated in the "Sylloge", vol. 3. The author has been misled into thinking that the dates on the title pages give the correct dates of many species that were founded by Allescher and Diedicke. These, however, are points of nomenclatorial compilation, and the interest of the book is wholly taxonomic; it has, in fact, quite clearly grown out of a lifetime's comparison of the British flora with the diagnoses in a well-thumbed and well-loved copy of vol. 3 of the "Sylloge".

In common with all the foundation mycological books of any country, the present volume has required of its author a knowledge of our local phanerogams in bud, in leaf, in flower, in fruit and in decay—especially in decay. It appears to me that it will be welcomed by all British botanists who believe that the plants themselves, and the fungi themselves, are the thing. It is a milestone in our slow—our very slow—advance in the study of the microfungi. It may happily help to dispossess the commonly copied figures of a few fungi of their predominating influence on the young idea. It may even serve to distract attention from hypothesis and speculation and direct it rather to the original source of mycology itself—the yearly pageant of our woods and fields.

E. W. MASON.

Crustacea:

Anomura, Macrura, Euphausiacea, Isopoda, Amphipoda and Echinodermata: Asteroidea and Echinoidea. By Lee Boone. (Bulletin of the Vanderbilt Marine Museum. Volume 6: Scientific Results of the World Cruise of the Yacht *Alva*, 1931, William K. Vanderbilt commanding.) Pp. 264+96 plates. (Huntington, L.I., N.Y.: Vanderbilt Marine Museum, 1935.)

THE present volume relating to Crustacea and Echinodermata collected by Mr. Vanderbilt and deposited in his museum is full of interesting material. Careful descriptions and good figures are given of every form described. The larger crustaceans are already known, but much new matter is added, and among the Caridea there are many new species. These last were mostly taken in coral and include a *Leptochela*, an *Athanas*, *Alpheus* spp., a *Coralliocaris*, a *Thor* and a *Pontophilus*, besides a pontoniid which the author has referred to a new genus which she has named *Vanderbiltia*. Besides all these new species, many little-known forms are redescribed. There are also two new species of *Euphausia*. Some isopods and amphipods are included.

Among the most striking of the Caridea is the pontoniid *Conchodytes biunguiculatus* Paulson, which was found inhabiting the pearl oyster *Meleagrina* sp. Its peculiarly modified hind legs (pereiopods 3–5) end in large hook-like claws, presumably for clinging to its host, and the abdominal terga of the female are very broad, forming a brood pouch, which holds 75–100 young.

The echinoderms must be magnificent, judging from the exquisite photographs, especially the sea-urchins.

Molekülspektren und ihre Anwendung auf chemische Probleme

Von Prof. Dr. H. Sponer. 1: Tabellen. Pp. vi+154. 17.60 gold marks. Teil 2: Text. Pp. xii+506. 37.80 gold marks. (Struktur und Eigenschaften der Materie, Bd. 15, 16.) (Berlin: Julius Springer, 1935–36.)

THERE is a good deal to be said in favour of the manner in which Prof. Sponer has arranged the material which he discusses in these two books. The first is really an appendix or collection of results for use in conjunction with the description of the applications of band spectra to chemical problems in part 2, and consists of a series of tables of the terms of spectra emitted by polyatomic molecules. Similar tables were, of course, given in Jevons's "Report on Band Spectra" for diatomic molecules, but the Sponer collection for more complicated molecular systems is new, and the data for diatomic molecules have been brought up to date. While it appears unlikely that the descriptive matter in the five hundred page Part 2 will soon need serious revision, it should be a relatively easy matter to add fresh results in a new edition of the one hundred and fifty page Part 1.

Part 2 is intended to assist experimenters, and there is little attempt at serious mathematical treatment of the subject. It opens with a brief, but good, introduction to the older quantum theory of spectra and to the new quantum mechanics, and continues with an excellent survey of the several types of band spectra and their peculiarities. The main interest lies in the examination of the methods and results of band spectra measurement and the chemical and physical data which can be obtained from them, and in the discussion of their importance in problems of chemical combination and valency. Considerable attention is paid to the methods by which molecular spectra are excited and to photo-chemical reactions. The book is bound to appeal considerably to chemists and to physicists who are interested in the applications of band spectra.

Destiny and Disease in Mental Disorders:

with Special Reference to the Schizophrenic Psychoses. By Prof. C. Macfie Campbell. (Thomas W. Salmon Memorial Lectures.) Pp. 207. (London: Chapman and Hall, Ltd., 1935.) 10*s.* 6*d.* net.

PROF. MACFIE CAMPBELL, who is professor of psychiatry at Harvard University, gives us a very readable account of personalities struggling against the difficulties of their environment, particularly with reference to the schizophrenic psychoses, which are a particular type developing in early adult life. This comes as quite a relief when contrasted with lengthy dissertations on infected bowels and sinuses. We feel on reading all these books on mental disorder that the problem in many ways has not even yet been stated, far less grappled with. There are so many factors involved, and we know so little. The writer, however, points out the importance of the environment and its manifold reaction on personalities, many of which we feel were already psychopathic in build.

Insect Enemies of Shade-Trees

By Prof. Glenn W. Herrick. Pp. x+417. (Ithaca, N.Y.: Comstock Publishing Co., Inc., 1935.) 5 dollars.

THE name of Prof. G. W. Herrick, of Cornell University, as a guarantee for a sound, trustworthy textbook is fully substantiated in the present volume. It brings together much scattered information regarding the insect pests of shade trees east of the Rocky Mountains and most of those on the Pacific coast. The economic values of each species of tree are discussed and the most effective control measures against their chief enemies are dealt with. For the most part, each species of tree, with its insect invaders, forms the subject of a separate chapter while, at the end of the book, pests of the smaller trees and shrubs, and some miscellaneous enemies, are dealt with collectively. In so far as certain of the species of insects mentioned are of European origin, the book will interest English readers, while the control measures advised are often applicable on this side of the Atlantic Ocean. The book is admirably printed with 331 clear text figures, which are mostly original. Considering the excellence of its general 'get up', the book is reasonably priced at five dollars.

Hydrostatics:

a Text-Book for the use of First Year Students at the Universities and for the Higher Divisions in Schools. By A. S. Ramsey. Pp. viii+169. (Cambridge: At the University Press, 1936.) 7*s.* 6*d.*

THIS volume has been specially prepared for the use of first year students in universities and for pupils reading for scholarships in the higher divisions of schools. It is thus a companion volume to the author's books on dynamics and statics, which have been published in recent years. The course well covers the academic requirements in the subject, and includes some simple applications of the metacentre, together with a brief discussion on capillarity. A working knowledge of the calculus is assumed, and there are numerous exercises provided for the student, many of which are taken from Cambridge examination papers. Answers to these are given where necessary. The text is illustrated with clearly drawn diagrams and elegantly worked-out examples. The book is admirably suited to its purpose.

Outlines of General Psychopathology

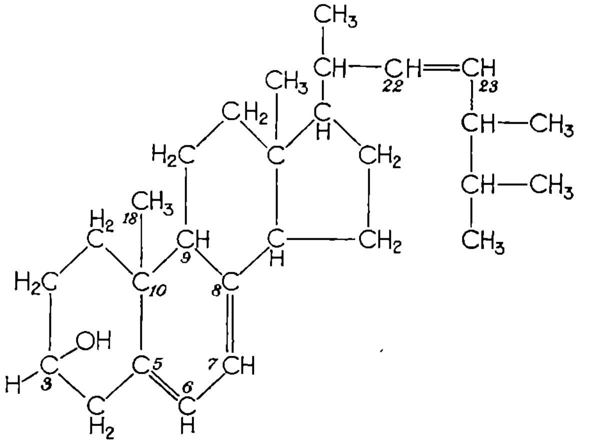
By Prof. William Malamud. Pp. xiv+462. (London: Chapman and Hall, Ltd., 1935.) 21*s.* net.

PROF. W. MALAMUD, who is professor of psychiatry in the State University of Iowa, gives a very readable and useful account of the principles of general psychopathology. We wish, however, that he had enlarged somewhat on the physiological concomitants: action currents, particularly the Berger rhythm, chronaxie, and the psychogalvanic reflex are all subjects about which the reader will want to know more than the author gives us—a mere page for the three.

The chapter on the psychopathological disturbances of sleep is very well done.

Chemistry of Calciferol and Vitamin D_3

CALCIFEROL (Windaus's vitamin D_2) and ergosterol have, according to the view accepted to-day, the formulæ shown in II and I below, respectively.



I

The important common features of the two molecules are:

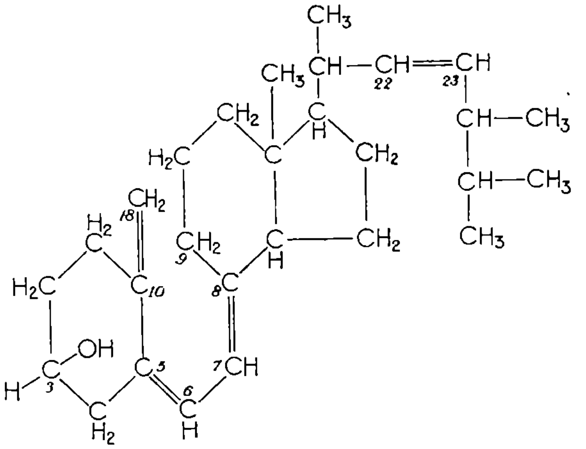
(*a*) The possession of two conjugated double [illegible]nds at $C_5{=}C_6$ and $C_7{=}C_8$.

(*b*) The possession of a hydrocarbon chain containing a double bond at $C_{22}{=}C_{23}$.

The two substances differ in one fundamental respect, namely, the fracture of ring *B* between carbon atoms 10 and 9 and the replacement of the methyl group containing carbon atom 18 by a methylene group, with the consequent introduction of a third conjugated double bond between carbon atoms 10 and 18. It is also possible, indeed probable, that the hydroxyl group at carbon atom 3, which is present in ergosterol—and in all other naturally occurring sterols—in the *trans* position (making the sterols members of the cholestanol series), occupies the *cis* (*epi*) position in calciferol. The point seems not yet to be settled.

A series of papers just published by Windaus and his Göttingen colleagues* is another landmark in vitamin chemistry. They report the logical conclusion, or almost the conclusion, of investigations that have been conducted at Göttingen during the past four or five years.

For some time it has been believed, on the basis of differential biological experiments with two species of animals, that the vitamin D of cod-liver oil is not calciferol. (Bills goes further and maintains that at least *two* separate antirachitic substances occur in fish-liver oils, in different proportions according to the species of fish.) Attempts to isolate this substance have so far been unsuccessful, though claims for a very high degree



II

of concentration have been made, notably by Rygh and by Ender.

A crystalline 3,5 dinitrobenzoate of this vitamin, and a colourless non-crystalline preparation of the hydrolytic product from the ester, have now been prepared by Brockmann. The source was tunny-liver oil. The activity of the liquid vitamin is stated to be 25 × 10^6 I.U. per gram, but it is not inconceivable that traces of impurity may be responsible for its failure to crystallize, and the pure compound may prove to be more active. The absorption spectrum is very similar to that of calciferol, thus disproving Ender's claims for concentration, since his product showed no bands in the ultra-violet. Brockmann argues that Ender's claims must have been overstated by 900 per cent! In other words, that his preparation cannot have contained as much as 10 per cent of the vitamin and cannot have had more than one tenth of the biological activity claimed by him.

The constitution of this vitamin, for which Brockmann proposes the symbol D_3, would not be known but for the brilliant parallel investigations of Windaus, Schenck and Werder, whose results are published alongside Brockmann's. It is now rather more than a year since Windaus, Lettré and Schenck announced the preparation of 7-dehydro-cholesterol ($\Delta^{5,6;\,7,8}$ cholestadien-3-ol) and stated that it could be made antirachitic by irradiation. They have now isolated the crystalline 3,5 dinitrobenzoate of the active irradiation product, as well as its colourless non-crystalline hydrolytic product. Both appear to be in every respect identical with the corresponding substances prepared from tunny-liver oil. It would therefore seem almost beyond doubt that, since 7-dehydro-cholesterol has formula III, the tunny-liver vitamin must be constituted as shown in IV.

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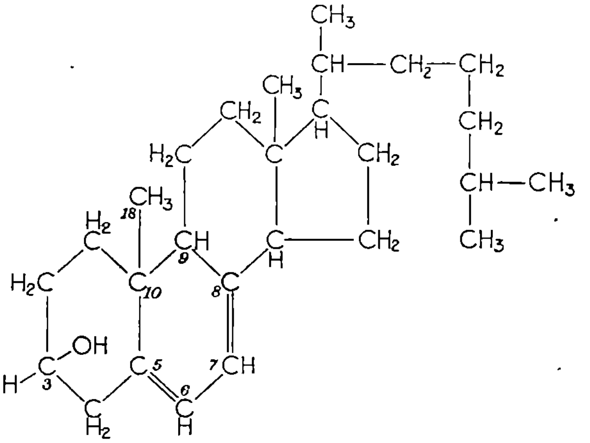
* *Hoppe-Seyler's Zeitschrift für physiologische Chemie*, **241**, 100, 104, 116, 125, 129 (1936).



III

If this formula correctly represents the constitution of vitamin D_3, it differs from calciferol only in the absence of the double bond at the side-chain position $C_{22}=C_{23}$, and the replacement of the terminal side-chain group $—CH(CH_3)—CH(CH_3)_2$ in calciferol by $—CH_2—CH(CH_3)_2$ in vitamin D_3. The physiological differences between the two vitamins must be determined by the differences in the two side-chains which are shown here alongside.

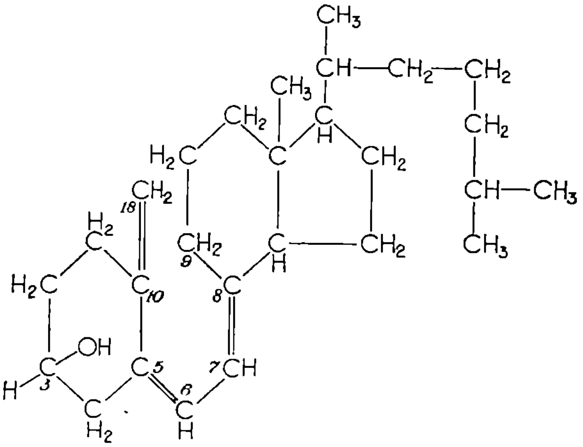
$—CH(CH_3)—CH=CH—CH(CH_3)—CH(CH_3)_2$
Calciferol

$—CH(CH_3)—CH_2—CH_2—CH_2—CH(CH_3)_2$
Vitamin D_3

This is in itself a quite remarkable finding, but it becomes a mystery when we consider two further investigations reported simultaneously with those summarized above. Wünderlich has prepared 7-dehydrositosterol and irradiated it. The crude irradiation product appears to have only about one fortieth of the antirachitic potency found in irradiated ergosterol, produced presumably under identical conditions. It is not, however, legitimate to argue that the isolated vitamin will have one fortieth the activity of calciferol, since the relative amounts in the two crude irradiation products may be different. If, however, the general course of the photochemical changes is identical, then the vitamin from dehydrositosterol must differ from calciferol and vitamin D_3 only in the structure of the side-chain, which is

$—CH(CH_3)—CH_2—CH_2—CH(C_2H_5)—CH(CH_3)_2$
(Sitosterol)

There is, in fact, a replacement by an ethyl group of one hydrogen atom on carbon atom C_{24} in the side-chain of cholesterol. From the above data it would appear as if the $C_{22}=C_{23}$ double bond in calciferol were responsible for its exceptionally potent effect on rachitic rats, compared with that on chickens, and this is borne out by the fact that the irradiation product of 22-dihydroergosterol has been reported by Windaus and Langer as having only one thirtieth the activity of irradiated ergosterol. Here again, however, it must be emphasized that crude irradiation products, not distin[illegible] crystalline compounds, were being compared. The low activity of irradiated 7-dehydrositosterol may, therefore, be due either to the absence of the $C_{22}=C_{23}$ double bond, or to the extra carbon atoms in the side-chain, or to both.



IV

The greatest puzzle, however, arises from a study of 7-dehydrostigmasterol, prepared and irradiated by Linsert. The side-chain of stigmasterol, and therefore presumably of 7-dehydrostigmasterol and its active irradiation product, is

$—CH(CH_3)—CH=CH—CH(C_2H_5)—CH(CH_3)_2$
(Stigmasterol)

Here we have the $C_{22}=C_{23}$ double bond associated with the activity of calciferol, and the simple replacement of the ergosterol methyl group at C_{24} by an ethyl group. According to Linsert, the irradiation product of 7-dehydrostigmasterol is "überraschenderweise" nearly or entirely without any antirachitic action! Yet it is chemically, to all appearances, much more akin to calciferol than any of the other products discussed in this article. Moreover, if 22-dihydroergosterol gives an irradiation product that is very active, though markedly less so than ergosterol, it is inexplicable that 22-dihydro-7-dehydrostigmasterol, which is in fact 7-dehydrositosterol, should give a *more* antirachitic irradiation product than the stigmasterol derivative.

The facts relating the side-chain constitution to the antirachitic properties of their irradiation product can be summarized thus:

Sterol	Carbon atoms in side chain	Double bond in side chain	Antirachitic potency
Dehydrocholesterol	8	0	++++
Ergosterol	9	1	++++
Dihydroergosterol	9	0	+++
Dehydrostigmasterol	10	1	?
Dihydrodehydrostigmasterol (Dehydrositosterol)	10	0	+

It has been suggested by Schoenheimer that the number of carbon atoms in the side-chain has a profound effect on the absorbability of sterols. If this be so, and if it apply also to the irradiation products, the explanation of the facts cited may be found along these lines. Difficulty in accepting such an explanation, however, arises from the fact that ergosterol shows, like sitosterol and other plant sterols, poor absorbability, while cholesterol is very well absorbed, yet the irradiation product of ergosterol is apparently absorbed as easily as that of dehydrocholesterol.

The various papers here summarized are supplemented in the same journal by a very interesting account, from Brockmann and Chen, of an antimony trichloride colour-test for both vitamin D_3 and calciferol. The authors claim a considerable degree of specificity for the test, and it will doubtless be eagerly tried by many workers in this field.

A. L. BACHARACH.

British Regional Geology

IN the new Museum of the Geological Survey at South Kensington the exhibition of British geology has been arranged on the basis of a division of the country into eighteen districts, each of which forms a geological and geographical province of distinctive type. To each region a separate division of the main floor or first gallery has been assigned, and in order to render the exhibits more intelligible descriptive handbooks have been prepared to serve as guides. These handbooks, issued under the general title of "British Regional Geology", also serve as compendious summaries of local geology. Eleven have already been published and these are briefly noticed below.

The Survey is to be warmly congratulated on the success of this important new enterprise. Each handbook is beautifully illustrated with maps, diagrams and plates, and the descriptive matter adequately provides all the necessary detail for a general comprehension of the area concerned. The complete series will constitute the most authoritative and attractive account of British geology as a whole which has ever appeared; one, indeed, that will be indispensable to students for purposes of general study. The individual numbers, issued at the remarkably low price of 1*s.* 6*d.* each, serve as welcome introductions to the more specialized sheet memoirs, and also as guides to tourists and others who wish to appreciate the interest and significance of the geological features of any British district.

"London and Thames Valley"[1] embraces a region from Oxfordshire and north Wilts to Essex and north Kent. It thus comprises beds ranging in age from Lias to Pleistocene and Recent, the main features being the Chalk escarpment of the Chiltern Hills and its continuation west of the Goring Gap, and the middle of the London Basin. Palæozoic formations are known from numerous borings, most of the rocks bearing a general resemblance to those of the Welsh Borders. As in most of the other handbooks of the series, an excellent list of maps and memoirs and a selected bibliography of other publications dealing with the district are appended.

The handbook on "The Wealden District"[2] covers the area to the south of the above and is probably one of the most familiar geological regions in the world. The Weald proper is continued across the Straits of Dover into the Bas Boulonnais. Beds of many ages are concealed beneath the covering of surface rocks, and at the eastern end of the Weald every system of older stratified rocks from the Silurian upwards is represented, although the complete sequence recognized has not been found in any one boring. A very clear diagrammatic section is given showing the active collieries and working seams of the Kent Coalfield. Water, however, is fundamentally the most important of the economic resources of the Wealden District, since practically all that is used is derived from underground sources.

"Bristol and Gloucester District"[3] extends from the Forest of Dean across the Severn to the Cotteswold and Mendip Hills. Geologically speaking, it is one of the most varied districts of Britain, for, with the exception of the Ordovician and possibly the Permian, there is exposed at the surface every geological formation from the Cambrian to the Cretaceous. Scenically, some of the most striking features, including caverns, gorges and bare rocky crags and uplands, are developed from the Carboniferous Limestone. On the west, limestones again dominate the scenery, the Inferior and Great Oolites forming the mural scarp of the Cotteswolds. These great limestone formations have attracted many famous geologists, the names of Arthur Vaughan and S. S. Buckman being pre-eminent as a result of their classic work on zoning. Tectonically, the synclinal areas of the Bristol, Somerset and Forest of Dean Coalfields and the echeloned periclines of the Mendips are of special interest.

"South-West England"[4] is a region of high moorlands, including the Devonian rocks of Exmoor and the Quantocks, and the granite masses from Dartmoor to Land's End and the Scilly Isles. At the base of the geological sequence lie the Pre-Cambrian rocks of the Lizard and Start Point. In 1834, De la Beche had already produced a geological map of Devon which led to his appointment as the first Director of the newly established Survey. Since then the region has been famous not only for the pioneer investigations of its mineral wealth, but also for the many contributions it has stimulated to our knowledge of petrology generally, culminating in the work of Teall, Flett, Dewey, and, still more recently, of Brammall and his school of co-workers. This handbook is itself a most valuable introduction to a great variety of petrological problems and there is, moreover, a most interesting section on mines and mining.

The handbook entitled "The Welsh Borderland"[5] covers a region from Shrewsbury to south of Monmouth. It includes such geologically classic areas as the Wrekin, the Longmynd and the Malverns, where some of the most ancient rocks of England and Wales appear boldly at the surface; the Stiperstones and Shelve country and the Breidden Hills, where Ordovician rocks are magnificently displayed; and Wenlock Edge, famous in the sequence of the Silurian System which was first established by Murchison in 1835 as a result of his work in the Welsh Borderland. Much of the modern research in the region was initiated by Lapworth and Watts, whose stimulating example has been vigorously followed by a host of colleagues and former students. Indeed, many geologists have received their field-training in this area, which is unrivalled for the great variety and interest of its formations, many of which, moreover, are highly fossiliferous. The present handbook provides an invaluable guide to the classes who annually visit Shropshire and the country about the Malverns for instruction in field-geology.

Another classical region in the history of geology is dealt with in "North Wales"[6]. Here Sedgwick set himself the task of disentangling the structure of the rugged mountain district of Snowdonia and Lleyn, and here he founded the Cambrian System. Since then North Wales has attracted to its study an ever-growing band of stratigraphers, palæontologists and petrologists. The region is essentially characterized by Lower Palæozoic rocks, displaying one of the finest sequences of Cambrian, Ordovician and Silurian strata to be found in Europe; showing by deep-seated erosion the cores of ancient volcanoes; and revealing in its crumpled, folded, cleaved and fractured sediments the record of several periods of major earth-movements. Of the remaining systems, the underlying Pre-Cambrian is well represented in Anglesey, while the Carboniferous and New Red Sandstone cover fairly extensive tracts on the borders. Like the foregoing, this handbook will be in great demand by students attending geological field-courses.

"The Pennines and Adjacent Areas"[7] include the Fell country from Stainmore Pass to the Craven district, consisting mainly of Carboniferous Limestone; the Central Pennines between Skipton and the Peak, largely formed of the Millstone Grits (and shales); the Derbyshire Hills of Carboniferous Limestone; the Lancashire and North Staffordshire Coalfield on the west; and, on the east, the coalfield of York, Derby and Nottingham which, in potential resources, is the most important in Britain. The great diversity of geological and physical features is accompanied by an even greater variety of economic interest and by a corresponding inequality in the distribution of population. The oldest rocks in the region—apart from the supposed Pre-Cambrian of Ingleton—are the Lower Palæozoic formations exposed in the valleys below Ingleborough and in the Howgill Fells. The interest of the coalfields needs no stressing, but geologists will particularly appreciate the useful summary of the structure of the region and the excellent account of the Pleistocene glaciation.

Northumberland, Durham, the Lake District and the Isle of Man are dealt with in "Northern England"[8]. The Northern Pennines continue to the Border and separate a great coalfield on the east from the most attractive scenic area of England, an area which is itself fringed with coal and iron fields. The formations range from the Ordovician to the Jurassic and include a long history of igneous activity, the products of which are responsible for the rugged hills of Borrowdale; the worn-down volcano of the Cheviots; the well-known granites and Carrock Fell complex of the Lake District; the Great Whin Sill, surmounted for a considerable length of its outcrop by the Roman Wall; and a swarm of dykes which has been traced across Scotland to the Tertiary volcano of Mull. Along the Durham coast, the Magnesian Limestone of the Permian System constitutes one of the most puzzling formations—lithologically and structurally—to be found anywhere in the world. The results of much recent work in the Lake District have been incorporated in the handbook, but in a future revision more attention might be given to the North Pennine ore-deposits and to the Tertiary dykes, or at least to the desirability of including bibliographical references to these subjects of recent research.

"The South of Scotland"[9] is devoted to the region between the Cheviots and Solway Firth on one hand, and the faulted southern margin of the Midland Valley on the other. Here some of the fundamental principles of geology were established by Hutton and recorded in his "Theory of the Earth" (1795). It was in the Southern Uplands, too, that Lapworth began the far-reaching studies in which he demonstrated the value of graptolites as aids in working out the complicated succession and structure of a highly folded region. The area is mainly occupied by Ordovician and Silurian strata folded in part after the Arenig and, as a whole, at the close of the Silurian. The intrusions of serpentine and other plutonic rocks which have usually been regarded as pre-Glenkiln are considered by Dr. Pringle to be part of the Pre-Cambrian floor on which the Arenig strata were deposited. Small areas of Old Red Sandstone, Carboniferous and New Red Sandstone occur, with abundant illustrations of igneous activity in the great granite complexes of Galloway and the volcanic rocks and necks of Lower Carboniferous age. This handbook, like the one that follows, has a selected bibliography after each section, in some respects a preferable arrangement to placing the whole at the end. The map of the region, showing many localities of geological interest not easily found on detailed maps, is particularly clear.

"The Grampian Highlands"[10] embraces the region between the Highland Boundary Fault and the Great Glen Fault. It excludes Arran, but is extended to take in Colonsay. The two fault lines represent great dislocations along which movements are still taking place, as witnessed by the earthquakes which occur about Inverness and Comrie. The district includes the highest ground in Britain and is geologically by far the most difficult on account of the inexplicable complexity of its structure. The most important formations are those of the Moine and Dalradian divisions of the Highland Schists. A particularly valuable feature of the handbook is the clear summary which it contains of the different interpretations of succession and structure which have been proposed; this is the more useful because, as the author says, "it will doubtless appear to the reader that there are as many opinions as observers". The treatment of the igneous rocks earlier than, or associated with, the Dalradian metamorphism, and that of the Newer, or Caledonian, intrusions is also worthy of special praise. All students of tectonics and petrology will find this handbook a most helpful guide to a region of tantalizing perplexity.

Under the title "Scotland: The Tertiary Volcanic Districts"[11] the magnificent record now exposed in the west of Scotland, of the intense and prolonged igneous activity which broke out in Early Tertiary times, is discussed. The vast amount of denudation which has since taken place has revealed the extensive roots of mighty volcanoes and the deeper-seated plutonic rocks that crystallized beneath the covering of lavas. The complexity of the vents and intrusions and the orderliness of the ring-structures (ring-dykes and cone-sheets) are unsurpassed in any other part of the world. Only brief accounts of the pre-Mesozoic formations are given, the bulk of the handbook being devoted, as its title indicates, to (*a*) the plateau lavas; (*b*) the Central Intrusion complexes of Mull, Ardnamurchan, Skye, Rum, St. Kilda and Arran; and (*c*) the dyke-swarms. This justly famous petrographic province has stimulated world-wide discussion of problems of petrogenesis. In this connexion it may be pointed out that the official interpretation of the upward passage of gabbro into granophyre in the ring-dykes of Mull as the result of gravitational differentiation *in situ* has not remained unchallenged. The handbook is lavishly illustrated and, at least for petrologists, it may be hailed as the most attractive example of a series that is a worthy commemoration of a hundred years of geological research in Britain.

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[1] "London and Thames Valley." By R. L. Sherlock Pp. 70+5 plates.

[2] "The Wealden District." By F H. Edmunds. Pp. 85+13 plates.

[3] "Bristol and Gloucester District." By F B. A. Welch and R. Crookall. Pp. 86+12 plates.

[4] "South-West England". By H. Dewey. Pp 75+12 plates.

[5] "The Welsh Borderland." By R. W. Pocock and T. H Whitehead. Pp. 81+11 plates.

[6] "North Wales." By B. Smith and T. N. George. Pp. 92+12 plates

[7] "The Pennines and Adjacent Areas." By D. A. Wray. Pp. 87+11 plates.

[8] "Northern England." By T. Eastwood. Pp. 76+8 plates.

[9] "The South of Scotland." By J. Pringle. Pp. 97+7 plates.

[10] "The Grampian Highlands." By H. H. Read. Pp. 81+10 plates.

[11] "Scotland: The Tertiary Volcanic Districts." By J. E. Richey. Pp. 115+9 plates.

London: H.M Stationery Office. 1*s*. 6*d*. net each.

Obituary

Lieutenant-General Sir Alfred Keogh, G.C.V.O., G.C.B., C.H.

IT can scarcely be doubted that, by coming generations, the Great War will be held to mark an epoch in the history of medicine. Taking medicine in its widest sense, as a calling centred on the preservation of life and the mitigation of human suffering, its historian will have to go back to the day of Lister for anything comparable to the rapid and marvellous advance that was made during the War. The two cases are certainly widely different. Lister, like Pasteur, stands in solitary grandeur on the plains of peace, conferring after laborious days the splendid and enduring gift which his rare genius had put into his hands to bestow. In the case of the War, many great names are involved—it was team-work on a titanic scale. No one man among them stands as Lister stood among his fellow labourers. But moving about among the soldier and civilian members of the medical profession who are most competent to judge, the impression is left that if a name were to be chosen for the seat of honour, none could come before that of Sir Alfred Keogh, whose death at the age of seventy-nine years occurred on July 30.

Of talent of almost every kind, the Briton, like the men of other nations, is apt to say we have no lack; but in the art of fostering talent, of affording it the best field for action, of bringing it into focus on the things that are of most vital concern to the nation, the Briton is much less inclined to boast. Of the master art of the harmonious control of gifted men, it is still less the case. Here indeed lies the loudest complaint to-day about the expiring generation, and here also arises the haste to organize, systematize, rationalize, and almost, if one may be permitted to say, to 'Germanize' our ways. According to the adage, "It is lawful to learn from the enemy; it is both wise and lawful to learn from a friend who may also be a potential enemy". This in the Great War meant that Lord Haldane, when Minister of War, had embodied in the administration of the army sufficient of the ways of the German General Staff to help him in securing that six divisions were ready for instant embarkation to the field of war in August 1914, going at once into action. This, according to Earl Haig, was the foundation of victory.

Sir Alfred Keogh's appointment as Director-General of the Army Medical Services was almost simultaneous with that of Lord Haldane as Minister of War. It would, perhaps, be adding too much in praise of Lord Haldane to say that he had at once taken the full measure of the man whose appointment was to mean so much. Suffice it to say, that in Sir Alfred Keogh there was embodied all that was best in the ways of the German General Staff and all that was best in the military traditions of our own country. He was, however, not an imitator, but a man in whom great powers of initiation were inborn.

It would be out of place here, and beyond the writer's power, to give in any detail the record of Sir Alfred Keogh's work in the army. Its essential character can only be briefly indicated. In the first place, the imagination of Keogh, like that of his illustrious fellow countryman Earl Roberts, had enabled him to foresee in wonderful degree the conditions which would obtain in Great Britain in the event of foreign war. He foresaw its magnitude, and the scale of preparation that was required. On the formation of the Territorial Army, under Haldane's regime, Keogh laid, along with it, the foundation of a vast voluntary civilian medical service, which at the outbreak of war sprang into action, appearing with its great military hospitals, staffed with men of the highest medical skill, and the countless number of voluntary aid detachments, with their minor hospitals and training centres. He blended the civilian medical profession and the Army medical service and effected a perfect liaison between the organizations in the field and the organizations at home. It is confidently stated that no other army had its like in the efficiency of its medical service. How many thousands are there to-day, alive; how many thousands are there repaired, who in the conditions of any preceding war would have perished, or been left with grave injuries of kinds which gr to be remediable during the Great War ?

The Army Medical Services were not prepared for everything. Among the unforeseen conditions of war in the field, no more conspicuous case could be cited than that of the outbreak of gas warfare. If foreseen as a possibility by Keogh, he, like other soldiers, regarded its incidence as so unlikely that he had no measures of defensive protection designed or in readiness. The results of this, if ever revealed in detail, would serve like the exception that proves the rule to show how much danger must have been entailed by any gap in Keogh's prevision and provision. He did all he could on the spur of the moment amid the toils of hard labour, to meet the new peril, and happily the co-operation of another born leader of men, Sir Henry Thuillier, brought the protection of troops against gas in advance of the attack, and kept it so up to the end of the War.

Keogh was ever ready to listen to proposals that came from people whom he could trust. He assumed no pontifical air; he was rather the supreme and vigilant officer, under whose direction the collected legions of the profession, and the collected outcome of medical investigation at home, passed without delay to wherever lay the appointed place in the field of war.

Turning now to the other field in which Keogh worked, we might stop to say much on the position of medicine in relation to experimental science. It might well be contended that Keogh in his Great War work exhibited the scientific method. He certainly had imagination, a real love of science, and far more of real science in him than most medical men. If he is not strictly to be regarded a man of science, at least he believed in science wholeheartedly, and knew its ways. This gave him one great qualification for an administrative scientific post, and when we add to this his administrative achievements, as D.G.A.M.S. before the War, we cannot wonder that Lord Haldane, best aware of them, urged in 1910 the appointment of Keogh to the rectorship of the Imperial College of Science, which at that time, above all things, needed a talented administrator at its head. This post Keogh held actively from 1910 until 1914, when he was recalled to his old position at the War Office.

After the War, Keogh returned to it eagerly, and retired reluctantly from it only when he reached the age of sixty-five years in 1922. How much he loved the work can be gauged from the fact that at the most critical period of the War he said, with a rueful smile to the writer, that he was longing "to get back to South Kensington". Many readers of NATURE will have personal recollections of Keogh at the Imperial College. They may, perhaps, be puzzled to pick out any conspicuous act of reorganization likely, outside the College, to be associated with his name. If those who had the happiness of holding teaching or other office at the College during his rectorship are asked what he did, they too cannot, or will scarcely stop to tell you. For all thoughts of what he did are overwhelmed by the thought of what he *was*.

Keogh was above all else a veritable knight, a Christian Irish Catholic gentleman, endowed with all the graces that these words imply, not forgetting the savouring salt of humour. No wonder he was so much beloved by those who were nearest to him, and honoured and respected by those further removed who came into contact with him. By his War work he earned his place among the greatest who have served mankind, and incidentally to the work, he stood a noble figure bent on the advancement and right use of natural science. A. S.

Mr. R. R. Webb

ROBERT RUMSEY WEBB, the last of the famous coaches for the old Mathematical Tripos, died in Cambridge on July 29, at the age of eighty-six years. He was born at Monmouth on July 9, 1850 and went up to St. John's College, Cambridge, in 1868 as a sizar. In 1870 he was admitted a scholar of the College; in 1872 he was Senior Wrangler and first Smith's Prizeman. His election to a fellowship followed immediately; in 1878 he was appointed College lecturer in mathematics, holding this post until 1911; from 1878 until 1893 he was also lecturer at Emmanuel College. He retained his fellowship until his death, and he lived in rooms in College until a few years ago, when he moved to the house of his former 'gyp'.

From the date of his degree, Webb devoted his energies to training pupils for the competitive struggle of the Tripos. He was one of the famous line of coaches which included Hopkins, Routh and Besant; he worked his men hard, but, as the letters which appeared in *The Times* after his death testify, he inspired and retained their affection, as well as their admiration for the masterly way in which he could manipulate such things as 'moving axes' in rigid dynamics and differential geometry. Naturally, in later days, after he had given up dining in Hall, for reasons variously reported, he became somewhat of a legendary figure. For example, the story was told that, in term time, after a strenuous morning's teaching, it was his invariable practice to go by train to Royston and walk the thirteen miles back to Cambridge, arriving so precisely at the same time each day that the College porters set their clock by him.

Webb did not take a great share in University business, though to the end of his life he was keenly interested in what was going on and, even in his seclusion, he always seemed to know the latest gossip. He examined four times for the Mathematical Tripos; the present Vice-Chancellor of the University recalls how hard he was made to work solving Webb's problems, and how much mathematics he learnt, when he was a co-examiner in 1905 and 1906.

Webb's published work is small in volume, but he was always interested in the progress of mathematics, and kept in touch with many of its developments, even after his retirement; his rooms were crowded with mathematical periodicals and treatises, as well as with paper-backed novels, in French and other languages. He had been a member of the London Mathematical Society since 1873 and he certainly attended one meeting, in January 1878, when the minutes record that "Prof. Cayley gave an expression for the surface of an ellipsoid which had been communicated to him by Prof. Tait", and "Mr. Webb made a few remarks upon the subject". On this occasion, Webb was persuaded to print his own version, and the result is "Some Applications of a Theorem in Solid Geometry" (*Messenger of Math.*, 9, 170; 1880), one of eight papers appearing under his name in the *Messenger*, vols. 9–11, the most considerable of which deal with dynamics and elasticity. He also published a paper on attractions in the *Quarterly Journal* (14, 98; 1877), and communicated in 1886 a short note "On the Problem of Three Moments" to the Cambridge Philosophical Society (*Proc.*, 6, 42; 1889). But he never could be persuaded to work up into a book any of his numerous manuscripts, which he was so generous in lending.

WE regret to announce the following deaths:

Prof. Henry Sewall, emeritus professor of medicine in the University of Colorado, an authority on human physiology and tuberculosis, on July 8, aged eighty-one years.

Mr. C. F. Talman, meteorologist in the U.S. Weather Bureau since 1922, on July 24, aged sixty-one years.

Prof. Frédéric Wallerant, formerly professor of mineralogy in the University of Paris, aged seventy-eight years.

News and Views

Television in the Home

On the occasion of the opening of the Radio Exhibition, referred to on p. 410 of this issue, on August 26, an opportunity was provided by Messrs. Baird Television, Ltd., of witnessing the reception of the television programme broadcast from the B.B.C. station at Alexandra Palace. The demonstration was given on a standard Baird Televisor receiving set installed in the company's offices in Haymarket, under conditions which approximated to reception in the home. The receiving set was contained in a cabinet similar to the ordinary radio-gramophone, the picture on the screen of the cathode ray tube being viewed in a mirror in the raised lid of the cabinet. This picture was of such dimensions and height that it was comfortably visible by the viewer seated on a settee at a distance of about ten feet. The transmissions from the Alexandra Palace are, of course, only experimental; but the direct-vision pictures provided, including half or three-quarter length views of single persons, such as the announcer and a singer, were very satisfactory. The bulk of the programme, however, comprised the transmission of sound films, and while these were good on the whole, they emphasized the somewhat limited field of the vision picture by a loss of detail when this picture covered a large area or a crowd of persons. As an indication of the present-day possibilities of practical radio-television, however, this demonstration was most successful.

Dr. J. H. Hutton

It is announced that Dr. John Henry Hutton has been appointed a lecturer in the Faculty of Archæology and Anthropology in the University of Cambridge, for a period of three years as from October 1. When the intention to appoint a lecturer in this Faculty was notified in the course of last term, it was intimated that a special knowledge of the peoples of India would be a requirement. In this respect, Dr. Hutton's qualifications are beyond question. As a member of the Indian Civil Service, which he entered in 1909 after taking his degree at Worcester College, Oxford, Dr. Hutton has made a special study of the ethnography of the Nagas of Assam. Not only is he himself the author of two of the volumes in the series of monographs published under the auspices of the Government of Assam, one dealing with the Angami Nagas (1921) and the other with the Sema Nagas (1922), as well as a contributor of numerous papers on Naga culture to scientific periodicals, but he has also so stimulated and organized the researches of his colleagues that the hill tribes of Assam are now as well, or even better known to anthropological science than any other comparable population of India. When Dr. Hutton was seconded under the Government of India to take charge of the Census of India, 1931, it was generally felt that no more suitable selection could have been made. His introduction to the Report marked him as no unworthy successor to the late Sir Herbert Risley. However much opinions may differ as to the validity of the conclusions on the racial history of India at which Dr. Hutton arrived in that remarkable document, it cannot be denied that he has shown a notable breadth of outlook in grasping the essentials of his problem in their archæological and historical perspective, combined with a detailed knowledge of the multifarious facts, which is without rival in the Indian field.

Economic and Military Armaments

In the eighth Richard Cobden Lecture entitled "The Common Menace of Economic and Military Armaments" delivered on May 25 and now published (Cobden-Sanderson, Ltd., 1*s*. net), Prof. W. E. Rappard, discussing the relations between economic and military armaments, points out that as military armaments have contributed to the development of economic armaments, so the latter in turn have promoted the extension of military armaments by emphasizing the claims of the national State as against the rights of the individual and of mankind, and thereby increasing the tension in international relations. Both economic and military armaments are largely the legacy of past wars or the fruit of anticipation of future wars. Their primary source, however, is the doctrine of political nationalism which leads nations to look upon their own State as a universe in itself and therefore to disregard the rights of all others. A further source is in the present depression and in the efforts to overcome it by thorough-going State intervention.

Both economic and military armaments are weapons forged to enhance the independence, security and power of the national State. While a burden to the individual and a menace to the international community, they are incapable even at this price of truly fulfilling their professed purposes, and the present international situation must inevitably be aggravated by a persistent adhesion to these methods. Discussing the difficulties due to the existence to-day of at least three Great Powers of professedly and defiantly nationalistic Governments, Prof. Rappard suggests that the problem of international peace resolves itself into one of national ideals and conversions. Unless these nations can be led to adopt a more humane and less exclusive creed, peace can only be maintained by the closest co-operation between all those States, which, while respecting their own as well as their neighbours' statehood, still believe in the legitimate rights of the individual and in the supreme rights of mankind. Without a federal organization of the international community, there can be no real liberty, no lasting peace and no true relief from economic and military armaments.

Maiden Castle, Dorchester

THE most striking point to emerge from this season's excavations at Maiden Castle, so far as they have gone, is the conclusive evidence confirming Dr. Mortimer Wheeler's inferences as to the importance of the pre-Roman fortress-settlement in Britain. Should further investigation confirm his views as to its prevalence as an organized system, this should have a profound effect on theory as to the origins and form of town life in early and medieval England. The importance of Maiden Castle itself may be gauged from the evidence now being found of the deliberate destruction of the walled system of defences when the inhabitants were removed in Roman times to the newly founded neighbouring city of Dorchester. As investigation proceeds, the character of the prehistoric stone walling, which has now been found incorporated in the ramparts, and of which the existence was previously unsuspected, becomes more and more impressive. These walls were built of limestone from Upwey, some of the blocks weighing as much as five hundredweight. At the eastern entrance a later wall of fine masonry now being uncovered still stands to a height of six courses. Not only is it evident that it overlies earlier prehistoric levels of occupation, but it is also clear that it was designed to form a blocking wall across the prehistoric gateway when the hill-top temple was being built in the century preceding the coming of the Romans. Within the fortress itself, the remains of a substantial structure of wood, standing at the highest point of the camp, is being excavated. This was evidently of considerable size, and was in part constructed of tree-trunks a foot in diameter. Nearby a skeleton was found buried at some depth, an unusual feature in a fortress. The excavations will be continued until the end of the present month, when the three years' investigation which was undertaken by the Society of Antiquaries of London with the co-operation of the Dorset Natural History and Archæological Society will have been completed.

Meare Lake Village

EXCAVATIONS at Meare Lake Village have been resumed by the Somerset Archæological Society under the direction of Dr. Arthur Bulleid, and will continue until at least the middle of September. According to a preliminary report in *The Times* of August 29, the stone walling overlying the timber structure, apparently the foundations of a crannog, found last year in the central part of the eastern half of the village, is being examined further. The eastern margin and the south-eastern and north-eastern portions are now in course of investigation. Work has also been begun on the southern border of the village outside a definite dwelling. Timber and oak piles are being revealed, and in a layer of black earth a number of small finds have been made, which include a La Tène III brooch, a few objects of bronze, an antler weaving comb, a 'pygmy' pottery vessel, and a small Romano-British pot of the type known as 'Cossington' ware.

im Thurn Memorial Lecture, 1936

IN the recent lecture for 1936 on the foundation in memory of the late Sir Everard im Thurn, delivered at Edinburgh, Prof. J. L. Myres directed attention to the effect of changing outlook and development in method of research on the broader philosophic principles, which underlay the work of im Thurn. To the study of primitive peoples he conjoined the application of its results to the practical problem of the approach to the primitive mind in administrative and other affairs. He realized that this problem was but the counterpart of any native's difficulty in understanding European ways. im Thurn, Prof. Myres pointed out, insisted on the significance of 'character' which, whatever the superficial changes in culture, continues to influence native reactions to 'civilization'. This 'civilization' was defined as that in which "the prime motive of human action was the good of others or of one's whole race". As regards 'character' and 'culture' and their interaction, all grades between the individual completely disciplined by 'culture' and the man of genius can be discerned.

SINCE im Thurn's day, advance in scientific method has shown that culture and character alike appear as a composite system, or complex of elements, combined in different peoples in infinitely varying degrees of intensity. In a society in which transitions from one phase of life and society are effected mainly by individuals in isolation, character and initiative stand high, and in that society institutions are relatively unstable. Where, however, the rites of transition are matters of public concern and are performed by whole groups of initiates, behaviour and social structure are stabilized, character is stereotyped, originality suppressed and stagnation ensues. Our knowledge of 'primitive' cultures is mainly derived from such societies. Out of such closed cultures what way of escape is there, Prof. Myres asked. How does what im Thurn defined as civilization emerge as an altruistic prime motive of human action ? Prof. Myres illustrated from the history of ancient Egypt, early Greece and elsewhere how in fact such transformations do take place, though they do not preclude the apparition of a dominant individual character as first cause, and they presume elementary freedom to choose the well-being of others, once presented as the prime motive of human action.

Bibliography of Natural History

THE first general meeting of the Society for the Bibliography of Natural History was held in the rooms of the Royal Entomological Society on August 26. The provisional committee set up to establish the Society made a report and submitted draft by-laws which were accepted as the by-laws of the Society. The following officers were elected : President : Dr. C. Davies Sherborn ; Treasurer : Mr. Francis Hemming ; Secretary : Mr. Francis J. Griffin ; and a committee of management set up consisting of Prof. F. Balfour-Browne, Mr. J. R. Norman, Mr. J. Ramsbottom, Dr. T. A. Sprague and Mr. A. Cockburn Townsend. It was announced that the first part of the Society's *Journal* would appear in September, and that it would contain a catalogue of all known papers giving information relating to the dates of publication of books on natural history. No such catalogue at present exists, and the publication should be of value to all systematists. An item on the programme of the Society which it is hoped will be of great value to all naturalists is the publication of facsimiles of rare works of importance to natural history. The decision of the Society to maintain an information bureau for the use of its members is an indication of the present trend of societies to make available to the individual member the collective experience and knowledge of all. The annual general meeting of the Society will be held on the first Saturday in February.

International Botanical Congresses

A FEATURE of the sixth International Botanical Congress held at Amsterdam last September was the re-organization of the Botanical Section of the International Union of Biological Sciences and its recognition by the Congress as a liaison between successive International Congresses. Hitherto, each quinquennial congress has been independent of preceding congresses, and has been organized entirely by an *ad hoc* committee of the nation which was acting as host. Participation by other nationals in its various activities was by invitation. A drawback of this arrangement has been the absence of any body to ensure that resolutions passed by one congress were carried out and that committees appointed for definite objects were set to work. A circular has now been issued by the honorary secretary of the Botanical Section of the Union describing the aims of international collaboration in science in general, and in particular defining the work of the Botanical Section in relation to successive congresses. The circular emphasizes the independence of the quinquennial congresses, the organization of which remains entirely in the hands of a national committee; but the various commissions and committees appointed by successive congresses will be adopted by the Botanical Section of the Union and thus "be united into a permanent, active and well-subsidized organization". This should ensure that work initiated at any one congress will be effectively carried out. For the present a definite liaison is suggested between the two organizations as the president of the Botanical Section of the Union, Prof. N. E. Svedelius, is vice-president of the next International Congress to be held in Stockholm in 1940. The president of the Congress is Prof. R. E. Fries.

Forestry Research in Canada

As a result of recommendations made at a Conference on Forestry Research held in Ottawa in November 1935, the National Research Council of Canada has appointed a committee to study the requirements in respect to research in all branches of forestry, including measures for the better utilization of forest products. This committee is to function as an associate committee of the National Research Council, and includes in its membership representatives of the Dominion Departments of the Interior and Agriculture, in addition to the National Research Council; the forestry departments of each province; members of the forestry faculties of universities in which there are departments of forestry; the lumber, pulp and paper and allied industries throughout the Dominion; the forest engineering societies; the forest protective associations and the Canadian Forestry Association. It is understood that the committee will base its preliminary programme on the findings of the Conference on Forestry Research held in November 1935 already alluded to. The importance of forestry and her forests to Canada needs no emphasizing. Much valuable work is being done already in the direction of research by federal and provincial agencies, individual companies and other organizations. The new committee will bring together data on the work at present in progress, correlate the information thus obtained, investigate the need for further research, and so forth. It is evidence of broad and statesman-like views among those responsible for the formation of the committee that representatives of all sides of forestry interests are included. In Great Britain, the position is far otherwise—research work is too often relegated to water-tight compartments, energies being thus dissipated; forestry committees are not fully representative of all sides of forestry; whilst representatives of the individual forestry staffs of the universities as a whole do not automatically find places on forestry research committees.

Control of Rabbit Infestation by the Use of a Virus

OF all the pests from which the pastoral industry in Australia has suffered, rabbit infestation is probably the most serious economically, and little permanent success seems to follow the methods of control in use at present, such as trapping and poisoning. One hope would appear to lie in the discovery of some infectious disease, deadly to the rabbit but innocuous to man and other animals, and easily communicable to, and spreading widely by natural means among, the rabbits. Sir Charles Martin, as a result of an experimental inquiry, suggests that a disease 'rabbit myxomatosis' may fulfil these requirements (Commonwealth of Australia. Council for Scientific and Industrial Research, *Bull.* No. 96. Melbourne, 1936). This is an infectious, highly fatal, febrile disease caused by an ultra-microscopic virus, causing mucinous discharges, swellings and tumours in affected animals, fatal within twelve days or so, transmitted sufficiently by contact, and with a fatality of almost a hundred per cent. It attacks animals of the genus *Oryctolagus*, to which wild rabbits in Europe and Australia, and domesticated rabbits in Europe and America, belong; but it does not affect the indigenous rabbits of America, or man and other animals and birds. Experiments were conducted by Sir Charles Martin in a pen measuring 50 yards × 10 yards, with both tame and wild rabbits. A colony having been established for three weeks or thereabouts, one or two rabbits inoculated with the disease were introduced. With colonies of 27 and 30 tame, and 55 and 44 wild, rabbits, the fatality was 99·6 per cent among the tame, and 100 per cent among the wild. The disease originally came from epizootics among tame rabbits in South America.

Research at Millport

THE Annual Report of the Executive to the Council of the Scottish Marine Biological Association for 1934–35 includes the director's report on research. Drs. Orr, Marshall and Nicholls are concentrating on the development and food of the herring from hatching onward. In this connexion, it is found that copepods are by far the most important food organisms, the larval and post-larval herring eating chiefly the small species. In view of this fact, it was decided to investigate seasonal distribution and breeding periods of these small copepods, in the same way as has already been done for *Calanus finmarchicus*. Results so far show that in the early months *Microcalanus pusillus* and *Oithona helgolandica* were the most abundant species, with *Pseudocalanus elongatus*, *Centropages hamatus*, *Temora longicornis* and *Acartia clausi* occurring in smaller numbers. Most of the important planktonic organisms have been weighed, and in some cases the chemical composition determined. During the winter, when zooplanktonic organisms are scarce, a beginning was made on the analysis of non-planktonic animals important as fish food. Investigations on shore ecology, especially in Kames Bay, by Dr. A. C. Stephen and Mr. Elmhirst, have been continued. The work already done has shown a very rich fauna important for fish food. Various fishes from the seine net have been examined and shown to feed on the dominant invertebrates. A very interesting feature in these investigations is the work by Dr. Nicholls on sand-dwelling copepods, especially minute species living in the interstices between the sand grains on the beach. Several new species of these and three new genera have been found. Other researches include algal ecology and preserving colour in green seaweeds, experiments on timber preservation in the sea and the growth of the dog-fish *Acanthias*.

Seismology in New Zealand

THE report of Dr. C. E. Adams, Dominion Astronomer and Seismologist, for the year 1934 (*Dept. Sci. Indus. Res. Bull.*, No. 105) shows that the seismic activity of New Zealand was much greater during that year than in 1933, the number of earthquakes felt being 230, instead of 108. Of these, 158 were felt in the North Island only, 60 in the South Island only, and 12 in both islands. The most important shock was that of March 5 at 11.16 p.m. N.Z. time (11.46 a.m., G.M.T.). Its intensity in several parts of northern Wairarapa reached the degree 9 of the Rossi-Forel scale and chimneys fell over a wide area in the southern part of the North Island. The map that accompanies the paper shows that most of the epicentres lay in the extreme north of South Island and the southern half of North Island. Owing to the increased activity off the east coast of the latter island and to other changes that have been reported along the coast, it is strongly recommended that a detailed marine survey should be carried out of the whole east coast, including soundings in the seas to the east of New Zealand.

Solar Activity and Terrestrial Phenomena

IN 1924 the International Research Council (now transformed into the International Council of Scientific Unions) formed a Commission for the Study of Solar and Terrestrial Relationships, a field of science which extends over the domains of at least three of the International Scientific Unions. This Commission, among other activities, has published triennial reports, reviewing the state and progress of knowledge on solar and terrestrial relationships, and, where necessary, making recommendations regarding action that may conduce to further progress. These reports are distributed to certain libraries and to institutions and individuals occupied in work relating to the subject. The fourth report has recently been issued (Conseil International des Unions Scientifiques : Quatrième Rapport de la Commission pour l'Etude des Relations entre les Phénomènes Solaires et Terrestres ; pp. 159. Firenze, 1936) under the editorship of the president of the Commission, Prof. G. Abetti, Astrophysical Observatory, Arcetri, Italy. It differs from its predecessors in being better and more attractively produced, and in having a valuable 28-page introduction by the editor, giving a general survey of the subject for the past three years. The remainder of the volume consists of twenty-one brief articles on different aspects of the subject, by various authors.

Electric Supply in the Irish Free State

THE annual report of the Electricity Supply Board of the Irish Free State for the year ending March 31, 1936 shows that a further increase in the sale of electricity has been effected, and results in a surplus of income over expenditure of about £310,000. The total capital expenditure is now about 10½ million pounds, of which 5 per cent is paid to the State. The total sale of electric units during the year amounted to 187 millions, and the average receipts per unit dropped from 1·92*d*. to 1·84*d*. The figures show a very satisfactory acceleration in the development of the consumption of electricity for domestic purposes. In the environs of Dublin the consumption increased by 63 per cent. The total units generated during the year were 243 millions, of which 211 millions were supplied by the hydro-electric power station on the Shannon. Details are given of the extension of plant, and the building of new works on the Shannon and at the Pigeon House in Dublin. Two Swiss experts have reported on the development of the River Liffey for hydro-electric purposes. As it is the intention of the Corporation of the City of Dublin to use the water-storage reservoir on the Liffey to augment the ordinary water supply to the city, it was found inadvisable to take full advantage of the Liffey water-power project for six or seven years. As soon as the necessary legislative provision has been obtained, the work on the reservoir will be begun. The average yearly production of the Liffey hydro-electric development is computed to be 30 million units.

Scientific and Technical Literature

SEVERAL suggestions for the improvement of scientific and technical literature are made by Commander T. W. Macalpine in the *Publishers' Circular and the Publisher and Bookseller* of July 18. Criticizing the present procedure followed by a specialist or a publishing company in regard to a projected scientific book, he suggests that the exposition of the subjects treated in scientific and technical works, etc., would be improved, their utility for easy and quick reference increased, the cost of production decreased, and their filing and storage on shelves, etc., facilitated, if there existed an independent body of recognized standing in the world of science which could furnish authors and publishers with general information and guidance: At present an author is rarely able to give much information of assistance to the publishers on such matters as form of treatment, size of volume, number of words, type or types, number and kind of illustrations, diagrams, paper, binding. Accordingly, the utility of a book is liable to be limited by the publisher's experience. An independent advisory body of recognized standing which could supply information on such matters, assist in the standardization of nomenclature and symbolism, as well as of formats and sizes of printed area on pages, and advice on subdivision, synopsis, contents list and index, etc., would make an important contribution to efficient publication.

Composition of Cereal Straw

THE seemingly facetious title, "The Two Ends of Straw", appears over an article by Dr. H. Nicol in *Agricultural History* (10, No. 1, Jan. 1936), reviewing some early, but fundamental, research upon the composition of cereal straw. The work of Prof. J. F. W. Johnston in 1842, of J. P. Norton and P. F. H. Fromberg in 1845, and of J. I. Pierre in 1863 and 1866 is collected to show that straw has a great diversity of composition between the root end, and the parts towards the flower. The work of Pierre is particularly detailed, and supplies a great deal of material not widely known at the present day. Dr. Nicol discusses some of the results in relation to the recent hypothesis of 'negative migration' of plant constituents, where nitrogen and mineral elements are returned to the soil. Several additional papers upon the partitional analysis of straw have come to light since the publication of the article under review, but the most recent is dated 1879. There is considerable gratification, but also cause for humble reflection, that modern ideas are being confirmed by work which has remained in oblivion for nearly sixty years.

Greenkeeping Research

THE spring number of the *Journal of the Board of Greenkeeping Research* (4, No. 14, from the Board's Research Station, St. Ives, Bingley, Yorks, 2*s*. 6*d*. net) contains the annual report of the organization, which shows, *inter alia*, a very gratifying volume of advisory work. Many suggestions for future work of a practical kind have been made by the Greenkeepers' Advisory Committee, and the report of last year's annual conference is embellished by the full text of Prof. N. M. Comber's address on "The Constitution of Soil". Mr. R. B. Dawson, director of the Research Station, contributes a short but highly informative article on camomile lawns, and the previous accounts of lawn grasses, of weeds, and of fertilizers, are continued. The difficulties of accurate botanical description are being met by the publication of a glossary of botanical terms. Mr. R. B. Ferro discusses some of the difficulties of field experimentation on the golf course. Two short articles on water installations, a description of the management of a golf course on heavy clay soil, and a plea for special investigation of bowling green problems, are included in the issue.

A Journal of Marriage Hygiene and Birth Control

WITH the May issue (2, No. 4), *Marriage Hygiene* completes its second year. The objects of this quarterly journal are to secure for conjugal hygiene a proper place in preventive medicine, to publish scientific contributions treating marriage as a social and biological institution, and to promote and coordinate contraceptive clinics and marriage consultation centres in various parts of the globe. Each number contains notes and comments, original articles, reviews and abstracts of current literature. "The Positive Side of Birth Control" (E. B. Reuter), "Birth Prevention in France" (J. J. Spengler), and "Artificial Insemination" (H. Brewer) are some of the original articles in the present number. The yearly subscription for the volume of about five hundred pages is 18*s*. It is published from Kodak House, Bombay 1, India, the editor being A. P. Pillay. The London agents are Messrs. H. K. Lewis and Co., 136 Gower Street, W.C.1.

Anti-Noise Regulations

THE City Council of Philadelphia has adopted a noise abatement ordinance prepared by a Special Committee of the Philadelphia County Medical Society. The ordinance prohibits sounding of motor-horns except when absolutely necessary for the prevention of accidents, building operations at night except by special permit, the use of sound devices by pedlars, unnecessary noise in handling rubbish cans, and the use of gongs, sirens or exhaust whistles on any vehicles except those of the police and fire bureaux, and hospitals. Loud playing of radios in homes or in front of stores is also among the specific noises forbidden in the ordinance.

Costing Returns of Hospitals and Sanatoria

IN recent years, the value of costing methods in securing business efficiency has become increasingly recognized, not only in industry but also in local government. The Ministry of Health has issued Part 1 and Part 2 of the costing returns of hospitals for the year ending March 31, 1935 (H.M. Stationery Office, 1936. Price 1*s*. and 1*s*. 3*d*. net). Part 1 contains particulars of Poor Law hospitals, general hospitals administered by local authorities under the Public Health Acts or the Local Government Acts, sanatoria and other institutions for the residential treatment of tuberculosis, and maternity homes and hospitals. Part 2 contains the similar particulars for Poor Law institutions and separate casual wards.

Research at the London Hospital

THE annual volume of "Researches Published from the Wards and Laboratories of the London Hospital during 1935" has recently been issued (London: H. K. Lewis and Co., Ltd., 136 Gower Street, W.C.1. Price 7*s*. 6*d*. net). The matter has been selected and issued by the Publications Committee for Researches from the London Hospital, of which Prof. Bedson is honorary secretary. The volume includes twenty-seven papers, all published in various current journals, which cover a wide range of subjects included in the science and art of medicine.

A Large Sunspot

THE rising solar activity continues to yield, amongst other phenomena, a fairly high frequency of sunspots —about six groups a day being visible. These groups are usually of moderate extent, but about a dozen seen since the beginning of 1936 may be discriminated as naked-eye spots. These spots or groups of spots have areas of not less than 500 millionths of the sun's hemisphere or about 585 million square miles. The latest of these large spots is now crossing the sun's disk, from August 25 until September 6, with central meridian passage on August 30·7 U.T. Its growth to a large spot with multiple umbræ was considerable between August 27, when its area measured 400 millionths, and August 29, when it had increased to 900 millionths. The spot was surrounded by extensive faculæ, as seen in integrated light, and by flocculi as seen in hydrogen light ($H\alpha$) or in that of ionized calcium (H and K). There was marked activity recorded with the spectrohelioscope at the Royal Observatory, Greenwich, on August 27 and 28—in particular a bright eruption, visible in $H\beta$ as well as in $H\alpha$, on August 28 between 10^h and $11\frac{1}{2}^h$.

Announcements

FOLLOWING her record-breaking westbound passage across the Atlantic from Bishop Rock to the Ambrose Lightship, the *Queen Mary* has recently beaten the eastbound record. She passed Bishop Rock at 7.12 hr. G.M.T. on August 30, having taken 3 days 23 hr. 57 min. for the crossing. The average speed for the voyage of 2,939 miles was 30·63 knots, as compared with the average of 30·31 knots for the 3,015 miles which gave the *Normandie* the blue riband of the North Atlantic in June, 1935.

A WORLD Peace Conference is being held at Brussels on September 3–6. It has been organized by the International Peace Campaign; the Viscount Cecil and Pierre Cot are joint presidents; Miss Rose Manus, 48 Boulevard Botanique, Brussels, is the international secretary; Dame Adelaide Livingstone is vice-chairman of the British National Committee, which has its office at 27 Chester Terrace, Eaton Square, S.W.1. The Congress has special committees on medicine, science and education, and will raise general points, too, likely to be of interest to scientific workers.

DR. FRIEDRICH KÜSTNER, of Mehlem a. Rh., professor of astronomy and formerly director of the observatory of Bonn University, celebrated his eightieth birthday on August 28.

AN Institute for Industrial Medicine has recently been inaugurated in Milan.

THE twenty-fifth Congress of the German Society of Legal and Social Medicine will be held at Dresden on September 17–19. Further information can be obtained from Dr. Schrader, Lahnstrasse 9, Marburg a.d. Lahn.

THE Association for Photographic and Cinematographic Documentation in Science will hold a Congress in Paris on October 9–15. Further information can be obtained from Dr. Claoué, rue Scheffer 39, Paris, 16e.

ERRATUM.—In the letter entitled "Measurements of Cosmic Rays in a Deep Mine" by Drs. J. Barnóthy and M. Forró in NATURE of August 22, p. 325, lines 9 and 15, for "2,500 m." read "1,500 m."; line 15, for "0·09" read "0·18".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A lecturer in electrical engineering in the Borough Polytechnic, London, S.E.1—The Principal (September 9).

A lecturer in mechanical engineering in the Handsworth Technical College, Golds Hill Road, Handsworth, Birmingham—The Principal (September 12).

A junior bacteriologist in the University of Bristol —The Registrar (September 12).

A vice-principal (industrial and/or mining engineering) of the Wakefield Technical College—The Director of Education, Education Department, 27 King Street, Wakefield (September 14).

An assistant lecturer in mathematics in the University of Sheffield—The Registrar (September 15).

An investigator for research in problems of falls of ground and haulage in coal mines to the Safety in Mines Research Board—The Under Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, London, S.W.1 (September 19).

A demonstrator in mechanical engineering in the University of Leeds—The Registrar (September 21).

A regius professor of natural history in the University of Aberdeen—The Private Secretary, Scottish Office, Whitehall, London, S.W.1 (October 31).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 407.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Radio-Helium

THE following experiment concerning the nature of the radioactive element produced in beryllium when bombarded by fast neutrons[1] was made on the suggestion of Dr. O. R. Frisch.

Beryllium was precipitated as a hydroxide in a very fine-grained form (this was kindly done for us by Prof. G. v. Hevesy), so that it might be able to give off any helium produced in the process. The $Be(OH)_2$ powder was bombarded by neutrons from a beryllium-radon source of about 200 mc. strength, and a stream of hydrogen was at the same time passed through the tube containing the $Be(OH)_2$ and then through a capillary tube to a thin-walled jacket around a thin-walled Geiger counter. The distance between the neutron source and the counter was 60 cm., and the latter was properly shielded by lead.

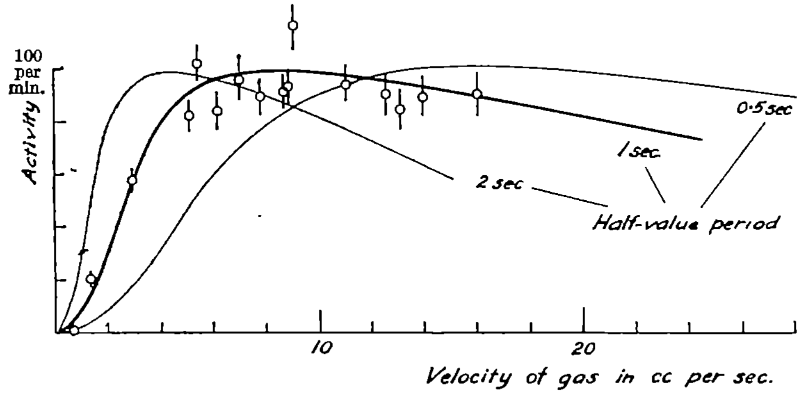

FIG. 1.

When the velocity of the gas was zero, the rate of counting was 20 per minute: when the velocity of the gas was increased, the counting rate increased as shown in Fig. 1, where the counting rate (less the γ-ray effect of 20 per min.) is plotted against the velocity of the hydrogen. This shows that a radioactive body in a gaseous state is produced in the $Be(OH)_2$. From the volumes of the $Be(OH)_2$ tube, the capillary and the jacket around the counter, one can calculate roughly the shape of the curve for the cases of the activity having a half-value period of 0·5 sec., 1 sec. or 2 sec. These curves are drawn in Fig. 1, and it is seen that the activity has a half-value period of about 1 sec., thus being identified as the one previously reported[1].

A radioactive gas produced by bombarding $^{9}_{4}Be$ by neutrons could scarcely be anything but $^{6}_{2}He$ or possibly $^{8}_{2}He$.

T. BJERGE.

Physical Laboratory,
Technical Highschool of Denmark,
Copenhagen.
July 29.

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[1] T. Bjerge, NATURE, **137**, 865 (1936).

β-Ray Spectrum of Radio-Helium

IN order to investigate the energy distribution of the β-rays from radio-helium[1], we have employed an expansion chamber constructed by Dr. J. C. Jacobsen and kindly lent to us. In the middle of the top plate, a thin-walled brass cylinder (0·05 gm. per cm.², 1·5 cm. diameter) was inserted, into which an activated beryllium cylinder could be dipped. The latter was made of beryllium powder (0·12 gm. per cm.²) stuck on to a brass tube (0·1 gm. per cm.²) and could be moved automatically from a position around a neutron source (beryllium-radon) to the position in the Wilson chamber in 0·4 sec., this movement also starting the timing arrangement for expansion and light. A suitable lead shielding was arranged which cut down the electrons due to the γ-rays to a number small compared with the number of β-rays. The radioactivity induced in the brass tube carrying the beryllium is negligible as the latter is exposed to the neutrons only for a few seconds at most every minute.

The β-rays were bent by a magnetic field of 1,500 oersteds. The gas in the chamber was air at about half an atmosphere pressure, the condensing vapour a mixture of ether and alcohol.

Radio-helium emits negative electrons. 120 tracks have been measured and corrected for the stopping power of the brass cylinder and half of the beryllium layer. The uncertainty in the individual values of $H\rho$ is estimated to be about 10 per cent. The energy spectrum obtained is shown in Fig. 1. As usual, it is somewhat difficult to determine the upper limit: the scarcity of tracks in this region tends to give a value which is too low, whereas the

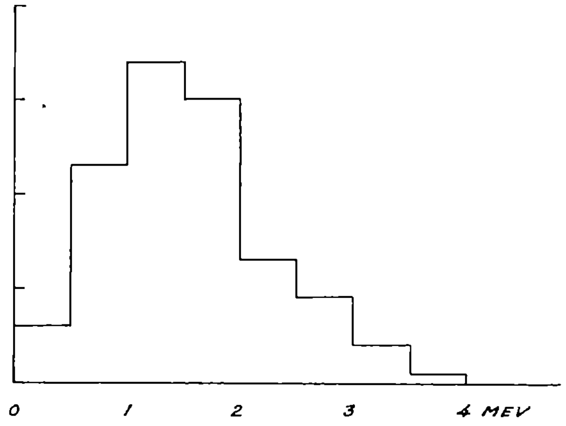

FIG. 1. Energy spectrum of β-rays from radio-helium.

uncertainty of the individual tracks tends to give a value which is too high. We consider 3·7 ± 0·5 m.e.v. as the most probable value from our measurements.

The most reasonable assumption as to the formation and disintegration of radio-helium are the processes :

$$ {}^9_4\mathrm{Be} + {}^1_0n \rightarrow {}^6_2\mathrm{He} + {}^4_2\mathrm{He} \qquad (1) $$

$$ \text{and } {}^6_2\mathrm{He} \rightarrow {}^6_3\mathrm{Li} + e^- \qquad (2) $$

If the energy release in (2) is 3·7 m.e.v., the mass of ${}^6_2$He would be 6·0207, using the masses given by Oliphant[2]. Recently Oliphant has reported[3] that (1) takes place even if the bombarding neutrons have only 1·5 m.e.v. kinetic energy. If these figures are applied in (1), it follows that the energy available for the breaking up of the intermediate ${}^{10}_4$Be nucleus into He and ${}^6_2$He is 0·8 m.e.v., which does not seem unreasonable.

We wish to thank Prof. N. Bohr for his interest in the work, and the Radium Institute of Copenhagen for the gift of the emanation.

T. BJERGE.
K. J. BROSTRÖM.

Institute for Theoretical Physics,
Copenhagen.
July 31.

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[1] See preceding letter.
[2] M. L Oliphant, NATURE, 137, 396 (1936).
[3] M. L. Oliphant, Copenhagen Conf. 1936 (unpublished).

Passage of Fast Electrons through Matter

WHEN a fast electron passes through matter, it loses its energy mainly by emission of a few large quanta of radiation (*Bremsstrahlung*). The radiation quanta are absorbed again, the absorption being due mainly to the creation of pairs. Thus, in a *thick sheet of matter*, a fast primary electron produces quite a number of secondary positive and negative electrons, which appear as a *small shower* giving rise to triple coincidences, etc.

Using the cross-sections for the above processes as obtained from relativistic quantum mechanics[1], we have calculated the probability for the production of secondary electrons with an energy greater than E, say, when a primary electron of energy E_0 passes through a sheet of matter of thickness L. The result can be expressed in the same form for all materials if the thickness L is expressed in certain units characteristic for the material. The unit thickness ($L = 1$) corresponds to :

0·40 cm. Pb; 7·4 cm. Al; 33 cm. H_2O; 280 m. air.

The average number of positive *or* negative electrons emerging from the sheet depends only on L and the ratio E_0/E. It is given in the accompanying table (the total number of positive + negative electrons being twice the corresponding figure given in the table) :

E_0/E	20	100	400	1000	10,000
$L = 2$	0·5	1·3	2	2·5	3·7
3	0·7	1·8	3·4	4·4	7
4	0·7	2	3·8	5·2	8·6
5	0·5	1·8	3·8	5·4	9·3
7	0·2	1·2	3	4·7	10·3
10	0	0·5	1·8	3	8·4

The results are only valid for $E \gg mc^2$.

The table shows that the maximum number of secondaries is produced at a thickness L_m of about 3·5 – 5, increasing slowly with E_0/E. $L = 4$ corresponds to 1·6 cm. lead. For this thickness a primary electron of 2×10^9 e.v. produces, for example, on the average 2 positive and 2 negative electrons with energies greater than 20×10^6 e.v.

There can be no doubt that the process discussed above is responsible at least for a large part of the triple-coincidences obtained by Rossi and others. The thickness $L_m = 4$ (1·6 cm. lead) at which the number of secondaries is a maximum agrees well with the maximum of Rossi's well-known curves[2].

Showers of this sort can also be produced by hard light quanta. After having travelled an average distance $L = 1·7$, the light quantum creates a pair, each electron of which produces secondaries in the way described above.

A more detailed discussion of these processes and in particular of the higher stages (tertiary, quaternary . . . electrons) will be given elsewhere. The latter have to be taken into account for large values of L and E_0/E.

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July 29.

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[1] Bethe and Heitler, *Proc Roy. Soc.*, A, 146, 83 (1934).
[2] Int. Conf. Nuclear Physics, London, 1934.

Intrinsic Uncertainty of Reference Frames

PHYSICAL ideas which seem at first sight somewhat arbitrary become, as Eddington has stressed, almost inevitable when the relativity principle is taken to its proper conclusion. As examples may be quoted the law of gravitation, in which the radius of curvature anywhere in the universe is proportional to the corresponding amount of matter there, and the principle of unit weights (equal *a priori* probabilities) in statistical mechanics.

Eddington has pointed out further, following earlier ideas of Mach, that the *ad hoc* introduction in quantum theory of a term m to represent mass is theoretically unsatisfactory, in view of the necessary dependence of such a term on the remaining unspecified matter. It seems logical to realize not only that relativity has denied the absolute independence of mass, space and time ; but also that these concepts should rigorously be regarded merely as aspects of the configuration and changes of configuration of matter. On any kind of atomic theory it follows that these three associated concepts of mass, space and time are all statistical in character.

Any mechanical properties of a system will be implicitly affected by fluctuations in our frame of reference. If in particular we use the rest of the world as our reference frame, there will be an uncertainty of order $R/\sqrt{N}$, where R is the radius of the universe, and N the number of particles it contains. From this uncertainty, Eddington has considered what term should represent the 'reference mass' of the universe. If this statistical view of the origin of mass is accepted, it does not seem unreasonable that we should assume a corresponding uncertainty of the conjugate co-ordinate, proper time, of order h/mc^2 or $R/c\sqrt{N}$.

The above argument could thus be regarded as one approach to Flint's assumption that in addition to the usual limitations imposed by Heisenberg's uncertainty principle, there is a limit to the subdivision of proper time, from which postulate he shows that a paradox of negative energy levels disappears[1]. It seems in any case significant that the order of these uncertainties is that at which it is known that wave mechanics begins to break down.

A further conceivable development of the argument is its connexion with changes associated with a direction of time. If recognizable changes of configuration could be imagined referred to an ideal time defined in terms of the number of interactions that take place, then as entropy increases, the approach of equilibrium will imply that more interactions will take place before a recognizable change occurs. If our observable time is regarded as dependent on recognizable change, then, being a statistical average, it will as a macroscopic phenomenon eventually disappear. Before this stage is reached, however, it will in terms of our ideal time go more and more slowly; and it could appear to follow, if we adopt conventionally a fixed relation between measurements in space and time (denoted by the constant c), that space will correspondingly expand. Equivalently, the velocity of light could be said to decrease, though it should be noted, in view of past suggestions (on rather insufficient evidence), that this velocity *is* apparently decreasing, that even the present observed expansion of space, whatever its cause, would, on the assumption of an absolute constant for the velocity, only give rise to an apparent decrease of about 16 cm./sec./year, which would be undetectable[2].

In spite of possible fallacies in the above arguments, they may serve to stress properties of an observable time that are now perhaps becoming appreciated. Thus it should be remembered that a clock is not merely an oscillating system that is observed at a particular instant—this would define in terms of space a periodic sort of time; if it has also to record its *number* of oscillations without disturbance, it begins to be a more complicated mechanism.

M. S. Bartlett.

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[1] Nature, 137, 313 (1936).
[2] cf. Edmondson, Nature, 133, 759 (1934).

Genotypic Control of Chromosome Size

The differences in size between the chromosomes of related species are usually differences that can be attributed to structural changes such as fusion, fragmentation, etc. In many groups, however, enormous differences of size are found, which may be of the order of 1 : 100 or even 1 : 1,000. Such differences, uniformly affecting as they often do the whole complement, must be due to a unitary genotypic control of chromosome size. In other words, the size of chromosomes, like other properties of the organism, must be subordinate to the action of the genes they carry[1].

Experimental examples of this principle are very rare, the only clear case being that of a bud sport in a triploid plant presumed to be a hybrid between diploid and tetraploid *Tradescantia* species with different chromosome sizes. The mutant had chromosomes 1/5 the size of the stock[2].

In experimental material of grasses[3], kindly supplied by Dr. T. J. Jenkin, of the Welsh Plant Breeding Station, Aberystwyth, I have been able to find evidence of the inheritance of this genotypic property governing chromosome size. A male sterile plant of *Lolium perenne* (Fig. 1, *A*), with chromosomes of about a quarter the size of the normal, was crossed with a normal plant and gave 8 male sterile seedlings, two of which were examined. One of them (Fig. 1, *B*) proved to have chromosomes of normal size for the species. The other (Fig. 1, *C*) has chromosomes of more than twice this size.

I have found similar differences in crosses between *Festuca arundinacea* and *F. pratensis*[4].

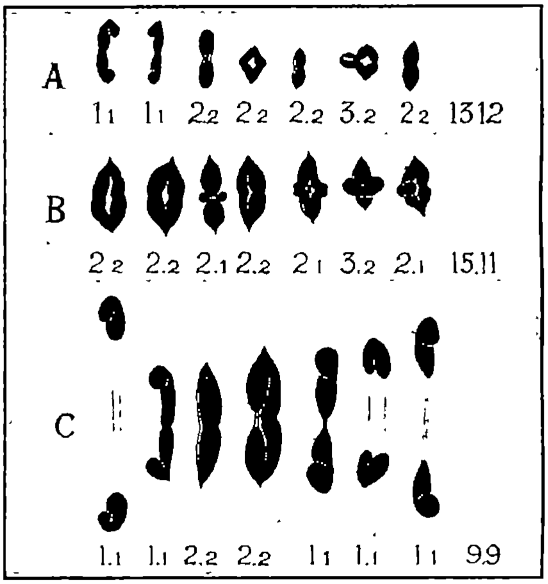

Fig. 1. Metaphase and early anaphase bivalents in three *Lolium perenne* plants. *A* is the female parent of both *B* and *C*. Total and terminal chiasmata are given under each bivalent. Aceto-carmine preparations. × about 1,700.

Further study will be necessary to determine the mode of inheritance of this character, but the present observations prove that it is subject to Mendelian segregation. They therefore throw doubt on statements that characteristic chromosome size differences between species are maintained in their hybrids. Some of these statements have already been disproved[5].

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August 5.

[1] Darlington, *Amer. Nat.*, 66, 25 (1932).
[2] Darlington, *J. Genet.*, 21, 207 (1929).
[3] Jenkin, Welsh Plant Breeding Station Bull., *H*.12 (1931).
[4] Jenkin, *J. Genet.*, 28, 205 (1934).
[5] Upcott, *J. Genet.*, (in the press).

Behaviour of Local *Drosophila melanogaster* during Late Larval Stage

During March 1935 a few local *Drosophila* flies which emerged from the soil and leaves of a millipede culture of Dr. N. F. Paterson were collected, and a culture was started. The stock proved to be of good viability; the flies were identified as *Drosophila melanogaster*. After the cultures had been kept for a few generations it was observed that the larvæ of this 'Witwatersrand' stock displayed an interesting difference in behaviour compared with the standard *D. melanogaster* cultures. During their late larval stage, the larvæ of the latter, in order to pupate, creep up against the side of the culture bottle, whereas those of the 'Witwatersrand' stock only very occasionally behave in this manner, the great majority pupating on or even in the culture medium. We tentatively labelled this behaviour as 'positive hydrotropism' in contrast to the general 'negative hydrotropism' of *D. melanogaster*.

This positive behaviour apparently is the cause of the high percentage of wing abnormalities observed in our 'Witwatersrand' cultures, for when the flies emerge from the moist culture medium their wings often fail to unfold normally.

On April 14 this year, a random culture of our Witwatersrand stock was used for two series of selection experiments, a negative and a positive series. This culture had eight pupæ on the side of the bottle and between 150 and 200 on the culture medium. The negative series started with the eight pupæ removed from the side of the bottle, and the positive series with the pupæ on and in the culture medium. This method of selection was effected for each generation obtained. It follows that the number of parents each time for the negative series was very small in comparison with that of the positive series. This notwithstanding, the eight generations so far obtained for the negative series show an average of 38 negative pupæ per generation, and an average of only 10 negative pupæ for the six generations so far obtained for the positive series. The negative pupæ in the latter, after being counted, were always destroyed, and only the positive pupæ used; in the former only the negative pupæ were used.

It seems justified to conclude that this negative behaviour differs innately from the general positive behaviour of our Witwatersrand stock. Probably multiple factors are involved. This general positive behaviour again differs innately from the general negative behaviour of the standard stocks of *Drosophila melanogaster*.

Furthermore, several experiments have been made to cross our Witwatersrand stock with the standard *D. melanogaster* stocks, but without success.

It seems reasonable to conclude that our local Witwatersrand stock must belong to a geographic race of *D. melanogaster*.

We are indebted to Dr. Smart of the British Museum and to Dr. Paterson of the University of the Witwatersrand for the trouble taken to identify the flies, and also to Messrs. Paff and Bosazza for the photographs taken.

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July 8.

Creeping Movements of *Spirogyra*

THERE are several references in the literature to the movement and behaviour of masses of the alga *Spirogyra* when kept under water in a vessel. Hofmeister[1] described the unravelling of the filaments into wave-like hanks; this he believed to be due to the action of light. The same author, Oltmanns[2] and Langer[3] have also described the way in which the algal threads creep considerable distances up the sides of a containing vessel. Oltmanns suggested that the latter movement might be related to a secretion of mucilage from the cells. Langer showed that it was not a growth movement, and that it took place more rapidly and vigorously in the dark than in the light.

We have carried out a series of experiments to discover the effect of non-plasmolyzing solutions of various electrolytes and non-electrolytes upon the extent of these creeping movements in a species of *Spirogyra* tentatively named as *S. longata* Vauch. The method employed was the same for all experiments. A fixed quantity by weight of the alga was placed in a series of different solutions of electrolytes and non-electrolytes in tap water, of concentrations ranging from 0·0 per cent to 1·0 per cent contained in similar test-tubes. The volume of the solution was constant for all the experiments. Since it was found that light had an inhibiting effect upon the creeping movements, the experiments were carried out in the dark. Measurements of the heights climbed above the meniscus of the solution were made after a period of twenty-four hours.

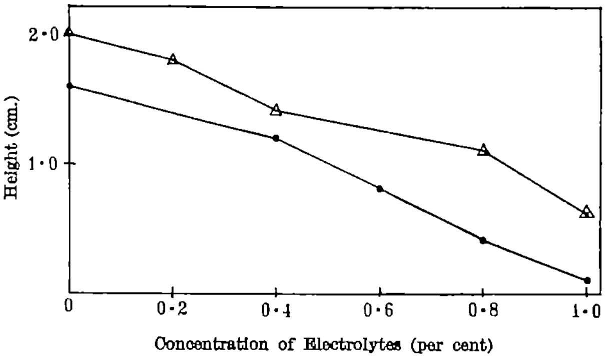

FIG. 1. Graph to show the relation between the extent of climbing and the concentration of electrolytes; —△—△—, potassium nitrate; —●—●—, sodium chloride.

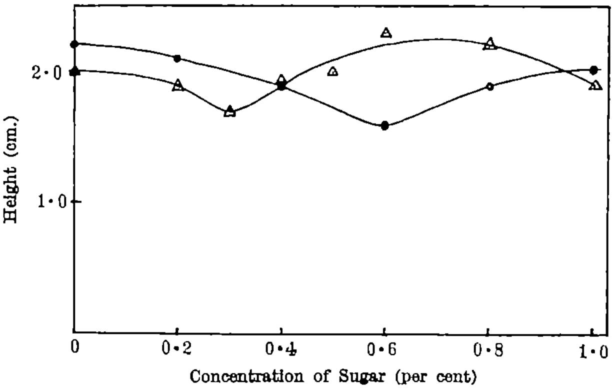

FIG. 2. Graph to show the relation between the extent of climbing and the concentration of non-electrolytes; —△—△—, sucrose; —●—●—, dextrose.

Using electrolytes such as sodium chloride and potassium nitrate, it was found that with increasing concentration of the electrolyte there was a corresponding decrease in the climbing effect. This is illustrated by Fig. 1.

Using non-electrolytes such as dextrose and sucrose, it was found that up to a certain definite concentration the behaviour was very similar to that obtained using electrolytes. Beyond this point, however, the effect was reversed and a further increase in concentration caused an increase in the extent of climbing (Fig. 2).

There seems to be a parallel between our observations on the effect of sugars upon the extent of climbing of these algal filaments and those of Maige and Nicolas[4] upon the effect of sugar solutions on the respiratory activity of various plant tissues. The latter showed that, during the first period of immersion in a sugar solution, a plant tissue showed a period of decreasing respiratory activity followed by one of increasing activity during the period of sugar penetration.

It is hoped to carry out further experiments to determine the effect of electrolytic and non-electrolytic solutions upon the rate of respiration of this alga, and also to develop a more accurate quantitative method of measuring the extent of the climbing phenomenon.

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[1] Hofmeister, Jahresber. ver. Vaterl. Naturkunde, Würtemburg, **30** (1874).

[2] Oltmanns, "Morphologie. u. Biologie der Algen". Band 1 (1922)

[3] Langer, "Folia Crypt.", 1 (1930).

[4] Maige and Nicolas, *Ann sci. nat. Bot*, Sér. 9, **12** (1910).

The Electric Quadrupole Moment of the Nucleus ${}^{127}_{53}$I

THE hyperfine structures of many terms in the arc, as well as in the first spark, spectrum of iodine show deviations from Landé's rule[1]. As Murakawa has pointed out, the cause of this may be an electric quadrupole moment of the nucleus. The existence of such nuclear quadrupole moments was shown for the first time by Prof. H. Schüler and me in europium and cassiopeium[2]. The exact theory was given by H. Casimir[3]. In the case of iodine the frequent occurrence of deviations leaves no doubt that they are due to the same cause. Because the electronic structure of the terms is very complicated, most of them are not suited for a determination of the quadrupole moment. The best term is $5p^4\,6s\;{}^4P_{5/2}$ of I I measured by Tolansky. Its eigenfunction is approximately the product of the $6s$ eigenfunction and the eigenfunction of the $5p^4\;{}^3P_2$ term of I II. The latter can be determined from the coarse structure, using the theory of intermediate coupling. By calculations analogous to those for bismuth[4] one gets from Casimir's formula and Tolansky's measurements a value of about $-\,0{\cdot}2 \times 10^{-24}$ for the nuclear electric quadrupole moment of iodine. That the sign is negative, one may infer also from the term $5p^3\,({}^2D)\,6s\;{}^3D_2$ measured by Murakawa.

Two remarks should be added: first, Murakawa and Tolansky have determined the spin of iodine only by means of the interval rule. As we know it fails in most terms, the value of 7/2 cannot be excluded at present. Secondly, the structure of ${}^4P_{5/2}$ of I I was deduced by Tolansky under the assumption that the combining higher levels have no perturbation. His measurements on several lines seem to show that ${}^4P_{3/2}$ and most of the higher levels have deviations in the same direction as ${}^4P_{5/2}$. This would make the deviation in ${}^4P_{5/2}$ somewhat greater.

All one can say at present is, that the sign of the quadrupole moment is negative and that its value is smaller than $-\,0{\cdot}5 \times 10^{-24}$. The negative sign indicates that the charge distribution is flattened in the direction of the spin axis. It may be noted that the positive quadrupole moments now determined (^{75}As, ${}^{151,\,153}$Eu, ^{175}Cp, ^{201}Hg) have values ranging up to 5×10^{-24}, whereas the negative quadrupole moments (${}^{63,\,65}$Cu, ^{127}I, ^{209}Bi) all have values[5] smaller than $-\,0{\cdot}5 \times 10^{-24}$.

Note added in proof: Recently, L. A. Strait and F. A. Jenkins[6] have shown by means of intensity measurements in the band spectrum that the spin of iodine is 5/2.

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[1] S. Tolansky, *Proc. Roy. Soc.*, **152**, 663 (1935); *Proc. Phys. Soc.*, **48**, 49 (1936); K. Murakawa, NATURE, **137**, 1030 (1936).

[2] H. Schuler und Th. Schmidt, *Z. Phys.*, **94**, 457 (1935); **95**, 265 (1935).

[3] H. Casimir, *Physica*, **7**, 719 (1935).

[4] H. Schuler und Th. Schmidt, *Z. Phys.*, **99**, 717 (1936).

[5] H. Schuler und Th. Schmidt, *Z. Phys.*, **98**, 430 (1936).

[6] L. A. Strait and F. A. Jenkins, *Phys. Rev.*, **49**, 635 (1936).

IN the preceding note, which the Editor of NATURE has been good enough to let me see in advance of publication, Schmidt, following Murakawa[1], suggests that the frequent occurrence of perturbations in terms of both the arc and spark spectra of iodine indicate a nuclear quadrupole moment. This may be correct, but as I have shown that at least in the spark spectrum[2] term interaction perturbation occurs, and in view of the complex electronic structures involved, it is very likely that the perturbations may be due to either of the above causes or possibly both, depending upon individual terms (that is, if a quadrupole moment is assumed to exist). This fact makes caution desirable and any calculation of the quadrupole moment can only be very approximate. Schmidt has been obliged to employ my measurements for the arc spectrum, and as I have previously pointed out, the structures in this spectrum are not so well resolved as in the spark spectrum. His calculation is therefore based upon a small deviation from the interval rule in which I was not able to prove whether more than one level was affected, so that the type of perturbation is uncertain.

Regarding Schmidt's suggestion that the spin may be 7/2, it may be pointed out that Murakawa[3] (spark spectrum), Tolansky[4] (arc spectrum, spark spectrum) and Lacroute[5] (Zeeman effect) all give 5/2. This value may be considered as certain, therefore, particularly in view of the Zeeman effect support.

The approximate quadrupole moment suggested by Schmidt is of course only tentative. I am engaged now in investigating the fine structures in the ultraviolet lines of the iodine spectra with the view of obtaining further data.

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[1] K. Murakawa, NATURE, **137**, 1030 (1936)

[2] S Tolansky, *Proc. Phys. Soc.*, **48**, 49 (1936).

[3] K. Murakawa, *Sci. Pap. Inst. phys. chem. Res. Tokyo*, **20**, 285 (1933).

[4] S. Tolansky, *Proc. Roy. Soc.*, A, **149**, 269 (1935); *Proc. Roy. Soc.* A, **152**, 663 (1935); *Proc. Phys. Soc.*, **48**, 49 (1936).

[5] P. Lacroute, Thesis (Faculty of Science, University of Paris, Nov. 1934).

Monomolecular Layers of Chlorophyll

IN order to study the properties of monomolecular layers of chlorophyll, a mixture of the modifications *a* and *b* in the proportion 3 : 1 (the proportion encountered in living plants), furnished by Prof. Stoll of Basle, was dissolved in ether or acetone. The solution was first added to pure water, to 0·01 normal and to 0·1 normal sulphuric acid. The relation obtained between area and pressure showed that a monomolecular layer actually is formed. No noticeable difference was found between the case of pure water and that of the acid, so that all the results can be incorporated in Curve I (Fig. 1). The spreading with a solution in acetone is recommended because on account of the greater volatility of the ether, traces of solid chlorophyll frequently remain at the opening of the pipette, making it more difficult to obtain reproducible values. Curve I corresponds to a film of the liquid type. The limiting area per molecule at zero compression is 124 A.^{2}, a value in satisfactory agreement with the value of about 133 A.^{2}, recently given by Hughes[1]. The small difference probably is due to impurities. At a pressure of about 26 dynes per cm. the film becomes polymolecular, the curve becoming a horizontal line.

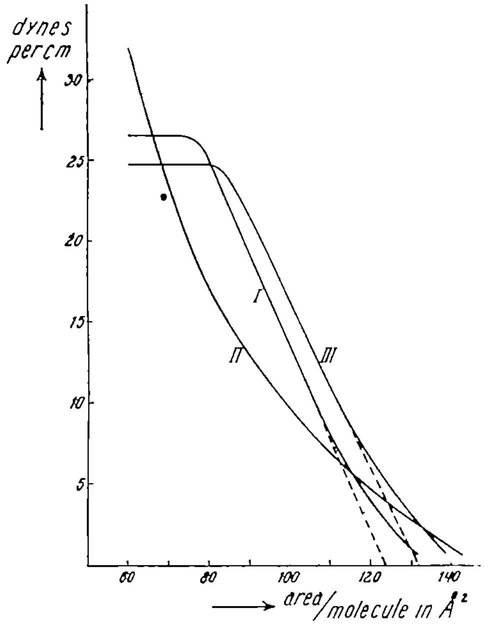

FIG. 1.

As the chlorophyll molecule possesses several double bonds, another curve was expected when spreading on an acid solution of potassium permanganate. This expectation proved to be justified. Curve II was obtained on a 1 per cent solution of potassium permanganate in 0·1 normal sulphuric acid. Over the whole range, but more particularly at small pressures, the film is more compressible than the films previously studied. It was impossible for us to measure the pressure where the film becomes polymolecular, this pressure being too high for registration by the instrument used.

Finally, the behaviour of chlorophyll on water containing carbon dioxide was studied. Great care had to be taken not to have the water oversaturated with carbon dioxide. Ultimately the experiments were carried out on water in equilibrium with carbon dioxide at one atmosphere. The results are contained in Curve III. The molecule appears to require a greater space under the influence of carbon dioxide, having a limiting area of 132 A.^{2}. That this is not due to the acid character of the solution is indicated by the experiments on sulphuric acid. The pressure required to make the film polymolecular is slightly less than in the case of pure water. Experiments with nitric oxide showed that this gas, which in its physical properties (solubility, etc.) strongly resembles carbon dioxide, has no effect.

In conclusion, I wish to express my thanks to Prof. E. Gorter in Leyden for the loan of a Langmuir trough of special construction, which enabled me to work in atmospheres other than air. Also I am much obliged to Prof. Prins for putting at my disposal the sample of chlorophyll and for suggesting the investigation on water containing carbon dioxide, to Dr. J. H. P. Jonxis for valuable advice concerning the technique of the experiments, to Dr. R. de L. Kronig for stimulating discussion and to Messrs. J. Vermeer and F. H. Robaard for their kind help in the performance of the measurements.

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July 30.

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[1] A. Hughes, *Proc. Roy. Soc.*, A, 155, 710 (1936).

Contact Potentials of Reversible Soluble Films of Lauric Acid

WHEN a nearly saturated solution of lauric acid in distilled water is placed in an Adam-Jessop film-pressure trough, the soluble adsorbed film may be compressed or swept in the same manner as an insoluble film of a higher fatty acid. However, the surface is rapidly replenished by diffusion from below, after sweeping, or the compressed film diffuses downward. In either case the reading of the film-balance returns to zero, in a period of about thirty minutes at 25° C. Similar effects have been noticed with benzopurpurin solutions[1] and with soap solutions[2]. Since the contact potential of solutions is proportional to the concentration of the surface-active solute, simultaneous contact potential measurements with a polonium-covered silver electrode on the above surfaces might be expected to yield potential-time curves nearly parallel to the force-time curves. Such proved to be the case, with the following notable differences.

Referred to a pure water surface as zero, the contact potential of a nearly saturated surface of lauric acid solution is −120 mv. Upon sweeping rapidly, the surface tension of the swept surface rises about five dynes and returns to its original value slowly. The surface potential immediately after sweeping rises to 0 mv., and falls rapidly to − 100 mv. in twelve minutes, whilst the surface tension has changed but a dyne per centimetre. This result is to be expected, since the first film to be formed by diffusion from below is necessarily dilute, and contributes but a small surface pressure, but a large change in surface potential. After twelve minutes the film becomes more close-packed, and the surface tension falls more rapidly, while the potential changes but slightly, in complete accordance with the results of Harkins and Fischer[3] on lauric acid films spread by the aid of a solvent.

Upon compression, the pressure may rise to so high as 25 dynes per centimetre, while the potential drops to − 200 mv. Both surface potential and surface pressure return to their equilibrium values in half an hour, the surface pressure falling very rapidly, due to solution of the compressed film, to a value of 6 dynes per cm., in two minutes. This is again in accordance with expectations, since Harkins and Fischer found that a highly compressed film of lauric acid lowers the surface potential about 80 mv. more than that of a dilute film.

These results indicate that (1) the time element is very important in the determination of surface tension of solutions of surface-active materials, (2) determinations of surface potentials by dynamic methods (such as Kenrick's jet method) are unsuited for examination of solutions of materials such as these which require considerable time for equilibrium in the surface.

The work is being continued on solutions of undecylic acid.

The results obtained by Bouhet[4] by an optical method may be mentioned as further evidence that sweeping a solution of a higher fatty acid removes the adsorbed film, the swept surface then having the physical properties of a pure water surface.

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July 31.

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[1] Doss, *Current Sci.*, 4, 405 (1935).
[2] McBain and Wilson, private communication, and *J. Amer. Chem. Soc.*, 58, 379 (1936).
[3] *J. Chem. Phys*, 1. 852 (1933).
[4] *Ann. Phys.*, x, 15, 5 (1931).

Dissociation Pressure of Copper Sulphate Pentadeuterate

J. R. PARTINGTON and K. Stratton[1] have found by a tensimetric method the dissociation pressure of copper sulphate pentadeuterate to be 6·655 mm. Hg at 25° C., and 9·285 mm. Hg at 30° C. One of us, in collaboration with H. Perpérot[2], has constructed a tensimeter by means of which he ascertained in a preliminary experiment that the dissociation pressure of copper sulphate pentadeuterate is lower than that of the pentahydrate. Continuing this research, we have modified the original tensimeter so that the pressures are now measured by means of an ordinary shortened manometer instead of a differential one, the new results being as follows :

° C.	20	30	40	50	60
mm. Hg	4·4	9·9	21·0	42·1	80·9

For 25° the value of 6·5 mm. Hg is found by interpolation.

The pressures obtained are in good accord with those measured by Partington and Stratton, giving in addition a wider range of temperature. The value published in collaboration with H. Perpérot[2], which is mentioned by F. T. Miles, R. W. Shearman and Alan W. C. Menzies[3], was not intended to be exact, as is seen from the fact that it was rounded off to whole units and mentioned only in passing in a paper describing the apparatus, and is decidedly a little too low, whereas the measurements of Miles, Shearman and Menzies lead, on the contrary, to dissociation pressures a little too high, if we understand these authors rightly.

The aim of the communication published with H. Perpérot was not to give a precise value of the dissociation pressure of copper sulphate pentadeuterate, but to show only that this pressure is lower than that of the pentahydrate, which is corroborated by experiments of the authors quoted.

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August 1.

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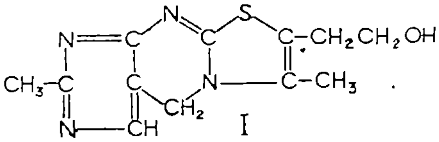
[1] NATURE, 137, 1075 (1936).
[2] *J. Phys. et le Rad.*, vii. 6, 439 (1935).
[3] NATURE, 138, 121 (1936).

Synthesis of Thiochrome

THE formation of thiochrome by oxidation of aneurin (vitamin B_1) with alkaline potassium ferricyanide was first reported in these columns[1]. Continuation of our synthetic work[2] has resulted in the synthesis of thiochrome. 2-Methyl-4-chloro-5-chloromethylpyrimidine, synthesized from 2-methyl-4-hydroxypyrimidine-5-acetic ester, was condensed with 2-amino-4-methyl-5-β-hydroxyethylthiazole. The condensation product (I) proved to be identical with thiochrome prepared from aneurin ; the melting point of both substances was the same (225°–226°) and the melting point of the mixture showed no depression.


I

The intense blue fluorescence shown by thiochrome appears to be a property of the condensed ring system present in the molecule, for we have prepared other compounds of this type, all of which have a similar fluorescence. This synthesis affords independent proof of the structure of aneurin, the synthesis of which has just been reported by Williams and Cline[3].

Full details of the work will be published elsewhere.

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The Amylase System of Rice Grain during Ripening and Germination

THE formation and properties of α- and β-amylases in germinating grains have been frequently studied by many investigators. Some workers[1] believe that dormant grains contain only β-amylase which increases during germination, while α-amylase appears only during sprouting. Others[2] consider that the increase in amylolytic activity during germination is not a fresh enzyme formation, but is due to an activation by an activator of organic nature, 'amylokinase', which arises during the process of germination, or to an increase in the soluble part of the amylase, especially in the case of the β-component, which increase is based on proteolytic decomposition. Our researches on the amylolytic changes during ripening and germination of rice grains have thrown fresh light on this important question. The results thus far obtained may be briefly summarized as follows.

The rice grain contains both α- and β-amylases, which are differentiated by their hydrolysis on amyloamylose, according to the method introduced by Samec and Waldschmidt-Leitz[3]. These two amylases are further differentiated by their differences in *p*H optima, the α- and β-amylases having their optima at *p*H 7·0 and 4·6 respectively. At their optimum *p*H, they behave like pure α- and β-amylases in their hydrolysis of amyloamylose. In the case of the amylase the optimum *p*H of which lies at *p*H 7·0, the iodine colour end-point (violet) was reached without any measurable maltose formation. This observation demonstrates for the first time the occurrence in plants of an amylase of *p*H optimum 7·0, which in the early stages of starch digestion yields no reducing groups.

These two enzymes are present in the dormant seed, and exist largely in the insoluble condition, so that they cannot be extracted with water, but they can be obtained in an active state by extraction with phosphate buffer (*M*/15) at *p*H 7·0. The α-amylase becomes inactive (in the sense that it cannot be extracted with water) as ripening advances, and again becomes active during germination. In the light of these findings, it can be said that the view put forward by Ohlsson and co-workers, that the amylase arises only during the germination of grains, is untenable. Further work on the behaviour and nature of these enzymes during germination and storing, their distribution in the seed and their relation to the cooking quality of rice is in progress.

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Points from Foregoing Letters

WHEN beryllium is bombarded by fast neutrons, a radioactive substance is produced of half-period about one second. New experiments by Dr. T. Bjerge show that it is a gaseous substance, probably helium of atomic mass six or five. The energy distribution of the β-rays (electrons) emitted by this radioactive gas has been measured by Dr. T. Bjerge and Dr. K. J. Brostrom, and agrees with the view that the electrons arise during the transformation of helium atoms of mass six into lithium atoms of the same atomic mass.

The probability for the production of secondary electrons when a fast primary electron passes through various thicknesses of matter has been calculated by H. J. Bhabha and Dr. W. Heitler. A primary electron of 2×10^9 electron volts energy, passing through a thickness equivalent to 1·6 cm. of lead, produces, on the average, two positive and two negative electrons, with energies greater than 2×10^7 e.v.

M. S. Bartlett discusses further aspects of the uncertainty principle applied to time, and conceives that, in relation to an ideal time defined in terms of the number of interactions that take place, our observable time may slow down, as the universe approaches equilibrium. Such a 'slowing down' of observable time would be equivalent to an expanding universe or a decrease in the velocity of light.

The occurrence of chromosomes of double normal size in a male sterile specimen of the perennial rye-grass, *Lolium perenne*, is described by P. T. Thomas. The mode of inheritance indicates that chromosome size is subject to Mendelian segregation.

Drosophila cultures derived from flies collected on the Witwatersrand and bred by Dr. G. Eloff, although identified as *D. melanogaster*, nevertheless show a remarkable innate difference in behaviour in that during late larval stage, contrary to the general behaviour of the standard *D. melanogaster* cultures, the larvæ stay on or even in the culture medium in order to pupate; also, crosses between the two types of stocks are sterile.

Spirogyra, in the dark, climbs up the sides of the containing vessels. Solutions of electrolytes such as sodium chloride or potassium nitrate up to one per cent in concentrations—which do not produce collapse due to loss of water (plasmolysis)—are found by D. R. Chesterman and C. L. Foster to reduce the creeping. With non-electrolytes the behaviour up to a definite point is similar; beyond this point it is reversed. The authors suggest that these results may be related to effects upon the respiratory activity of the algal cells.

From measurements of the iodine hyperfine structure Dr. Th. Schmidt concludes that the iodine nucleus has a negative electric quadrupole moment smaller than $-0{\cdot}5 \times 10^{-24}$. The negative sign means that the charge distribution is flattened in the direction of the spin axis. Dr. S. Tolansky points out that the perturbations upon which Dr. Schmidt's calculations are based may have a different origin, and therefore the approximate quadrupole moment suggested can only be considered tentative.

From experiments with monomolecular surface films of chlorophyll, W. Sjoerdsma finds an area per molecule of 124 square Angstrom units. Under the influence of carbon dioxide, the chlorophyll molecules appear to require a greater space (132 $A.^2$).

The rate of change in surface pressure and in the contact electrical potential when the surface of a solution of lauric acid is swept clean of its adsorbed film and the lauric acid allowed to re-accumulate at the surface, by diffusion from the interior of the solution, have been determined by R. T. Florence, R. J. Myers and Prof. W. D. Harkins. They point out that possible variations due to the time factor must be taken into account when measuring the surface tension or surface potential of such solutions.

Research Items

Social Origins in India

Two things in the social organization of India immediately strike the observer, it is pointed out by K. P. Chattopadhyay (*J. Asiat. Soc. Bengal. Letters*, 1, 1935) in discussing peculiarities of caste in relation to early racial movement. One is the peculiar system of endogamy combined with exogamy running through the whole system, the other is that the giving of food and drink, or acceptance thereof, between different social groups depends on certain ideas of purity associated with the groups. In the course of further discussion, it is also noted that theories of caste, which have been put forward, tend to ignore local differences. Applying to conditions in India the results of an analysis of culture and the effects, issuing in rivalry and group isolation, presumably produced by racial migrations, it would appear that there were not two, but three cultured peoples who contended for mastery in India and built up the caste organization. Of two early streams of culture bringers one was a fisher folk, who were acquainted with, or later acquired, knowledge of iron and practised a rude form of agriculture, comparable to jhuming, but not terracing or systematic irrigation. Another people worked copper, silver and gold and practised terraced irrigation with hoe cultivation. Cattle were valued for meat only. A third stream of later date is associated with cattle for dairy work, but not for plough cultivation. This last-named employment of cattle is associated with another people, who sometimes preceded and sometimes followed the dairy folk. With this people and the people of the hoe cultivation is a tradition of origin from, or occurrence of, incestuous unions of brothers and sisters. The fisherfolk practised burial, at first in the house, but the hoe culture people practised cremation. In some instances the burial people, after being submerged, again recovered and then a formal, but not actual, cremation was made to precede burial. Alliances between different groups and bitter struggles appear to have taken place before equilibrium was reached and the caste system evolved.

Hormones and Evolution

In a communication recently presented to the Royal Anthropological Institute, Dr. S. Zuckerman discusses the evidence bearing upon the relation of hormones to the evolutionary problem (*Man*, 1936, August). How far, it is asked, is the endocrine system responsible for physical and psychological characteristics; what value is to be attached to Bolk's view of the endocrine mechanism as one through which man has become a fœtalized primate? Does the so-called hormone theory of evolution in fact reveal some novel evolutionary mechanism? Recent research has largely justified the *a priori* view that all the characteristics of the organism are moulded by an endocrine mechanism to subserve the developmental integration of the various bodily systems, in order that the correlated action of an organism as a whole should be possible. At the same time, physical and psychological characters are dependent on an enormous number of factors besides hormones. There is not the slightest direct experimental evidence in support of the view that different individuals and different racial types possess distinctive types of endocrine balance. We do not yet possess the data for making definite interpretations of racial types in terms of hormones. There is a correspondingly unfortunate lack of evidence in Bolk's view of the fœtalization of man, and within the order of primates an orderly process of fœtalization cannot be recognized. Yet it is not unlikely that human evolution may have proceeded by a series of changes in the endocrine complex; but we are defeated in any attempt to find in this conclusion some novel understanding of the evolutionary process. The endocrine complex, like any other character, is genetically determined, and we have no knowledge that the effect of its response to environmental influence is transmitted to a succeeding generation. The available facts of endocrinology provide no measuring rod by which to estimate the divergence between different racial types.

Sickness Absence and Labour Wastage in Industry

An attempt has been made by the Industrial Health Research Board of the Medical Research Council, by an investigation of data furnished by several organizations, to obtain some sort of datum line by which absenteeism due to sickness and wastage by lapsing from employment may be evaluated (Report No. 75. London: H.M. Stationery Office. 1*s*. 3*d*. net). This Report is divided into two parts, sickness being dealt with by May Smith and Margaret Leiper in Part i, and labour wastage by Major Greenwood and May Smith in Part ii. The measurement and incidence of sickness absence in clerical work and light organizations are considered, and in two large groups examined the rates for men are 3 days and 4½ days respectively, and for women 4 days and a little more than 6 days, per year. The crude rates obtained are subject to various fallacies, for example, long periods of absence due to serious illness of two or three workers may upset any simple arithmetical ratios obtained. Respecting labour wastage, the problem to be solved is discussed, the crude wastage rate is considered, and an 'industrial life table' is constructed. The actual labour wastage in two organizations is then studied, and various interesting features emerge from the analysis. Finally, suggestions are made for recording and analysing sickness absenteeism and labour wastage.

False-killer Whale in Scotland

Two papers dealing with the recent stranding of false-killer whales (*Pseudorca crassidens*) in Britain record an exceptionally interesting occurrence (*Scottish Naturalist*, 1936, p. 93). The greatest stranding, of forty-one individuals, took place in the Tay Estuary on November 27, 1935; but odd occurrences of single individuals or of small groups up to eleven in number which took place between November 16 and December 10, and ranged along the east coast from Norfolk to Montrose, show that a considerable movement must have been taking place in the North Sea. Prof. A. D. Peacock and his collaborators have recorded minutely the measurements and other striking characters, of the Carnoustie school of whales, reserving more detailed studies for later publication.

Hydroids from the West Indies

DR. EUGÈNE LELOUP in his monograph "Hydraires Calyptoblastiques des Indes Occidentales" (Mémoires du Musée Royal d'Histoire Naturelle de Belgique, Deuxième Série, Fasc. 2, 1935) describes collections made by P. Wagenaar Hummelinck on his voyage in 1930 to the West Indies, especially to the Islands Bonaire, Curaçao and Aruba. With these are specimens taken from floating Sargasso weed in the Atlantic and a series of calyptoblastic hydroids dredged at Dry Tortugas (Florida), the last sent by Dr. Waldo L. Schmitt, Smithsonian Institution, U.S. National Museum. Among these hydroids, four are found for the first time in the Atlantic : *Halecium dyssymetrum* from Florida, hitherto only known from the East Indies, and for the first time recorded since the type specimens were described; *Synthecium cylindricum* var. *pusilla* on Sargassum weed, previously known only from the Pacific ; *Laomedea kincardi* and *Sertularella minuscula* from Bonaire, previously known only from the Pacific and from the Indian Ocean respectively. Several other forms are reported for the first time since the discovery of the type specimens, and many are new records for certain localities. Among the fifty species and varieties described there are three new to science.

Principal Rots of English Oak

A SMALL volume on this subject by Messrs. Cartwright and Findlay of the Forest Products Research Laboratory has been issued by the Department of Scientific and Industrial Research (London : H.M. Stationery Office, 1936). Existing knowledge and recent work carried out at the Laboratory on the principal fungi causing decay in English oak are detailed and illustrated. One of the fungi attacking the tree is known as the beef-steak fungus, and the attack increases the value of the timber, producing the so-called 'brown oak' which fetches a higher price and is much valued in France. The report states that the general measures for controlling the attack of heart-wood of trees by fungi are the prevention, by sylvicultural methods, of the formation of large branches which may die by becoming infected with fungi. Attacks of this nature are serious in parts of England; but in some of the best managed oak forests in France are unknown. Probably one of the best preventives is to keep the young plantations dense and thin lightly in the earlier stages of growth; and to grow oak in mixture, preferably when possible with its natural companion beech. The economic aspects of the various rots of felled timber are dealt with ; and a final section treats of the stains and discolorations of oak wood such as 'golden oak', yellow, grey stains and chemical stain.

Composts for Mushroom Growing

THE food requirements of the common mushroom have not yet been determined with accuracy, though a considerable amount of success has been obtained with composts of a more or less synthetic nature. Mr. G. Paterson-Hart has described a number of such mixtures (*Gard. Chron.*, Aug. 1, 1936). Soya bean compost, a mixture of bean straw with tree leaves, and sphagnum moss impregnated with stable drainage, have proved fairly successful. Straw, covered with soil, and impregnated with salt solution, has grown mushrooms, whilst grass cuttings, ditch clearings, tree leaves and straw, when mixed and covered with mould, make quite a successful bed. The problem would seem to be to identify the common factor in all these different mixtures, and also in such varying habitats as stable sand dunes and heathy woods, where the fungus grows naturally.

Air Conditioning in Living Rooms

A SIMPLE device for humidifying air to a degree best suited for breathing has been developed by the A.E.G. Co. of Berlin and is described in *A.E.G. Progress*, No. 2, 1936. The water to be evaporated is contained in a tank in which rests a frame with capillary pads consisting of absorbent blotting paper overlapped and sewn together. These pads are completely saturated with water and can be readily replaced. The evaporation of the water is accelerated by an electric fan built into the back wall of the protective case. With a relative air humidity of 50 per cent and a temperature of 68° F., the apparatus evaporates about 7 oz. of water per hour. It is found that one filling of water is sufficient for eight hours operation. The quantity of water evaporated varies to a certain extent with the condition of the air, the rate increasing with the heat and the degree of dryness. The apparatus has been found useful in living rooms where the atmosphere gets close, in nurseries, in offices where smoking is allowed, as well as in hotels, hospitals, etc. In countries where a dry and warm summer climate has already rendered the electric fan indispensable, the apparatus is particularly useful, producing a refreshing and vitalizing effect.

The Nitrous Oxide Molecule

ALTHOUGH the molecules of carbon dioxide and nitrous oxide are both linear, it is known that one is symmetrical and the other unsymmetrical :

$$\mathrm{O} = \mathrm{C} = \mathrm{O} \qquad \mathrm{N} \underline{\leftarrow} \mathrm{N} = \mathrm{O}.$$

Cheng E. Sun and Ta-You Wu (*J. Chinese Chem. Soc.*, 4, 340 ; 1936) show that this difference may be explained by the energy contents of the two molecules. They used the semi-empirical method of Eyring and found that the unsymmetrical form of nitrous oxide has a lower energy content than the symmetrical form, whilst the reverse is the case with carbon dioxide. Although the method is only approximate, the differences between the energies of the two forms are sufficiently large to be significant.

Recent Advances in Enzyme Chemistry

IN a summary of recent work on enzymes, Prof. E. Waldschmidt-Leitz (*Chemistry and Industry*, 55, 620 ; 1936) points out that crystalline enzymes (urease, pepsin, trypsin, etc.) are all proteins, yet the reactions show that an enzyme cannot merely be a protein, the existence of a specific active grouping being necessary for enzyme differentiation. An iron porphyrin complex is the active group of liver and pumpkin catalases as well as of the peroxydase of horse-radish. A low molecular weight flavine compound, vitamin B_2, when connected with a protein carrier, becomes a true enzyme, the yellow respiratory ferment. The 'two-affinities' theory of von Euler, according to which an enzyme must be capable of reacting with its substrate at two distinct points in the molecule, is shown to be most defensible. The action of activators (for example, trypsin by enterokinase) is probably due to intermediate compound formation. Many other interesting features of enzyme chemistry are considered in the article.

Plankton Research

A SPECIAL plankton meeting was held by the International Council for the Exploration of the Sea in May 1935. The reports are published in vol. 95 of the *Proceedings* recently published. The papers by F. S. Russell and A. C. Hardy give an excellent picture of some aspects and methods of plankton research. H. Hoglund and S. Landberg report on investigations upon photosynthesis of phytoplankton by constant illumination, and B. Schulz on hydrographical problems.

In Russell's paper, all those studies of zooplankton are reviewed which are concerned with: (1) the distribution and abundance of the plankton in the open ocean and (2) in the coastal waters; (3) the relation of the animals with animate and inanimate environments and the causes of their fluctuation in abundance. A table based on data of various workers brings out facts of great interest, such as the greater number of cold-water species in the south as opposed to the north, the phenomenon of bipolarity of some planktonic species, the small number of purely subantarctic species of copepods, and differences between the faunas of the different oceans. The bearing of the plankton distribution upon the interpretation of hydrographical data is stressed. The author himself, in a notable study of the *Sagitta* population at Plymouth, has found that *S. elegans* is an indicator of Atlantic water and *S. setosa* of Channel water. Another important aspect dealt with is the relations between the plankton and the fish. "If correlations can be shown to hold consistently for a number of years it should be possible to predict certain conditions in the fisheries." Several other problems are discussed and attention directed to the need for further studies of life-histories and habits, food supply, and for more experimental work.

Hardy gives a preliminary account of experiments made by him and the research staff of the Oceanographic Department in Hull in the charting of the North Sea plankton. A new instrument has been used for the survey, the 'continuous plankton recorder'. This is an ingenious torpedo-shaped machine provided with a system of planes and a shock absorber, and inside with two bandings of filtering gauze arranged to wind off two rollers and to pass together into a tank of formalin. By means of a winding mechanism, for every mile of sea through which the instrument is towed a fresh section of gauze samples the plankton. Taken out of the preservative chamber, the number of organisms per division of silk can be estimated. With the co-operation of different steamship lines a programme of surveying was started in 1932. "The main objects of the survey are to chart the broad monthly changes in the density of the plankton along a series of lines across the North Sea . . . to correlate as far as possible the seasonal and yearly variations observed with changing hydrological and meteorological conditions on the one hand, and with fluctuations in the fisheries on the other, and in addition to provide extensive material for the study of ecological relationships between different members of the phyto- and zooplankton." Some promising examples of the results are given showing changes in the production of the phytoplankton and zooplankton in different seasons on the same line, and differences on different lines at the same periods.

B. Schulz reviews the results of hydrographical observations in the Kattegat in August 1931. Very numerous and detailed records were taken simultaneously during a week from five ships (one Danish, one Swedish, one Finnish and two German) lying within a relatively small area. The author summarizes the results as showing that "unperiodical changes of the hydrographical conditions (currents, temperature, salinity) at the points of observation were quite considerably bigger than one would have expected according to our previous knowledge and views. The mixing processes resulting in the Kattegat from the outflow from the Baltic Sea and the inflow from the North Sea are far more intensive and turbulent than was formerly supposed."

The Radio Exhibition at Olympia

THIS year's National Radio Exhibition at Olympia is the eleventh annual event of its kind, and the Radio Manufacturers' Association is to be congratulated on its successful organization of the show, which offered more comfort for the visitor than in the past, and also maintained the spirit of novelty which is so characteristic of this event. For the most part, the exhibition was a display of the vast variety of wireless receiving sets, which are now available to meet practically all the many and differing demands of the broadcast listening public. On a much smaller scale, the needs of the specialist and technically-minded enthusiast and experimenter are catered for, in the way of special components and of receiving sets for use abroad or for general experimental work. The impression was definitely conveyed that this vast industry of some twelve years standing is now firmly planted on its feet; with only a few exceptions, the names of the exhibitors are now almost common household words among the general public.

The general broadcast receiving set of to-day is similar in all essential features to its predecessor, various improvements in detail having been effected where in the past the control of the set has been difficult or inconvenient, or the performance has left something to be desired. It has undoubtedly improved in reliability due to the advanced testing methods adopted by the industry, and this is a feature that many members of the public will greatly appreciate.

The receivers now fall broadly into the two classes, comprising the straight amplifier and detector combination and the supersonic heterodyne type, and in each form separate models are generally available for either battery operation or for connexion to the electric supply mains. In one or two cases a spectacular method of visual tuning has been incorporated in the receiver. The great advance that has taken place in this year's sets, however, is the extension of the tuning arrangements to cover the short wave broadcasting bands. The title 'all-wave' tuning is generally applied to such receivers, but in only one or two cases can the set be tuned continuously from a wave-length in the region of 10–15 metres up to nearly 600 metres. The majority of the 'all-wave' receivers cover the short wave broadcasting bands only, there being gaps in the wave-length scale, where, at present, there are no transmissions of interest to the broadcast listener. Even with this restriction, however, it is necessary to provide the receiver with four separate wave-length bands, selected by an extension of the usual wave-change switch.

The production on a manufacturing scale of such a set in which the tuning on each band is controlled by the same knob, with a pointer reading on scales calibrated directly in wave-lengths, is a technical achievement of considerable merit. It is evident that, following upon the use of short-waves for Empire and other long-distance broadcasting, the reception of such short-wave programmes has now successfully passed beyond the experimental stage.

The other great feature of the exhibition was the demonstration of the present stage of television with the aid of the special test transmissions from the B.B.C. experimental station at Alexandra Palace. At this station separate television transmitters have been installed by the Baird Television Co. Ltd. and the Marconi E.M.I. Television Co. Ltd., and during the course of the radio exhibition these installations were used on alternate days for broadcasting a television programme. The accompanying sound was radiated from a separate transmitter installed by the B.B.C. The wave-lengths in use are 6·67 metres (frequency 45 megacycles per second) for the vision and 7·23 metres (41·5 megacycles per second) for the sound.

The daily programmes were received at the exhibition and demonstrated to the public on a number of receiving sets, the makers of which were not stated. Although naturally the interest displayed by large numbers of visitors precluded the study of the results for more than a short period, the demonstration was sufficient to indicate that the successful reproduction of a television programme broadcast from a station ten miles away is a present-day achievement. For the first time, the public has been enabled to see, as well as hear, the announcer in the studio and a well-known broadcasting singer. The majority of the programme comprised the transmission of sound-films, either constructed specially for this demonstration or extracted from standard news and entertainment films.

In the exhibition hall itself several firms displayed sets suitable for receiving these transmissions, although these were unpriced and were not in operation. The output on the vision side of these sets operates a cathode ray tube of unusually generous dimensions, the largest having a bulb of 22 inches diameter, the luminescent screen providing a picture area of 17½ in. × 13½ in. In most cases it is claimed that these receivers will give satisfactory results on the transmissions from the Alexandra Palace at distances up to 40 miles. In accordance with the recommendations of the Television Advisory Committee, all such receivers are arranged to reproduce the vision programme whether this be emitted on the Marconi E.M.I., or the Baird system.

It would thus appear that the time is ripe for the carrying out of practical and widespread tests of the possibilities of radio-television in Great Britain, although it is natural that some time must elapse before the technique has been simplified and the manufacturing costs reduced to such a point as to make television reception in the home available to the majority of the general public. R. L. S.-R.

Valency and Molecular Structure

By Prof. R. F. Hunter and Prof. R. Samuel

THE connexion between the numerical valency exhibited by an atom and the number of its outside electrons, which prevailed in certain pre-wave mechanical theories of valency and in the theory of Heitler and London, appears to us of fundamental importance to the problem. It cannot be fortuitous that iodine, for example, which possesses two *s*- and five *p*-electrons, exhibits odd covalencies of 1, 3, 5 and 7. Nevertheless, this relationship appears to have been lost sight of in the chemical theories of Lowry, Sidgwick, and others on account of the conception of co-ordinate covalency, in which only electrons belonging to one of the atoms concerned are made responsible for chemical combination. This conception appears to connect these theories with the theory of molecular orbitals (Herzberg, Lennard-Jones, Mulliken) in that chemical linkage is ascribed to the bonding power of single independent electrons, while the formation of pairs is an essential feature of the theory of Heitler and London.

Since valency is an ambiguous term, it is necessary to distinguish clearly between energetical questions and numerical chemical valency. While bond energy may vary from molecule to molecule, the valency number indicates the possibilities for chemical reaction and is a property of the free atom or radical. The maximal valency of the halogens is 7, but since this necessitates the fission of the s^2 group, considerable energy, which decreases with rise in atomic number, is required, so that heptavalency obtains with oxygen in Cl_2O_7 and with fluorine in IF_7. Although we are here mainly concerned with experimental facts, it is necessary to make brief reference to the wave mechanical interpretation of bonding power.

Wave Mechanical Considerations[1].—It is true that in the exchange integral (in formula 11 of Heitler and London's original paper),

$$E_{12}=\int\left(\frac{2\varepsilon^2}{r_{12}}+\frac{2\varepsilon^2}{R}-\frac{\varepsilon^2}{r_{a_1}}-\frac{\varepsilon^2}{r_{a_2}}-\frac{\varepsilon^2}{r_{b_1}}-\frac{\varepsilon^2}{r_b}\right)\frac{\psi_1\varphi_1\psi_2\varphi_2}{2}\,d\tau_1\,d\tau_2,$$

the attraction (negative sign) is produced by those terms which are caused by the terms of the potential representing interaction between one nucleus and one electron. The pure interaction between the electrons themselves (ε^2/r_{12}) gives an effect of opposite sign, and is antibonding. This, however, cannot be interpreted as proof of the bonding power of the single electron. That the whole expression E_{12} is called the exchange integral is not due to this term containing r_{12} representing the interaction of the electrons between themselves, but to the fact that the mere existence of the quantity E_{12} is connected with the use not of the wave function $\psi_1\varphi_2$, but of the wave function $\psi_1\varphi_2 \pm \psi_2\varphi_1$. This, in its turn, is the direct consequence of the degeneracy produced by the identity of the electrons.

Thus, the relation of the electron pair bond theory to the single electron bond theory in the method of molecular orbitals becomes quite clear. In the latter, the same terms appear even without the repulsion term with r_{12}, but the appearance of the double product $\psi_1\varphi_1$ is produced here not by the use of the function ψ_1 but of the function $\psi_1 \pm \varphi_1$. In other words, it is introduced by the identity of the nuclear fields.

From the point of view of a theory of valency, this is of course purely incidental. Chemical linkage is not confined to atoms of the same element, and attempts have therefore been made to explain this by means of a pseudo degeneracy of unequal nuclei, if the interaction is of the order $E_\psi - E_\varphi$, meaning that the valency of an atom not only as regards bond energy, but also in the numerical sense, should depend on the partner, and the greater the difference in the nuclear fields the smaller must be the distance between them to bring about this bonding effect.

The latter point is certainly empirically untrue as seen, for example, from the known diameters of oxides of the first short period. Regarding the first point, since we are not concerned here with the development of a perturbation method of calculation but with a theory of valency, it seems obvious that the valency number of an atom cannot depend on the partner with which it combines, other than in the energetical sense. Indeed the method of molecular orbitals gives incorrect results with regard to the products of dissociation of a molecule, due to neglect of the wave mechanical interaction of the electrons.

Since dissociation is the converse of molecule formation, this confirms our view that the method of molecular orbitals describes the electronic configuration and term system of the completed molecule but is not a theory of valency. Actually, it is unable to distinguish in itself between terms of attraction (molecule formation) and terms of repulsion (elastic collisions), and only becomes a theory of valency by the introduction of a postulate which identifies non-premoted with bonding electrons and premoted ones with anti-bonding. From new spectroscopical data it becomes increasingly evident, however, that this postulate can no longer be maintained.

Spectroscopical Evidence[1].—The number of molecules in which it is possible to correlate the molecular terms with those of the separated atoms has increased considerably of late. Particular interest is attached to the halides and oxides of the second group, in which it has been shown that the ground level of the molecule is correlated, not to an unexcited halogen or oxygen atom plus an unexcited metallic atom with the configuration $s^2\ {}^1S$, but to an excited metal atom with the configuration $sp\ {}^3P$. This now receives confirmation from some ten examples, the most striking of which are those in which the metal possesses high excitation energy. Whenever an excited molecular term appears in which the bond energy is higher than in the ground level, it is correlated to the so-called anomalous terms of the metal atom, in which both the original s-electrons have been simultaneously excited, showing that whenever a second linkage is formed (as in BeO and MgO), it occurs only in the presence of two p-electrons. Whenever an odd-electron molecule is formed (BeF and CaF), the partial removal of the odd electron increases the bond energy, showing that the unpaired electron is always disturbing.

Both these points receive confirmation from molecules of other types. NO, PO, and AsO, and also SiF and SnCl, all show the disturbing influence of the unpaired electron. On the other hand, molecules such as AlO and GaO are formed by the combination of oxygen with unexcited metal atoms of the configuration $s^2p\ {}^2P$, but the molecular term, of which the bond energy is much higher than in the ground level, is formed by the combination of oxygen with metal atoms of the configuration $sp^2\ {}^4P$; the second linkage again occurring only after fission of the s^2 group. These results are incompatible with the theory of the co-ordinate link and show the antibonding character of the closed helium-like s^2 group, which constitutes the 'lone pair' in the majority of cases. While the pair bond conception of valency gives a straightforward and consistent interpretation of these results, the theory of molecular orbitals, on account of its premotion postulate, would predict that molecules such as BeO and BeF would be formed by unexcited metal atoms because they possess an excess of non-premoted (and therefore bonding) electrons.

The difference between an electron pair bond theory of valency and that of molecular orbitals finally finds its expression between localized and non-localized electrons in polyatomic molecules. The first experimental evidence in this connexion has been obtained from a complete vibrational analysis of the band spectra of SO_2 and SeO_2. These results show that the harmonic vibrations, for example, of SeO in its unexcited and excited states, agree closely with two symmetrical valence vibrations of unexcited and excited SeO_2; the energy of electronic excitation being almost identical in the two molecules and the factor of anharmonicity of the ground states, which could not be accurately determined for SeO_2, appears at least to be of the same order. Furthermore, the heat of dissociation of SeO_2 into gaseous atoms is about twice that of SeO. The molecular constants of SO_2 bear the same relationship to those of SO, and the continuous absorption spectra of halides and oxyhalides of sulphur show that the bond energies of the S–Cl, S=O, and S=S bonds are approximately of the same order in widely differing molecules such as SO, SCl_2, $SOCl_2$, S_2Cl_2, and SO_2.

Each of the bonds in polyatomic molecules of this type appears to be localized between two atoms, in accordance with the older structural formulæ of chemistry. It is characteristic that there is one atom which may be regarded as the central atom, and for such cases the Heitler-London theory indicates strong localization of bonds.

Chemical Evidence[3].—It has been shown that the conception of the lone pair of electrons as an agent for true chemical linkage is in direct contradiction to the results of band spectroscopy. In our opinion, the spectroscopical evidence is of the greatest importance for the following reasons. The difference between two non-electrostatic links (normal and co-ordinate covalency) involves a difference of the role played by individual electrons. Physico-chemical measurements such as the parachor, dipole moment, etc., are concerned with the whole electronic cloud of valency electrons, and *a priori* cannot give information as to the part played by a particular electron. This can only be obtained from spectroscopical experiments. It is therefore always possible to interpret the mechanism of chemical linkage from the results of physico-chemical experiments in alternative ways, as has already been indicated in cases of the parachor, optical activity (for example, toluene-sulphonic esters and beryllium benzoylpyruvate), and crystal structure (SiF_6^{--}).

Similarly, the increase in dipole moment accompanying the formation of certain molecular associations in solution observed by Earp and Glasstone[4] is no proof of the presence of a co-ordinate link. The dipole moments of such associations sometimes decrease and sometimes increase, depending on the geometrical position of the constituent molecules as to whether there is a cancelling out, or an increase through induction[5]. The energies of dissociation of such complexes, determined by these and other authors, vary between 1 and 10 k.cal./mol., which is about 1/100 to 1/10 of that associated with a true chemical bond. This, in our opinion, proves conclusively that the complexes are loose associations held together by van der Waals forces.

With regard to the resonance linkage suggested, for example, for the NO_2 group, it is possible that a co-ordinate link would oscillate between the oxygen atoms if it existed, but no experimental proof has so far been advanced for its existence. These arguments therefore in no way invalidate our earlier conclusion that chemical and physico-chemical evidence fail to provide any proof for the existence of a second form of non-electrostatic linkage in molecules of the first order.

It is true that an atom possessing a lone pair of electrons is frequently associated with chemical reactivity in carbon chains and the formation of complex associations in inorganic chemistry. Since band spectroscopy excludes a mechanism of the 'donor' and 'acceptor' type, something else must be responsible for such phenomena. As a tentative suggestion, it may be pointed out that the molecular refractivity indicates that the polarizability is always high in such atoms so long as the electrons of the lone pair are not involved in chemical linkage, and that the large dipole moment induced on approach of a reagent molecule might be responsible for such phenomena.

We wish to express our gratitude to Prof. F. London for his help in connexion with the wave mechanical section of this article.

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[1] See Hunter and Samuel, *J. Chem. Soc.*, 1180 (1934), Lessheim and Samuel, *Proc. Ind. Acad. Sci. (Bangalore)*, 1, 623 (1935), and the literature mentioned in these papers.

[2] Lessheim and Samuel, *Phil. Mag.*, 21, 41 (1936); Asundi and Samuel, *Proc. Phys. Soc.*, 48, 27 (1936); *Proc. Ind. Acad. Sci. (Bangalore)*, 2, 30 (1935); 3, 466 (1936); Asundi, Jan Khan, and Samuel, *Proc. Roy. Soc.*, in press, and literature mentioned there.

[3] Hunter and Samuel, *Chem. and Ind.*, **54**, 31, 467, 635 (1935); *Rec. trav. chim.*, **54**, 114 (1935), and literature mentioned there.

[4] *J. Chem. Soc.*, 1709 (1935).

[5] cf. Stuart, "Molekülstruktur," p. 114 (1934).

Science News a Century Ago

Death of John Pond, F.R.S.

ON September 7, 1836, John Pond, the sixth Astronomer Royal, died at Blackheath at the age of sixty-nine years, and a few days later was buried in the tomb of Halley in Lee churchyard. Pond was born in London in 1767. After attending schools at Hadleigh and Maidstone, at the age of sixteen years he entered Trinity College, Cambridge, and attended the mathematical lectures of Vince. Ill-health led him to travel, and during visits to Portugal, Malta, Turkey and Egypt he made many astronomical observations. From 1798 until 1807 he lived at Westbury, near Bristol, where by his observations on the declination of some of the principal stars he showed conclusively that Bird's quadrant at Greenwich had altered its form.

Pond was elected a fellow of the Royal Society in 1807. He married and removing to London in 1811 was chosen to succeed Maskelyne at the Royal Observatory. In 1812 he mounted a six-foot mural circle by Troughton, in 1816 a transit instrument of 5-in. aperture, in 1821 substituted the mercury horizon for the plumb-line and spirit-level, and in 1825 introduced the system of observing the same object by direct and reflected vision. A sound practical astronomer, he published catalogues of stars, translated Laplace's "Système du Monde" and wrote many articles for Rees' "Encyclopædia". In 1817 he was awarded the Lalande Medal and in 1823 the Copley Medal. He was succeeded at Greenwich by Airy, who, writing to Henry Warburton, M.P., to support an application for a pension for Mrs. Pond, said that Pond's claims to the gratitude of astronomers were due first to the accuracy which he introduced into all the principal observations, secondly, to the attention he bestowed on those points (chiefly of sidereal astronomy) which he regarded as fundamental, and thirdly his regularity of observation. "Since the commencement of Mr. Pond's residence at Greenwich," said Airy, "Astronomy considered as an accurate representation of the heavens in the most material points has acquired a certainty and an extent which it never had before."

Discovery of Fossils on the Continent

IN its column of Miscellanea, the *Athenæum* for September 10, 1836, said: "Dr. Klippstein, a German savant, who has been long devoted to geology, and who directs the researches in the environs of Alzei (a little town of the Rhine Hesse) has lately made a discovery. On digging twenty-eight feet under the soil, near Eppelsheim, and a league from Alzei, his workmen found a head of a Dinotherium giganteum, in perfect preservation. This is probably the most colossal of all antediluvean animals, and the existence of which was first pointed out by the learned zoologist, Dr. Caup. This head is six feet long and three feet and a half broad. Near the head was also found a shoulder bone of which remains have not been met with elsewhere. Also at one thousand feet below the surface, in the mines of Anzin, an entire fossil palm tree has been found in an upright position. Its roots pierced the soil to a depth of several feet, and it is to be brought to the Museum of Natural History in the Jardin des Plants."

The neighbourhood of Mainz and Alzey early attracted the attention of geologists on account of its wealth of fossils. Von Zittel said: "The discovery of the famous Dinotherium skull at Eppelsheim by Klipstein and Loup induced Klipstein to contribute a more careful stratigraphical account of the strata in the Mainz basin, and he paralleled the bone-bearing sands of Epplesheim with the gypsum of Montmartre, and the limestone strata under the bone-bearing sands with the coarse limestone beds of Paris."

Yarrell's History of British Fishes

Among the books on natural history published in 1836 was the "History of Fishes" by William Yarrell (1784–1856), an original member of the Zoological Society and at one time treasurer to the Linnæan Society. In a review of his work in the *Athenæum* of September 10, 1836, it was said the book was "intended to form a continuation of Bewick, whose beautiful woodcuts, occasional vignettes and *naive* descriptions will ever be ranked among our standard works . . . and we can safely say, to all those who possess Bewick's works, that their collection is not complete without adding Mr. Yarrell's fishes to the birds and beasts.

"The description of species are 226 in number, but as several of them are figured in various stages of growth, the representations amount to 240—all made under the superintendence of the author; besides which there are more than 140 vignettes of modes of fishing, boats, nets, etc., foreign and English."

Societies and Academies

Paris

Academy of Sciences, July 15 (*C.R.*, 203, 137–216).

Gabriel Bertrand and Louis de Saint-Rat : A new colour reaction of copper with urobilin. This reaction is more sensitive and more specific than other reactions in use for the detection of traces of copper. 0·0001 mgm. of copper in 1 ml. of solution can be detected with certainty.

Gabriel Bertrand : Pentacetylxylite. Details of the preparation and purification of the acetate.

Robert Lespieau : The synthesis of *r*-arabite.

Serge Bernstein : Some extremal properties of successive integrals (correction).

Charles Pisot : Certain characteristic properties of algebraic numbers.

Farid Boulad Bey : The canonical forms of equations of nomographic order 6 and 5 representable by nomograms with symmetrical scales.

Christian Pauc : Directions, contingent and paratingent in *distanciés* spaces.

V. A. Kostitzin : The differential equations of the problem of Mendelian selection.

Gino Arrighi : The expression of the energy of acceleration.

Jean Jacques Trillat and Mlle. Renée Vaillé : The unctuosity of mineral lubricating oils.

Mme. H. Emmanuel-Zavizziano and M. Haissinsky : The electrolysis of solutions of titanium salts. By varying the conditions of the electrolysis, compounds of Ti'', Ti''', Ti'''' and of pertitanic acid can be prepared.

Michel Kantzer : The optical absorption of the vapours of tellurium dichloride and oxychloride.

Pierre Lambert and Jean Lecomte : Description of a recording spectrometer with a grating and its use for the determination of the absorption spectra of benzene derivatives in the 3000 cm.$^{-1}$ region.

Augustin Boutaric and Jean Bouchard : Study of the fluorescent power of some fluorescent solutions excited by ultra-violet rays.

Mlle. Yvette Cauchois : Study of the L spectra of emission and absorption of rhenium (75) I.

Marcel Lecoin : The form of the continuous β-spectrum of radium E. The method was based on the use of a Wilson chamber placed in a magnetic field. The results are given as a curve, and differ considerably from the values found by the method of coincidences.

Charles Haenny : The secondary radiation emitted under the action of neutrons.

Maurice E. Nahmias and Robert J. Walen : Some short periods in artificial radioactivity.

Henri Muraour and Gabriel Aunis : The laws of combustion of colloidal [explosive] powders.

Mlle. Niuta Klein : The transformation in glass.

Mlle. Valerie Deutsch : The absorption of proteins. Crystallized hæmoglobin from the horse.

Edouard Rencker and Pierre Dubois : The hydrates of manganous sulphate. The only definite hydrates are those containing 7, 5, 4, 3 and 1 molecules of water.

Alfred Maillard : The system monomethylamine-calcium chloride.

Maxence Meyer : A new method of preparation of the diethoxysuccinic esters.

Léon Enderlin : Contribution to the study of the reversible oxidizability of organic compounds. Iso-oxybis-*p*-bromphenyldiphenylnaphthacene.

Léon Denivelle : The sulphate of *o*-phenylene or sulphurylpyrocatechol.

Charles Courtot and Mohammed Gholi Bastani : Introduction to the study of the chemistry of diphenylene telluride.

Mlle. Berthe Delaporte : Cytological researches on the group Coccaceæ.

William Henri Schopfer : Researches on the nitrogen metabolism of a micro-organism.

Charles Chabrolin : The germination of the seeds of the orobanche bean (*Orobanche speciosa*). The substance which induces the germination of the seeds of the orobanche bean diffuses round the roots of certain plants and can be washed out with water.

Paul Bertrand : The embryos of angiosperms, ferns and lycopods.

Francois Rathery, André Choay and Pierre de Traverse : The comparative action of insulin and of the hypoglycæmic principle of the jejunum in the depancreated dog.

Raymond-Hamet : A new method of showing sympathicolytic power.

Gustave Guittonneau and René Chevalier : The utilization of salicylic acid as an energy producing food by *Azobacter* in the soil.

Anthelme Rochaix and Pierre Rivollier : A dissociation of the staphylococcus.

Washington, D.C.

National Academy of Sciences (*Proc.*, 22, 327–434, June 15).*

David I. Macht and Raymond E. Gardner : Phytopharmacological reactions of normal, toxic and atoxic sera. The phytotoxic index is defined as the ratio of the rate of growth in the dark for 24 hours at 12° C. of roots of seedlings of *Lupinus albus* immersed in a solution to be examined to the rate

* *Continued from p.* 378.

of growth of controls in a nutrient solution under the same conditions. Normal human blood and blood sera from a number of animals gave an index averaging 75 per cent. Reptilian blood was very toxic, as was also that of sera from cases of pernicious anæmia, pemphigus and leprosy. Virus diseases gave sera less toxic for plant growth than normal blood sera.

Albert W. Hull: Changing direct current to alternating current by means of thyratrons. Constant voltage 3-phase A.C. was changed to constant current by a 'monocyclic network' of capacitors and reactors. This current was converted by a conventional circuit of radio type into a constant direct current. The direct current is changed back into alternating current by an exactly similar circuit, with thyratrons in place of rectifiers. Special tubes were developed for the purpose, and in a circuit described, 15,000 volts at 200 amp. peak is rectified to 200 amp. at 30,000 volts D.C., and the latter 'inverted' to alternating current.

Francis G. Benedict and John M. Bruhn: Chimpanzee metabolism. Twenty-two animals ranging in age from two months to fifteen years were used. Respiratory exchange was measured with an open-circuit respiration chamber, the out-coming air being sampled. The average heat production of a chimpanzee per 10 × $w^{2/3}$ (where w is weight), ranges around 1,000 calories. Unlike man, it is not unusually high in infant and pre-adolescent years.

C. P. Haskins and E. V. Enzmann: A determination of the magnitude of cell "sensitive volume" associated with the white-eye mutation in X-rayed *Drosophila* (2)

C. P. Winsor and Anna-Betty Clark: Dark adaptation after varying degrees of light adaptation. The shape of human dark adaptation curves changes with the degree of initial light adaptation. The results are consistent with Wald's view that three substances are involved in the visual purple cycle.

Francis G. Benedict and Robert C. Lee: Studies on the body temperatures of elephants. The temperature of urine taken immediately it was voided averaged 35·9° C.; that of the fæces was 0·7° C. higher, due to fermentation. The elephant thus has the lowest body temperature of any of the large animals (man 37° C., birds 42° C.).

Morgan Upton: Differential sensitivity in sound localization. When the two ears are stimulated by equal energies at 800 cycles, the apparent sound is localized in the median plane of the head. The ratio of energy increment required to produce a noticeable shift of localization to original energy is large for low levels of energy, small for intermediate levels and increases again for very high levels. The results cannot be described in terms of the Weber-Fechner law.

W. J. Crozier: On the sensory discrimination of intensities. The increment of light intensity which is just detectable is variable and should be treated statistically. The relation of sensory intensity (effect) to stimulating intensity should be discussed as a 'band' which measures the probability of occurrence of the index response.

Morgan Upton and W. J. Crozier: On auditory intensity discrimination. A theoretical discussion of Upton's results (above). The energy increment involved can only be regarded as related to the mechanism of excitation so long as its statistical character is recognized.

J. van Overbeek: Light growth response and auxin curvatures of *Avena*.

James Bonner: Plant tissue cultures from a hormone point of view. Parenchyma tissue from the lining of the 'cups' left when immature seeds are removed from bean pods has shown cell elongation and cell division *in vitro* in a culture medium to which an alcohol extract of fresh beans was added. The cell mass continued to grow as parenchyma, and a limited number of sub-cultures could be made, but from the central tissue only. Some chemical properties are given of the factor which seems to make growth possible.

Carl Iver Hovland: 'Inhibition of reinforcement' and phenomena of experimental extinction.

Kenneth W. Cooper: Demonstration of a hatching secretion in *Rana pipiens* Schreber. The jellies and vitelline membranes of early tail-bud larvæ were removed, and the freed embryos were kept in water until normal embryos of similar age had hatched. The contents of dishes containing free embryos were filtered and the filtrate centrifuged and decanted. This liquid was able to remove the jellies from fertilized eggs, etc., the vitelline membrane swelling away from the egg or rupturing, at stages when manipulative removal is very difficult.

Vienna

Academy of Sciences, June 12.

Jovan Jurišić: Morphology and biology of *Bryophyllum Daigremontianum* (Hamet and Perrier de la Bâthie).

Heinz Horninger: Geometrical theory of reflection at curved surfaces.

Walther Ruziczka: Accumulation of iodine by cumarin derivatives.

Leopold Schmid and Hugo Körperth: (1) The colouring matter of the poppy. (2) Extracts of petals.

F. Wessely, A. Münster, and K. Schonol: The bitter principle of Columbo wood. (4). Hydration of columbin and isocolumbin.

Richard Schumann: The moon, sun and variation of latitude (2).

Otto Redlich, Trude Kurz and Walter Stricks: Raman spectra and constitution of hexabromostannic ion and hypophosphite ion. The occurrence of five fundamental frequencies in its Raman spectrum shows that the hexabromostannic ion has D_{4h} symmetry.

O. Friedrich: Geology of the gravel bed of the Gross-Arl valley.

Elfriede Eysank: Coloration of fluorite and rock salt. Fluorite has an absorption band between 575 and 650 mμ and another between 380 and 405 mμ. The properties of these two bands are studied.

Irmberta Leitner: Quantum yield in the coloration of rock salt by X-, γ-, and β-rays. X-rays produce 10^4–10^5 and β- or γ-rays 10^2–10^3 colour centres per quantum. High energy quanta probably act through the secondary radiation they produce.

E. Guth and S. Rogowin: Mechanical properties of threads and films of cellulose derivatives.

Karl Schwarz and Franz Ebster: The possibility of producing multiply ionized atoms of very high energy.

O. Brunner and W. Kleinau: Visual purple (2). Mechanism of the bleaching process.

Friedrich Hartmann: The most general case of breaking of rods of structural steel.

Forthcoming Events

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (BLACKPOOL MEETING).

Wednesday, September 9

At 8.30 p.m.—Sir Josiah Stamp, G.C.B., G.B.E.: "The Impact of Science upon Society" (Presidential Address in the Empress Ballroom, Winter Gardens).

Thursday, September 10

At 10 a.m.—Prof. J. C. Philip, F.R.S.: "The Training of the Chemist for the Service of the Community" (Presidential Address to Section B, followed by a discussion).

Dr. J. S. Huxley: "Natural Selection and Evolutionary Progress" (Presidential Address to Section D).

Brigadier H. S. L. Winterbotham: "The Mapping of the Colonial Empire" (Presidential Address to Section E).

Prof. W. Cramp: "The Engineer and the Nation" (Presidential Address to Section G).

Miss D. A. E. Garrod: "The Upper Palæolithic in the Light of Recent Discovery" (Presidential Address to Section H).

Mr. J. Ramsbottom: "The Uses of Fungi" (Presidential Address to Section K).

Sir Richard Gregory, Bt., F.R.S., Prof. L. Hogben, F.R.S., S. R. Humby, S. V. Brown, Sir Daniel Hall, F.R.S.: "Cultural and Social Values of Science" (Discussion: Section L).

Sir John Orr, F.R.S., Sir Daniel Hall, F.R.S., Prof. J. A. S. Watson, Prof. H. D. Kay: "National Nutrition and British Agriculture" (Discussion: Section M).

At 2 p.m.—Conference of Delegates of Corresponding Societies. Dr. A. B. Rendle, F.R.S.: "Preservation of Native Floras" (Presidential Address).

At 4.30 p.m.—Exhibition of new Biological Films.

At 7.30 p.m.—Dr. Olaf Bloch: "The Scope of Photography" (Public Lecture at Lytham St. Annes).

Friday, September 11

At 10 a.m.—Prof. A. Ferguson: "Trends in Modern Physics" (Presidential Address to Section A).

Dr. C. R. Fay: "Plantation Economy" (Presidential Address to Section F).

Prof. R. J. S. McDowall: "The Control of the Circulation of the Blood" (Presidential Address to Section I).

A. W. Wolters: "Patterns of Experience" (Presidential Address to Section J).

Sir Richard Livingstone: "The Future of Education" (Presidential Address to Section L).

Denys W. Harding, F. C. Thomas, Rev. F. A. Farley: "The Psychology of Mass Entertainment" (Discussion: Section J).

At 2.15 p.m.—Prof. H. J. Fleure, F.R.S., Dr. J. S. Huxley, Dr. G. M. Morant, Prof. A. M. Carr-Saunders, Prof. R. Ruggles Gates, F.R.S., Prof. F. A. E. Crew: "Genetics and Race" (Discussion: Sections D and H).

At 7.30 p.m.—Dr. W. F. Bewley: "Science and the Glass-house Industry" (Public Lecture at Blackpool South).

At 8 p.m.—Prof. J. L. Myres: "Who were the Greeks?" (Public Lecture at Preston).

Sir James Jeans, F.R.S.: "Some Recent Advances in Astronomy" (Public Lecture at Southport).

At 8.15 p.m.—C. C. Paterson: "Science and Electric Lighting" (Evening Discourse).

Official Publications Received

Great Britain and Ireland

Air Ministry: Aeronautical Research Committee Reports and Memoranda. No. 1685 (2038a): Effect of Variation of Aileron Inertia and Damping on Flexural-Aileron Flutter of a Typical Cantilever Wing. By V. M. Falkern. Pp. 12+6 plates. 1*s.* net. No. 1693 (2237): Air and Vapour Locks in Fuel Systems. By M. A. A. Allfrey. Pp. 14+9 plates. 1*s.* 3*d.* net. (London: H.M. Stationery Office.) [108

Imperial Economic Committee. An Index of the Minor Forest Products of the British Empire. Pp. 116. (London: H.M. Stationery Office.) 5*s.* net. [118

Proceedings of the Royal Society of Edinburgh, Session 1935–1936. Vol. 56, Part 2, No. 7: Fossil Pollen in Scottish Tertiary Coals. By Dr. J. B. Simpson. Pp. 90–108+8 plates. 2*s.* 6*d.* Vol. 56, Part 2, No. 8: On the Suppression of Tangled in *Drosophila pseudo-obscura*. By H. P. Donald. Pp. 109–127+2 plates. 2*s.* (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [128

The North of Scotland College of Agriculture. Calendar, Session 1936–1937. Pp. viii+131. (Aberdeen: North of Scotland College of Agriculture.) [128

Other Countries

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol 100. 1ère partie: Procès-verbaux (mai 1936). Pp. 62. 3.00 kr. 2ème partie: Rapport administratif (1935-1936): 3ème partie: Appendices. Pp. 111+25. 4.00 kr. (Copenhague: Andr. Fred. Høst et fils.) [118

Cornell University. Agricultural Experiment Station. Bulletin 640: An Economic Study of Land Utilization in Chemung County, New York. By T. E. LaMont. Pp. 84. Bulletin 641: Seasonal Costs and Returns in producing Milk in Orange County, New York. By L. C. Cunningham. Pp. 41. Memoir 183: Measurements of Family Relationships in Farm Families of Central New York. By Howard W. Beers. Pp. 88. Memoir 184: Pollination and Life-History Studies of the Tomato (*Lycopersicon esculentum* Mill). By Ora Smith. Pp. 16+23 plates. Memoir 185: Effect of Narrow Ranges of Wave-Lengths of Radiant Energy and other Factors on the Reproductive Growth of Long-Day and Short-Day Plants. By N. A. Schappelle. Pp. 33. Memoir 186: Effects of some Environmental Factors on Growth and Color of Carrots. By W. C. Barnes. Pp. 36. (Ithaca, N.Y.: Cornell University.) [178

Annual Report on the Departments of Agriculture, Malaya, for the Year 1935. By Dr. H. A. Tempany. Pp. iv+84. (Kuala Lumpur: Government Printer.) 50 cents; 1*s.* 2*d.* [178

Smithsonian Institution: Bureau of American Ethnology. Bulletin 113: The Troyville Mounds, Catahoula Parish, La. By Winslow M. Walker. Pp. vii+73+16 plates. (Washington, D.C.: Government Printing Office.) 20 cents. [178

U.S. Department of the Interior: Office of Education. Vocational Education Bulletin No. 106 (Trade and Industrial Series, No. 30): Stone Setting; the Setting of Cut-Stone Trim in Brick Buildings. Revised 1935. Pp. ix+226. (Washington, D.C.: Government Printing Office.) 20 cents. [178

Indian Forest Records (New Series). Vol. 1, No. 13: Entomological Investigations on the Spike Disease of Sandal. (27) Chrysomelidæ (Col.). By N. C. Chatterjee and G. D. Bhasin. Pp. iv+243–318. 1.14 rupees; 3*s.* 3*d.* Vol. 2, No. 5: New Indian Tingitidæ (Hemiptera). By C. J. Drake and M. E. Poor. Pp. 141–149. 5 annas; 6*d.* (Delhi: Manager of Publications.) [178

Tokyo University of Literature and Science. Divisional Reports on Present Tendencies in the Development of Mathematical Teaching in Japan. Prepared by the Japanese National Commission on the Teaching of Mathematics. Pp. 174. 3.50 yen. Summary Report on Present Tendencies in the Development of Mathematical Teaching in Japan. By M. Kuniyeda. Pp. 50. 1.00 yen. (Tokyo: Maruzen Co., Ltd.) [178

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 101 (Radio Research Board, Report No. 11): The Temperatures and Constituents of the Upper Atmosphere. By Dr. D. F. Martyn and Dr. O. O. Pulley. Pp. 31. (Melbourne: Government Printer.) [178

Royal Agricultural Society. Summarised translation of Bulletin No. 19, Chemical Section: The Importance of Phosphoric Acid Supply for Egyptian Crops as illustrated by the Results of the Bahtim Permanent Experiments and Others. By Ahmed Mahmoud. Pp. 86. Bulletin No. 23: The Influence of Size and Weight of Seed upon the Course of Subsequent Growth and upon Yield of Wheat. By Dr. M. A. Fikry. Pp. 54+27 plates. (Cairo: Royal Agricultural Society.) [178

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Science and the Community

CENTURIES of tradition and experience have given us, as Prof. A. N. Whitehead has pointed out, a tradition that each generation will live substantially amid the conditions governing the lives of its fathers and transmit those conditions to the succeeding generation. In his words, "we are living in the first period of human history for which this assumption is false". The time span of important change no longer exceeds considerably the normal span of human life, and we have now to meet change as the normal—not the exceptional—experience.

This necessity for change has at least two aspects. It involves the modification of man's nature to meet the new conditions, a re-adaptation to his environment. It also involves the modification of his existing social, economic, political and industrial organization and institutions to meet the requirements of an era of power production and rapid change, or the evolution of new forms of organization where the old prove inadequate and incapable of development.

The seriousness of the present international situation, no less than our economic difficulties, is largely due to the failure to face change and adapt institutions to meet it. In the Fascist and totalitarian State there are deliberate attempts to put back the clock and return to a simpler order of society, creative thought and adaptability being repressed in an attempt to maintain institutions evolved in a pre-industrial era. Simultaneously, in the assumed defence of the State, the full resources of a power production era are being marshalled for destructive purposes.

On the scientific side, even though in the training of the man of science there is still no concern with the social consequences of his work, scientific workers are to an ever-increasing extent turning their attention to such matters. In the five years since, in his presidential address to the British Association, General Smuts directed attention to the dangers arising out of rapid scientific advance as opposed to a stationary ethical condition, the relations between science and society have been considered on an increasing scale at the British Association meetings both in the presidential addresses and in sectional meetings. Two years ago, the Council suggested in a memorandum to the organizing committees of the various sections that discussions, papers or symposia should be included in their programmes bearing upon the relations between the advance of science and the life of the community.

The attention given to this subject in the programme of the present meeting is fully as great as in previous years. Discussions on chemistry and the community, cultural and social values of science, national nutrition and British agriculture, the psychology of mass entertainment, the reform of the examination system, the poultry industry, traffic safety, chemistry and food science, the strain of modern civilization, and addresses on the engineer and the nation, soil science in the twentieth century, etc., indicate over how wide a field scientific workers are seeking the solution of problems of social well-being and the interpretation of the results to the general community.

It is not on this account alone, however, that the impact of science upon society forms most appropriately the main theme of this year's presidential address. While more scientific effort than ever before is probably being devoted to the elucidation of social problems and the interpretation of the results to the community, there has never been more general alarm about the possibilities of the application of the results of scientific discovery or greater willingness to endorse the late Sir Alfred Ewing's words: "The command of Nature has been put into man's hand before he knows how to command himself."

For this uneasiness the rapid deterioration in international relations during the past year, the weakening of international co-operation and the grim menace of re-armament have been largely responsible. In the growing effort being devoted to preparation for warfare, it is easy for the possibilities of a higher standard of living which science has placed within our grasp to be overlooked, and for the scientific worker to be associated rather with the perversion of his knowledge for destructive purposes. Again, the intensification of preparation for self-defence has tended to strengthen the fetters on freedom of investigation and exposition which dictatorships in many countries have already riveted on industrial and academic workers alike.

The growing impatience of the scientific worker at the extent to which his knowledge is made to serve inhuman ends finds admirable expression in Prof. J. C. Philip's presidential address to Section B (Chemistry) and is paralleled by the alarm at the continued threat to academic freedom and scientific research itself which, as the University Grants Committee pointed out in its report, lays a heavy responsibility on the universities of Great Britain if the Greek tradition of candid and intrepid thinking about the fundamental issues of life is to be preserved for mankind.

Sir Josiah Stamp, in his presidential address to the Association, which appears elsewhere in this issue (p. 435), has thrown down a challenge to creative thought on the impact of science upon society and the technique of change it involves, which comes at an opportune moment. The development of economic planning on a larger scale has made it painfully evident how the full effects of the wisest schemes may be neutralized by factors outside their control. Only by the widest co-ordination can the fullest benefits be secured, whether within the limits of an industry or of a national unit. The resistance of institutions to change not only increases the friction and makes change more difficult and the application of science less profitable and less readily accepted; it also tends to throw out of ratio what Sir Josiah Stamp has termed the scientific, industrial and political periods of gestation.

The present tendency is for the period of scientific gestation, or the interval between the first concept of the idea and its publication in substantially the form in which it is ultimately used extensively, to contract. It is even more demonstrable that industrial gestation, or the subsequent interval between this point and the time when the innovation becomes effective in an economic or industrial sense, has shortened materially and at greater social cost. This contraction is attributed to the greater amenability of the industrial community to scientific research and to our entering on an epoch of concerted industrial research in the last twenty years.

It is to the third question, that of political gestation, that Sir Josiah Stamp directs particular attention. Formerly, the normal span of life of man and machinery provided a phase to which scientific advance could be adjusted for a completely smooth social advance. Technical changes now occur so rapidly that political institutions work far too slowly to make the required adaptation. Political gestation is a function both of human psychology and of social structure, and at present we do not know enough about the way in which ideas permeate, infiltrate or saturate society.

While to prevent disequilibrium it is necessary to evolve some means of contracting the period of political gestation, some of the factors which hitherto have diminished the force of impact on society are losing their previous force. Among such, Sir Josiah Stamp cites the natural increase of population, which is disappearing in all Western industrial countries, and the labour demands of new industries, which offset dislocations caused by labour-saving machinery.

If, therefore, the risk of innovation becomes mechanically rapid, the danger of improvident tardiness is the more acute, and it becomes essential to treat on scientific lines those questions of man's abilities, his affections and his tools which have been brusquely dismissed in the past. With the intensification of scientific effort and the greater subdivision of industry, the possible dislocation becomes more frequent and the way of meeting such change of greater public importance. Impact and change must, in fact, be treated as an area for scientific study, and society must endeavour to regulate the rate of change to an optimum point in the net balance between gain and damage.

No scientific worker can fail to recognize the practical difficulties of economic and political prevision, as involved, for example, in Sir James Irvine's plea for a Ministry of Knowledge for the purpose of predicting the repercussions of new knowledge on all phases of life. None the less, a deliberate attempt may yet have to be made. Moreover, it is clear that the moral and social consequences of innovation, no less than the material, must be taken into account in our calculations, and it may even be desirable to repress the rate of development on the physical side in order to accelerate assimilation on the moral and human aspect. Birth control, for people, may yet demand corresponding measures for their impedimenta.

Sir Josiah Stamp adds one more voice to those which in recent years have pleaded for redistribution of scientific effort and resources. There is not too much effort being devoted to research in physics and chemistry as modifying industry, but there is too much relatively to the research upon the things they affect in physiology, psychology, economics, sociology. Additional financial resources should be applied more to the biological and human sciences than to the applied physical sciences or, if resources are limited, transfers should be made from one to the other.

What is required is not less science but a great extension of the area to which the scientific method is persistently and dispassionately applied. This is no time for a spirit of defeatism but for fuller support of those means of acquiring knowledge on the human and biological side where it is at present deficient. We must achieve an advance in the science of man commensurate with that which we have already secured in the science of matter.

For this task there are two essentials—a time of peace in which the problems can be effectively studied and the adjustments made, and courage and confidence strengthened by the conviction that the human spirit is not doomed to relapse into barbarism, but is fully as capable of emerging from an age of mechanization and standardization to one in which the teeming units of mankind enjoy not merely physical comfort and adequate leisure but also freedom of access to all the rich heritage of civilization. If scientific workers are stimulated by the presidential address and other discussions at the Association's meetings to make more constructive contributions to this question of peace and the impact of science upon society, the Blackpool meetings may well be memorable in annals wider than those of science alone.

Geophysics of the Indo-Pacific Region

Geographie des Indischen und Stillen Ozeans
Im Auftrage der Deutschen Seewarte verfasst von Prof. Dr. Gerhard Schott. Mit einem Beitrag von Prof. Dr. Ernst Hentschel und Dr. Wolfgang Schott. Pp. xx +413 +38 plates. (Hamburg: C. Boysen, 1935.) 36 gold marks.

EVER since Prof. G. Schott, ten years ago, published his great work on the geography of the Atlantic Ocean, geographers and oceanographers have been eagerly awaiting the companion volume on the Indo-Pacific region. In the present work the author has followed the same original plan and, commencing with a historical account of the discovery and exploration of these two oceans, he brings under review the whole sum of our present knowledge, ranging from the geological character of the coasts, through the topography and nature of the sea-floor, the meteorological conditions, the current systems and the physico-chemical character of the sea-water from the surface down to the great depths in the various regions into which these two oceans are divided, to the biological conditions present, including in this latter topic a survey of the anthropology of the whole area.

In his historical account of the great explorers, who opened up for us these wide spaces, Schott mentions the name of Francis Drake in a footnote and in his chart only shows him as having visited the west coast of America, whereas he also sailed the Malay seas, visiting Java and the Moluccas, and was in all probability the first to discover the Giant Robber crab (*Birgus latro*) and to note its habit of living in colonies and of climbing trees.

One great difficulty, which confronts all oceanographers, is the uncertainty of the mode of origin of the great oceans, and this applies especially to the northern part of the Indian Ocean, regarding which one school of geologists holds that it has been formed by the foundering of a great continent, Gondwanaland, while another school believes with Wegener that the oceans have been formed by a gradual drifting apart of the present continental masses. Schott apparently belongs to the former school, and he describes how Africa, Arabia and India are all stable land-masses that are bounded by scarp-faults, where the hypothetical continent of Gondwanaland, that once connected them, has broken off and subsided; it is to this permanence of these land-masses that Schott attributes the apparent comparative freedom of the Indian Ocean from volcanic islands, though, since we are as yet completely ignorant of the geological nature of the basis on which the Laccadive, Maldive and Chagos archipelagos rest, this freedom may be more apparent than real. Down the whole length of the Indian Ocean and across the south-eastern part of the Pacific Ocean two great submarine ridges have now been traced, the two together forming an almost complete semicircle that runs around nearly half the circumference of the globe; but wherever these ridges rise above sea-level, or fragments of rock have been obtained from the sea-floor along their length, the rock has been found to be volcanic in origin and is composed of basalt, thus giving no indication of its geological age; and Schott is thus scarcely justified in claiming that the recent John Murray Expedition, which in 1933–34 mapped a great part of the Carlsberg Ridge and discovered a subsidiary ridge running up towards and probably representing a submarine continuation of the Khirtar Range of India, has thus provided further evidence of the former existence in Permo-carboniferous times of Gondwanaland, or even of its later relic, the isthmus of Lemuria.

In discussing the great 'deeps' that almost invariably lie close to the eastern side of a continental land-mass, Schott reviews the possibility that these have been produced by either faulting or folding, but he makes no mention of the alternative theories of isostatic adjustment or of continental drift.

In his account of the currents, both surface and deep, Schott brings out clearly the enormous importance of the correlated study of the general meteorological conditions; evaporation and solar radiation produce differences in density of the water, thus inducing sinking of water-masses downwards, while the prevailing winds, by inducing horizontal movement of the surface-water in different directions, cause the zonation of the great oceans into tropical, sub-tropical and polar regions, separated from one another by 'convergence zones', along which one mass of water is driven beneath another and sinks down to a deeper level, thus causing a stratification of the ocean into depth-zones, in which temperature, salinity, oxygen content, etc., are sufficiently different to enable us to trace the course of the deep currents and thus discover the manner in which the deeper waters of the Atlantic and Indian Oceans sweep eastward to the south of the continental masses of Africa and Australia and flow into the Indian and Pacific Oceans respectively. Similarly, the Trade winds, by setting up off-shore currents, cause an up-welling of deep cold water that has a profound influence on the character of the fauna and flora, one notable effect of such up-welling being the absence of coral reefs even in tropical regions, as, for example, on the western coasts of Africa and South America or the south-eastern coast of Arabia and the neighbouring coast of Africa. Yet off the north-western coast of Australia, where the conditions would appear to be favourable to its formation, such up-welling appears to be absent.

The zonation of the surface water has, at any rate in certain regions, a profound influence on the character of the sea-bottom, for, as Schott points out, there is a close agreement between the south polar convergence zone and the change on the sea-floor from the tropical and sub-tropical Globigerina ooze to the polar Diatom ooze, and, to a less degree, the same holds good for the north polar convergence zone. It is, however, difficult to understand how this agreement is brought about, for it is now well known that the polar water, characterized by a profusion of diatom growth, dips at the convergence zone downwards under the sub-polar water and flows northwards towards the equator, and one would have expected this Antarctic Intermediate Current to carry the slowly sinking frustules of the diatoms far to the north; but for some reason not yet understood the convergence zone appears to mark, not only a change in the surface conditions, but one also in the general character of the plankton at all depths.

Another problem connected with the sea-floor is the mode of formation of the Red Clay that covers vast areas of the north and south Pacific regions and the eastern part of the Indian Ocean. The conditions favouring its formation appear to differ radically in these areas and in the Atlantic, for in this latter ocean the Red Clay is deposited where the Antarctic Bottom Current is strongest, whereas in the Pacific the reverse seems to be the case, and in the Indian Ocean to the north-east of the Carlsberg Ridge there is a patch of this deposit in an enclosed basin, where the bottom current must be at a minimum; nor in this connexion do we know anything regarding the mode of formation of the manganese nodules that are so characteristic of Red Clay deposits, and even less regarding the original source of the manganese.

Dr. Schott is to be congratulated on the completion of this most valuable work, in which he has rendered available so much information; but if there is one thing that is brought out most clearly, it is the great need of further investigation in every part of these oceans, which are "by nature left free for all men to deal withal, as very sufficient for all men's use, and large enough for all men's industry". R. B. SEYMOUR SEWELL.

All Manner of Televiewers

(1) Television Reception:
Construction and Operation of a Cathode Ray Tube Receiver for the Reception of Ultra-Short Wave Television Broadcasting. By Manfred von Ardenne. Translated by O. S. Puckle. Pp. xv + 121 + 43 plates. (London: Chapman and Hall, Ltd., 1936.) 10*s.* 6*d.* net.

(2) Popular Television:
Up-to-date Principles and Practice explained in Simple Language. By H. J. Barton Chapple. Pp. xiii + 112. (London: Sir Isaac Pitman and Sons, Ltd., 1935.) 2*s.* 6*d.* net.

(3) Television
By M. G. Scroggie. (Blackie's "Technique" Series.) Pp. ix + 68 + 7 plates. (London and Glasgow: Blackie and Son, Ltd., 1935.) 3*s.* 6*d.* net.

HE is a wise author who knows his own reader; he is a daring author who writes for more than one reader. The first public demonstrations of high-definition television will have rekindled the enthusiasm of the three main classes of potential televiewer, and these enthusiasts will turn to such books as those now before us for some guidance on how television works. On the criteria suggested, Baron von Ardenne is the wisest, Mr. Barton Chapple the most heroic, of our three authors. Mr. Barton Chapple writes for "the public", Mr. Scroggie, in an attractive preface, explains that he has tried to provide "a fairly comprehensive and unpadded survey for [the wireless amateur] without being unintelligibly concentrated for [the non-technical public]; so that neither is the one exasperated nor the other bewildered". Baron von Ardenne, with his more-than-translator and almost co-author Mr. Puckle, address themselves to the advanced amateur and the engineer. Mr. Scroggie's *via media* proves itself *tutissima* and his book can be recommended to the "wireless amateur who is already familiar with ordinary broadcasting"—and the class is an amazingly large one—as a clear well-balanced account of the present state and immediate possibilities of television, with a sufficient glance at the obsolescent, and a fair-minded scrutiny of the up-to-date. Mr. Barton Chapple does not wholly succeed in his difficult task of speaking to the non-technical public without going beyond its limited vocabulary; there are points at which he probably leaves it bewildered by dropping unconsciously back into the familiar jargon of the wireless amateur and engineer. His book is a good one, but he could make it better in its next edition by forgetting the wireless amateur and writing for one intelligent middle-aged lady who would like to know how she is to see the coronation next year from Croydon.

Baron von Ardenne's important work reveals the magnitude of the self-imposed task which will be undertaken by the many advanced amateurs who decide to build their own receivers for high-definition television. He does not gloss over the economic and technical difficulties and he produces, as he always does, a stimulating book which will certainly, as he hopes, "provide an impulse towards intense activity on the part of amateurs in the newest and perhaps most interesting branch of electrical engineering". He is also fully justified in his "hope that certain paragraphs will bring to the television specialist some fundamentally new ideas".

The book is not easy reading, for it is compressed and occasionally elliptic, but it never goes further in these directions than is compatible with stimulation short of exasperation. The keen amateur will have to stop fairly frequently to think how much has been said and how much the author has assumed it safe to leave unsaid because his selected reader will know already. The "construction and operation of a cathode ray tube receiver for the reception of ultra-short wave television broadcasting" will be made possible, but not disappointingly easy, for the advanced amateur who has the good fortune to read this book—and what fun, what fury and despair, what triumphs it will open up for him! The general treatment is philosophically and scientifically excellent, the book contains technical data not readily available elsewhere, and the detailed "Parts Lists", circuit diagrams, and descriptive material on mains supply units, time bases, filters, picture receivers and sound receivers are clear and satisfactory.

It has already been indicated that the book is more than a translation. Mr. Puckle, who has himself done very notable work in the advance of high-definition television, has introduced into the text a considerable amount of matter designed to help the home-constructor who is to deal with the London as opposed to the Berlin television service. These additions are very valuable, indeed essential, but it would have been better to set clearer boundary marks between the von Ardenne and the Puckle contributions. The joints at present are neither perfect welds nor good clean lap joints. The translation is adequately done, there are no defects in clarity, but Baron von Ardenne's colloquially flexible German takes on an occasionally forbidding aspect in the rigidities of a safe translation.

No one with a serious technical interest in television can afford to be without von Ardenne–Puckle; no one who can read Scroggie's lucid and relatively easy survey will fail to find pleasure and benefit in climbing to the more austere heights with von Ardenne and Puckle.

Collected Works of Kepler

Bibliographia Kepleriana: ein Führer durch das gedruckte Schrifttum von Johannes Kepler. Im Auftrag der Bayerischen Akademie der Wissenschaften. Unter Mitarbeit von Ludwig Rothenfelder. Herausgegeben von Max Caspar. Pp. 158 + 86 plates. (München: C. H. Beck'sche Verlagsbuchhandlung, 1936.) 18.50 gold marks.

A POPULAR version of Kepler's letters was published in 1930 by Messrs. Caspar and von Dyck, and was reviewed in NATURE of November 29, 1930, p. 835. Since then Prof. Walther von Dyck has died. We learn that he never lost an opportunity of pressing the claims of Kepler for a collected edition other than that of Frisch—which is open to many objections—and of collecting and studying any documents by Kepler, of which there are a great many. Before he died he had the satisfaction of seeing the Bavarian Academy of Sciences in Munich, with the co-operation of the Deutsche Forschungsgemeinschaft, consent to become responsible for the work. It has named Prof. Max Caspar as editor, and the Würtemberg State Government has set him free from other work for the purpose. He dedicates this volume to Walther von Dyck, and has been able to use the material collected by Dr. Rothenfelder.

The present volume consists of the bibliography preparatory to this edition. The preparatory work seems to have been very thoroughly done. Many of the manuscripts are at Poulkovo. There are certain known collections, public and private. Besides these, circulars were sent out to some 180 libraries, mostly in the neighbourhood of Kepler's residences, to ask them what editions or manuscripts of Kepler they possessed. Most of them replied. It was not to be expected that this step could lead to a large addition to the known works, but some idea of the distribution of these could be got, and also the practical certainty that if any work was missing, it might be looked for elsewhere in vain. However, it *did* lead to certain finds, though not to very important ones.

Actually what we have in this work is, after a preface, eighteen pages of introduction; then four pages of a facsimile of Kepler's communication to Guldin, giving a list of his works edited up to 1621; then sixty-eight pages of works printed in Kepler's time, carefully collated, and each with a descriptive supplement. Several of the minor works have been sought in vain. As Prof. Caspar remarks, "a bibliographer must know what each individual writing contains, from what view it is treated, what is its relation to the whole. So, only a few works receive mention in this book, that I have not been able to see for myself, and for which I had to content myself with taking them out of catalogues, because I could not inspect the originals. All care was taken to give the titles exactly." There are eighty-six titles under this section, originals or duplicates.

After the formal bibliography comes a description of each work. These are pretty full. For example, we note "51. *Calendarium und Prognosticum auf das Jahr* 1617", which Prof. Caspar has not been able to find. In spite of that, there is half a page upon it. These 'prognostics' Kepler did simply to get bread, because the foolish public would buy them. He condemned bitterly the time spent upon them, as being akin to begging, and scarcely in any way more venial—though he does not seem to have altogether disbelieved them.

After that we have seventy-six entries, or twenty pages, of briefer descriptions of various works of Kepler published afterwards, up to the present day. Then, still more briefly, a list of 224 writings which are about Kepler, or which contain some notable reference to him, also continued up to the present day. Then an alphabetical list (3 pp.) of the works in the first section; then a list (3 pp.) of the libraries quoted, and then four pages devoted to the names referred to. Then, a most valuable section, photographic facsimiles, reduced to fit the page, of all except a few of the title pages contained in the first section. Some of these are in two colours. All this has been done as well as possible, and, of course, costs money. The comparatively low charge to the public is because

Prof. von Dyck was able to allocate funds to this purpose which he had received from the Rhineland industry for investigations relating to Kepler.

Prof. Caspar shows a commendable enthusiasm for his subject, but it seems to us he altogether overrates Kepler as a mathematician. Admitted that Kepler was an outstanding man, a genius in his wild way, and that he had a hard life, and that without courage and strong convictions he would never have discovered 'Kepler's laws'; but because he did so, the world has put him into a niche from which he cannot be displaced. Of course, that happened after his death, when I suppose it did not matter to him how the world treated him. It is no part for this journal to decide whether he was or was not greater than his great contemporaries, Galileo and Tycho Brahe, still less, to step across time and compare him with his predecessor Copernicus and the rest, or his successors, Descartes, Huygens and Newton. But, to take an example—*Harmonices Mundi Libri V*, 1619, contains 'Kepler's third law', which is a very valuable asset; but it also contains a lot of sheer nonsense which no one now thinks of, except to dismiss it, such as the music of the spheres, spelt out in the notes each planet makes, with the remark that the earth utters those notes because misery and famine were found there. No doubt they were; so, too, were the courage and tenacity of a Kepler. Also some things with a less personal point and which we are able to judge impartially, such as the relations of the distances of the planets to the sides of the regular solids. We get no notion at all of this from Prof. Caspar's description. To translate a specimen: "The beginnings of this great work reach back to the earliest adult years, its roots are in the deepest soil of Kepler's thinking. He reveals to us the innermost kernel of his views on Nature and the World, he utters the last word of what he knows how to say of the Cosmos and the position of men. We see here not merely the astronomer . . ." and so forth; all rather rhetorical to our thinking. Although the technical work seems to be well done, this exaggerated language is characteristic. R. A. S.

The 'Factor School' in Psychology

Ability and Knowledge:
the Standpoint of the London School. By Frank C. Thomas. Pp. xx+338. (London: Macmillan and Co., Ltd., 1935.) 15*s*. net.

THE number and character of contending schools of psychology were well brought out a few years ago in a large volume issued in America under the title "Psychologies of 1930". No fewer than eleven schools came under review, one of them being the "Factor School", created by Prof. C. Spearman, and described by him as a school to end schools. That the other schools still flourish—for there is no one of them which does not contain some portion of the truth—does not prove that Prof. Spearman's expectation, or at least his hope, is entirely disappointed. On the contrary it is probably true to say that his theory of a general factor (the now rather famous g) and of a variety of specific factors in ability holds the field more securely than ever; and it is equally true to say that his analysis of the birth and growth of knowledge places the psychological study of cognition on a more scientific footing than has ever existed before. After reading Spearman, one can scarcely resist the conclusion that the time has come when William James's lament that psychology was no science, but only the hope of a science, is no longer justifiable.

Prof. Spearman's large books, however, and his extensive series of contributions to learned journals, make heavy going for many people who are not professional psychologists, but who yet desire a statement, which shall be clear without being superficial, of the steps of his argument. Such readers are numerous, and they include, in particular, workers in the fields of education, vocational guidance, and industrial psychology. For them, Mr. F. C. Thomas has written this excellent handbook.

In this book Mr. Thomas really takes up the position of a teacher who, having mastered his subject, takes a keen interest in presenting its essentials with all the lucidity of which its nature admits. We observe that Prof. Spearman and Prof. F. A. P. Aveling, to both of whom Mr. Thomas acknowledges his indebtedness as their former pupil, are abundantly satisfied as to the accuracy of the book as a statement of their joint position. Further, we believe we can answer for it that the readers whom Mr. Thomas has specially in view will be equally satisfied. He modestly disclaims any but "the most ordinary literary facility". We can certify, however, that the book is so well written that not once have we been compelled to re-read a sentence in order to be sure of its meaning.

(1) Bird-Lovers' Manuals

How to Know British Birds. By Norman H. Joy. Pp. 136+40 plates. Birds of the Green Belt and the Country around London. By R. M. Lockley. Pp. xix+236+4 plates. 5*s*. net each.

(2) The Birds of the Firth of Clyde:

including Ayrshire, Renfrewshire, Buteshire, Dumbartonshire and South Argyllshire. By John Morell McWilliam. Pp. 164+10 plates. 12*s*. 6*d*. net.

(London: H. F. and G. Witherby, 1936.)

THE house of Witherby, under the direction of a distinguished ornithologist, is justly renowned for its bird-books, both technical and popular. Two of the works named above belong to a new series of "Bird Lovers' Manuals" which seem likely to have a wide appeal.

(1) Dr. Joy's volume is a handy work of reference, intended primarily as an aid to identification. To this purpose it is admirably suited. Emphasis is laid on distinguishing characters rather than on general descriptions, and the value of song and call-notes in this respect is recognized. The numerous illustrations are well designed for their particular aim, and make the book very good value indeed for its modest price. Mr. Lockley's volume is a guide to bird haunts in the neighbourhood of London. Each chapter deals with a particular type of habitat, ranging from chalk country to salt marsh, from orchard and park to heather and pines, and pleasantly describes its characteristic bird-life. Actual localities are named, even means of getting there being indicated, and the book should prove very helpful to many who wish to explore the home counties in search of birds.

(2) Mr. McWilliam's book fills a gap among the local faunistic studies of its kind. It gives a straightforward and useful account of the occurrence of different species in the Firth of Clyde and the counties bordering it: the area, of course, includes the great sea-bird nursery of Ailsa Craig.

Das Zooplankton der Binnengewässer:

Einführung in die Systematik und Ökologie des tierischen Limnoplanktons mit besonderer Berücksichtigung der Gewässer Mitteleuropas. Von Prof. Dr. W. M. Rylov. (Die Binnengewässer: Einzeldarstellungen aus der Limnologie und ihren Nachbargebieten, herausgegeben von Prof. Dr. August Thienemann. Band 15). Pp. x+272+30 plates. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele) G.m.b.H., 1935.) 30 gold marks.

THIS work should perhaps have been entitled "Introduction to the Study of the Zooplankton". It is essentially a book for the student or one about to embark upon some limnological problem, and in these cases it should prove of the greatest value.

In the general introductory chapter, as well as in the sections dealing with the main groups of planktonic animals, there will be found in outline the present-day knowledge of such problems as reproduction, food, adaptations and vertical and horizontal distribution of the freshwater zooplankton. There is given, too, a brief introduction to the question of seasonal form variation and to the hypotheses of Wesenberg-Lund, Ostwald and Woltereck. References to a full literature list enable any particular aspect to be pursued in greater detail. Finally, the diagnostic keys, descriptions and plates of only those animals most likely to be encountered will greatly facilitate the task of sorting and identifying collections made in the field.

For the more advanced worker the book is naturally of less value, since the greater part is devoted to systematic descriptions of the commoner Rotifera, Cladocera and Copepoda of the plankton. The list of synonyms (pp. 221–224) is of service to those whose interests are only secondarily systematic. From it they will learn, surely with regret, that the genus *Keratella* disguises such characteristic rotifers as *Anurœa cochlearis* and *An. aculeata*, and that the latter now becomes *K. quadrata*.

General Chemistry:

an Elementary Survey; emphasizing Industrial Applications of Fundamental Principles. By Prof. Horace G. Deming. Fourth edition, rewritten and revised. Pp. xiii+774. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 17*s*. 6*d*. net.

PROF. DEMING'S popular text-book has been extensively revised in its new edition, and many new sections have been added. It now contains brief, but accurate, accounts of numerous modern physicochemical topics, such as photochemistry, the Raman effect, atomic structure and valency (Chapter xxiii), activity theory of electrolytes and *p*H values. The industrial sections have also been revised and amplified to take account of modern practice.

Although the interest and value of the book have been greatly increased, its appeal to the more elementary student is lessened. The reviewer is not altogether in sympathy with the plan of introducing unbalanced equations in the earlier part of the book, as this will encourage a habit which teachers find it hard enough as it is to eradicate among students. Balancing equations should be taught as soon as they are used.

Prof. Deming's book, although it does not fit in with any English course, will be found very interesting and suggestive by teachers.

The Self in Psychology:

a Study in the Foundations of Personality. By A. H. B. Allen. (Psyche Monographs, No. 5.) Pp. 282. (London: Kegan Paul and Co., Ltd., 1935.) 10*s*.6*d*. net.

MR. ALLEN, with whom we are familiar as the author of "Pleasure and Instinct", gives us his views on the relation of the self to psychology. Many of the moderns will find it difficult to accept his definition of psychology as the natural history of the *conscious* experience of *men*. Are the rest of the animal kingdom to be denied any consideration under the caption psychology? That the study of subjective experiences is the sole province of psychology, and that those phenomena which are only open to inspection by another observer are not to be included seems to us an alarming doctrine, to say the least of it.

Indian Conjuring

By Lieut.-Colonel R. H. Elliot, late I.M.S.

THERE is a widespread belief among British people who have not visited the East that India is the 'home of mystery'. I have come across not a few men and women in high and responsible positions who share this erroneous idea. In 'the dim red dawn of man' every strange natural phenomenon was ascribed to the supernatural. Slowly but surely knowledge grew, explanations displaced superstition, and reason, greatly daring, trespassed more and more on the once undisputed domains of the gods, with the result that one mystery after another was resolved by the onward march of common sense. The area of the 'supernormal' has steadily shrunk, and is daily still shrinking. The discovery of facts has always preceded the explanation of their causal origin. There are many things which still puzzle us ; we have no valid explanation for them ; we freely admit our ignorance and wait for the advance of the tide of knowledge which we believe will sweep on irresistible and ever progressive, washing out as it goes the ripples on the sands of ignorance.

In the early days of our colonization of the East, men watched with wonder the fearlessness with which the Indian snake-man handled his dangerous pets. They saw 'the mango trick', the disappearance of the girl from the basket which was stabbed in every direction by a sword, and the speedy return of the young woman unharmed at the bidding of her master. Then there was the duck, which bobbed at every word of command, answering by the number of its bobs the questions of the performer, and so on. At first the European looked on at these and at a number of other wonders of the same kind, and following the line of least resistance, ascribed the phenomena to mysterious causes which were beyond finding out. As time went on, men who had been imbued with an interest in conjuring before they left 'home', started to study the 'tricks' which had obtained so wide a fame. To their surprise they soon found that conjuring as practised in the East was dependent on the very same factors which governed the art they had learnt at home.

The veil of mystery which had shrouded the Orient was little by little lifted to expose trickery, misdirection and humbug. There was, however, one great difference. In the West, the performer made no bones about the fact that he was deceiving his audience, whilst the Eastern always claimed supernatural powers for himself. Around all his doings he threw a veil of mystery ; he was and is a past-master in the art of humbugging his clientele ; he never allowed one of his tricks to be taken as a laughing matter ; his whole technique was that of the 'priest of mystery' ; the matter was a very serious one, no matter how trivial the 'experiment'—he would not have it called a trick for anything—might be.

Step by step our people unravelled the mysteries, dragged them into light and saw them in all their pitiful fraudulence, until it became clear that the fact that a man has a brown, black or yellow skin, and lives in far-away parts of the earth little known to the majority of us, gives him no claim whatever to mystery. Man is man wherever you may find him ; his powers are as limited in China as in Chiswick, in Tibet as in Tooting. Nearly 2000 years ago Tacitus coined the phrase "omne ignotum pro magnifico", a dictum which has pricked the bubble of many a mystery. The wonderful 'mango trick' is based on such barefaced deception that were a performer to present it before the "Magic Circle" at one of our monthly meetings, he would be laughed off the stage. The marvellous nodding duck is dependent on a principle so elementary that my grandson of eleven years of age—a budding magician—would hesitate to use it, unless it were combined with other methods which would help to conceal the fraud. The earthenware medallion, on which the Christian is invited to inscribe the symbol of his faith, with the result that though the disk is ground to powder beneath his foot, the cross is found imprinted on his hand, suffices at first to astonish the subject of the experiment, until he has had time—provided he has the intellect—to solve the very simple device which led him astray. The wonderful seer who reads your fortune in the sand tells you things which seem supernatural in their source, unless you realize that your personal servant has been impanelled to help deceive you. Your conversation has been listened to, your letters read and the information so gained has been handed to the 'holy man' in exchange for the receipt of a small coin of the realm. One might go on with a number of other 'tricks' ; and please note that 'tricks' they are, nothing more and nothing less.

At the present time, most sensible people know all about the majority of these wonders of the East, but two remain to puzzle and disconcert a number of our fellow-countrymen, even including some who have spent the best years of their lives in the East. I refer to the 'Rope Trick' and to 'Levitation'. The Occult Committee of the Magic Circle, a Committee of which I have the honour to be chairman, spent a great deal of time sifting the evidence in favour of the former performance, for which supernatural origin has been so freely claimed. At a meeting held in London on April 30, 1934, with the late Lord Ampthill, a former acting-Viceroy of India, in the chair, we submitted a résumé of the evidence which we had collected. Lord Ampthill said that during his viceroyalty he had tried hard to see the 'rope trick', but in vain. Similar evidence had been sent us by letter from the late Viceroy, Lord Irwin. Lord Meston, the Right Rev. the Bishop Welldon (formerly Metropolitan of India), Sir Michael O'Dwyer and others supported Lord Ampthill, whilst the last-named mentioned that he had asked the Nizam of Hyderabad if he could help him, but though probably the most powerful prince in India, His Highness could not do so. Those who are interested in the subject will find it fully discussed in the second and third chapters of my book "The Myth of the Mystic East" (Blackwood).

No better illustration could be given of the way in which evidence in favour of this trick has been adduced than the statement made by a correspondent in the *Western Morning News* of November 29, 1934, who wrote as follows: "According to a correspondent, the Indian Rope Trick was performed before several hundreds of men who landed in India from Her Majesty's troopship Malabar. It was performed several times a day, not in bad light or when it was dark, but in the full light of the Indian sun. The Duke of Connaught watched the performance sitting on his horse and seemed highly interested." This story, so circumstantially told, seemed as if it must be true, but I had the privilege of being able to submit it to His Royal Highness, through the kindness of a member of his staff, and this is the reply I received: "With reference to the enclosed letter from Colonel Elliot, I sent it to the Duke. Quoting from his letter, he says: 'After these many years I am unable to remember small events of that time, but I have no recollection of ever having seen the rope trick during my service in India, or even heard of it.'" It is impossible to believe that His Royal Highness would ever have forgotten such a supernormal happening. I am greatly in His Royal Highness's debt for so graciously answering my question. It serves to show the way in which the names of our Royal Family are used behind their backs, in a manner which it is very difficult for them to resent. Their outstanding popularity carries great weight with the public, and leads many people to accept stories as ridiculous as this.

There are two recent incidents which deserve a brief mention. The first of these was the so-called 'Cheltenham Rope Trick'. A gentleman who styled himself "Professor" declared that he had discovered how to perform the 'Indian Rope Trick', and had actually done it before a meeting of a society of conjurers. This statement was widely advertised in the Press, and a local photographer stated that he had photographed a girl "as she reached the top of the rope—but when he developed the film, to his amazement, no trace of the girl was to be seen. The rope was bare". I took some trouble to run this story to earth, and was in communication with officials of the society, and with a gentleman of undoubted honesty who was present at the meeting in question. What did it all amount to ? It was just a joke at the expense of the local press-man. A wire had been suspended between the tops of two tall trees, a rope was hung from this, care being taken so to arrange the light that the wire was not visible, and the dupe was told that just before his arrival a girl had ascended the rope and disappeared. The members of the society were much annoyed at the publicity that this trick had attracted and were very unwilling that more publicity should be given to it than they could help. I had to fall in with their wishes. Measures had been taken to prevent any further absurd claims being made. All the same, from time to time notices appeared in the Press, dealing with this incident as if it were worthy of credence instead of being the joke—perhaps not in the best of taste—that it was. My son sent me a copy of it from an Indian paper in which it was taken seriously.

There remains the 'Plymouth Demonstration of the Rope Trick' by Karachi, who, by the way, in private life was a Mr. Arthur Darby. There can be no doubt that a number of honest witnesses, who, however, had not had the benefit of a training in conjuring, were taken in by Karachi, who was simply performing a conjuring trick, which some people have thought very clever, but which to those of us who have studied conjuring was a very cheap form of deception. Mr. Harry Price exposed it in the *Listener* (January 16, 1935), and there was a lot of correspondence on the subject, much of which called to mind Carlyle's bitter dictum on the subject of the intelligence of the population of Great Britain.

The other much disputed topic is that of the power of Oriental fakirs to practise 'levitation'. Many years ago, Messrs. Maskelyne put on a show in which a girl was apparently suspended in mid-air lying horizontally. Hoops were passed round her in various directions to show that there were no mechanical aids to her flotation. It need scarcely be said that it was simply a clever piece of illusion. The Eastern magician presents a similar trick, and much has been made of it in a recent issue of the *Illustrated London News*. Many Europeans have seen this clever performance, but some at least of those who have described it have not been very skilled observers. What actually occurs is substantially as follows: The girl lies on the ground and is covered up; a sort of tent is built round her; then under cover of it she is raised up; the tent is gradually taken away bit by bit, until she is seen lying suspended as it were above the ground, but with some of her coverings dropping down to the ground near her head end in what appears a very innocent way. The spectator is not allowed to go up and examine this drapery or he would find out that it conceals an iron post driven into the ground. Were he allowed further license, he would soon discover the secret of the trick, which indeed is very similar to the device used by Maskelyne long ago. An Indian civilian who occupied a high position in the country recently wrote to me describing how he had this trick performed in his compound at a garden-party. Among his guests was a well-known bishop who was greatly troubled by what he took for a satanic manifestation, until the Commissioner asked him how the man described his performance. "As a trick," replied the bishop. "Well, if he only claimed for it that it was a trick you may be sure it was nothing more. He would certainly not err on the side of modesty in his claims."

In reading of, or in listening to descriptions of this trick as given by men who have not had a training in conjuring—the art of suggestion and misdirection—I would urge readers to be very sceptical. They are often misled to think that events happened far differently from what they actually did. Time after time I have heard people describe what they thought they saw, and knowing how the trick was done I have been astonished that they can have been so hopelessly misled as to the real facts. The success of any and every conjuring show depends on this factor of deception.

We read and hear wonderful descriptions of *yogis* buried alive and being none the worse for it. In those cases in which expert conjurers have witnessed such experiments, it has been quite clear that the actual conditions were not those claimed by the performer. By means well known to expert magicians—I use the term without prejudice—the suffocation of the subject was easily avoided, though doubtless the experience was sufficiently unpleasant. I know the wonderful claims that have been put forward, but I have so often had the opportunity of checking such claims by careful observation and discovering their worthlessness that I am very far from being convinced.

Once again I would urge readers to look always for a natural explanation of any phenomenon, and when one is not forthcoming, to await the advent of more knowledge, confident that a normal and not a supernormal explanation is always forthcoming, provided that we have the requisite knowledge.

American Early Tertiary Mammals

THE White River formation of western North America contains numerous well-preserved fossil skeletons of mammals which date back to Oligocene times when some present-day families were beginning to flourish. The rocks seem to have been formed by floods on a very extensive plain, where the carcases of animals which lived under varied conditions were washed together repeatedly during a long period. The fossils therefore give a very good idea of the mammals which were living on the North American continent during a particularly interesting episode in the evolution of mammalian life. They have already been described in numerous scattered works and papers, but modern methods of collecting have provided so many more satisfactory specimens that there is now an opportunity for a comprehensive review of the whole fauna.

Such a review is being undertaken by Prof. W. B. Scott and Prof. G. L. Jepsen, of Princeton University, who have just published the first part of their work dealing with the Insectivora and Carnivora*. None of the Insectivora has the vacuities in the bony palate and the incompleteness of the zygomatic arches which characterize some existing Insectivora, so that these must be regarded as degenerate, not primitive features. Of the Creodonta or earliest Carnivora, only some Hyænodontidæ survive in the American Oligocene, but very fine skeletons have been obtained from the White River formation. The authors are as much puzzled as previous investigators to explain the use of the long passage above the palate of

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* The Mammalian Fauna of the White River Oligocene. Part I. Insectivora and Carnivora. *Trans. Amer. Phil. Soc.*, N.S., 28, Part 1. Pp. ii+153+22 pl. (Philadelphia: American Philosophical Society; London: Oxford University Press, 1936.)

Hyænodon by which the internal nostrils are displaced as far backwards as those of a crocodile. They remark that "there is no other feature in the teeth or skeleton of the hyænodonts to suggest amphibious habits". They also point out that *Hyænodon* cannot have fed on ants like the existing ant bear (*Myrmecophaga*), which exhibits a nearly similar arrangement of the palate.

The beautifully preserved skeletons of Canidæ or dogs are especially interesting, because they show that in Oligocene times the family was not so completely distinguished from other Carnivora as it is at present, while one genus, *Daphœnus*, seems to be the common ancestor of at least three distinct groups of modern Canidæ. The smaller Oligocene dogs must have looked much like civets.

There are very few Mustelidæ in the White River formation. This family seems to have been much more characteristic of the Old World than of the New World during Oligocene times. Of the Felidæ, no true cats have been found in North America before the Pliocene, but the sabre-tooth cats or Machairodontinæ are well represented in the White River formation. They are all much smaller than the familiar 'sabre-toothed tiger' of later date, but it is interesting to observe that the articulation of the lower jaw in the Oligocene genera is as completely adapted for the wide opening of the mouth as it is in the latest Pleistocene genera. There is no doubt that the sabre-shaped canines were used for stabbing; and one skull of *Nimravus* in the museum of the Dakota State School of Mines exhibits a large gash in the brain-case that was evidently made by such a stab.

From this brief summary it is clear that Prof. Scott and Prof. Jepsen are doing much more than providing technical descriptions of the fossils. They are publishing an illuminating treatise on Oligocene mammals, of which the succeeding parts will be eagerly awaited. A. S. W.

Daniel Gabriel Fahrenheit (1686-1736)

AMONG the many improvers of the thermometer in the eighteenth century, none laboured more assiduously or successfully than Daniel Gabriel Fahrenheit, the German natural philosopher and instrument maker who died in Holland at the early age of fifty years on September 16, 1736. His work was done at a time when the physical and medical sciences were making rapid advances, and there was great need for thermometers of good construction and furnished with a standard scale which could be used for comparisons. It was this need that Fahrenheit met. He was not the first to make thermometers, the first to use alcohol or mercury, or to devise scales with fixed points, but his improvements were such as to make his thermometers known all the world over, and though to-day it is generally recognized that the universal use of the centigrade scale would be a great advantage, the Fahrenheit thermometer seems likely to remain in use for many years yet.

For nearly a century before Fahrenheit's time, men of science had been using thermoscopes and thermometers, and a grand array of names is associated with their early history. Galileo, Boyle, Huygens, Hooke, Halley and others all contributed to the progress of thermometry. Doctors were especially interested in thermometers by which the temperature of human beings and animals could be taken, while natural philosophers required thermometers as much as barometers. The term 'thermometer' is first mentioned by the French Jesuit, Father Leurechon (1591–1670), in his "Récréation mathematique" published in 1624. The early instruments were subject to changes in atmospheric pressure and were really 'barothermoscopes'. Ferdinand II, Grand Duke of Tuscany (1610–70), founder of the Accademia del Cimento at Florence, was the first to produce a thermometer unaffected by atmospheric pressure.

There were all sorts of ideas regarding the graduation of thermometers. In 1665 Boyle suggested the freezing point of aniseed oil, and Huygens in the same year suggested as fixed points the freezing point and boiling point of water. Snow in very cold weather, the greatest heat in summer and melting butter were also proposed for definite temperatures. There were also many suggestions regarding scales, about a score of scales being used in the eighteenth century, of which, however, those due to Fahrenheit, Réaumur and Celsuis, or perhaps more correctly Martin Strömer, alone survived.

It is well known that Fahrenheit was the first to bring the mercurial thermometer into general use, that he devised his well-known scale about 1714, and that he described his method of making thermometers in five short papers in Latin to the Royal Society in 1724, but it is not generally known how he came to be an instrument maker. The bicentenary of his death, however, has led to the publication of a biographical memoir in the *Transactions of the Royal Academy of Sciences of*

Amsterdam, the authors of which, E. Cohen and W. A. T. Cohen-de Meester, add a great deal to our knowledge of Fahrenheit's personal history. This memoir shows Fahrenheit in a most pleasing light, gleaning information from many sources, writing and lecturing on such things as hydrostatics, optics and chemistry, and consorting with some of the most learned men of his time. Of special interest in this memoir are the references to some letters not long ago discovered in Leningrad. In one of these, written on April 17, 1729, to the famous physician Boerhaave, Fahrenheit tells of a visit in 1708 to the Danish astronomer Römer, whom he found placing thermometers in a mixture of ice and water and in blood-warm water. Inspired by his contact with Römer, Fahrenheit began to read about barometers and thermometers and studied the memoirs of Maraldi, de La Hire and Amontons in the publications of the Paris Academy of Sciences. Of the writings of British physicists, he knew only of Boyle's works, so far as they had been translated into Latin, as it was not until his visit to England and his election into the Royal Society in 1724 that he studied English.

Born in Dantzig on May 24, 1686, Fahrenheit was the eldest of a family of three boys and two girls, who were left orphans in August 1701 by the accidental death of both father and mother. He was sent by his guardian to Amsterdam to a merchant's house to learn business, and as a young man made journeys into Denmark, Sweden, Germany and Russia, probably settling finally in 1715 in Amsterdam, where by his lectures he stimulated the study of physical science and where he constructed the thermometers for which he will always be remembered. In 1736 he secured a patent for a mill for draining purposes but did not live to reap any benefit therefrom. His death took place at The Hague, and four days later he was buried in the Kloster kirke, the register of which contains the entry "Am 20 September 1736 am Tage begraben in dem Gewölbe unter dem Chor Daniel Gabriel Fahrenheit. Für Miete des Grabes und zwei Läuten 18 Gulden".

The memoir on Fahrenheit to which reference has been made above contains portraits of several of his most celebrated contemporaries, including Boerhaave, Römer, s'Gravesande, Musschenbroek and Nieuwentyt, but none of Fahrenheit himself.

Obituary

Mr. William Rintoul, O.B.E.

MR. WILLIAM RINTOUL died at the age of sixty-six years at his home in Ardrossan, Ayrshire, on August 25, after nearly a year's illness. His career had been a remarkable one, and began in Glasgow, where he was educated and received in Anderson's College his scientific training. In the late 'eighties there were (as there are even now) few schools of analytical chemistry. so that Mr. R. R. Tatlock not only filled the post of city analyst but also himself lectured and had a staff of lecturers on chemistry and physics to students many of whom afterwards became his assistants and later occupied important positions in the chemical profession. Ramsay was one of them.

After a short time as an assistant, Rintoul lectured to Tatlock's students until in 1891 a post of chemist offered in a paint manufacturer's near London, where he got chemical and works experience. After three years there he went in 1894 to the Royal Gunpowder Factory as a chemist in the laboratory, later becoming chemist-in-charge of the manufacture of nitroglycerine, and for two years before he resigned he was chief chemist in the laboratory.

At this time the Royal Gunpowder Factory under Sir Frederic Nathan as superintendent and Mr. James Thomson as manager led the explosives industry in Great Britain in organization, in safety precautions and in the invention of new processes and plant. Rintoul, naturally inventive and of remarkable manual skill, did his full share, of which the displacement process for the manufacture of nitroglycerine is an example. This process improved the manufacture of that explosive economically in that no high buildings were required to house the plant and also from the point of view of safety, as the nitroglycerine was removed (by upward displacement) from its acid mixture as soon as it had been formed and was sent at once for its preliminary washing, instead of being left to separate in bulk in an acid, and more or less dangerous, state. At this time also he was co-inventor with Robertson of a process and plant for the recovery of acetone, the solvent used in the manufacture of cordite.

Accompanying Sir Frederic Nathan to Nobel's Explosives Company (now part of Imperial Chemical Industries, Ltd.) at Ardeer in Ayrshire in 1909 as chief chemist, he became research manager there and devoted himself to the organization of the laboratories and erection of many new ones. His policy had several features which have been commended by others in like position, as for example, the provision that all chemists, whether destined for research or plant, should first undergo a thorough training in analytical chemical methods, the insistence on a good system of documentation of reports and of published work, the installation of physical methods of testing explosives and close contact with the universities.

While at Ardeer he was associated with a number of patents chiefly on stabilizers for explosives, and developed a keen interest in biochemical investigations, some of which are described (with Raistrick) in the *Philosophical Transactions of the Royal Society*.

About ten years ago Rintoul was brought up to the headquarters of Imperial Chemical Industries, Ltd., as a director of its research organization, from which he maintained an active and sympathetic contact with all the company's laboratories, and came into close touch with many prominent scientific men who were working directly or indirectly in the company's interests, for it was part of his duty to administer the support given by the company to widespread scientific activities. In these matters he gained the respect and affection of everyone with whom he came in contact, and as representative of his firm was well known abroad, where he attended many conferences.

Rintoul was made an O.B.E. for his work in the Great War, and assisted on many committees such as the Councils of the Chemical Society and Institute of Chemistry, the Safety in Mines Research Board, the Chemistry Research Board (D.S.I.R.), the Research Committee of the Midland Railway and the British Standards Institution. When he died he was president of the Faraday Society, in the discussions of which he took much interest.

Rintoul married twice: first Lottie Edwards, by whom he had two sons and a daughter, and secondly, two years ago, Jess Isabel Robertson.

R. ROBERTSON.

Dr. N. A. F. Moos

To those interested in terrestrial magnetism and in Indian science, the name of Dr. Nanabhai Ardesher Framji Moos is well known, and they will learn with regret from *Current Science* for June of his death on March 12 last. Born in 1859, he graduated in engineering at the Poona College of Science in 1878, and after some years of teaching there entered the University of Edinburgh, taking the B.Sc. degree with distinction in 1886. On his return to India he held a series of appointments, including that of professor of physics at the Elphinstone College, Bombay.

At that time the observatory at Colaba, Bombay, was in charge of Mr. C. Chambers; and on his death, in 1896, Moos was appointed director, soon having the responsibility of overcoming the disturbances produced in the magnetic records by electric traction in the city. He shifted the magnetic work to a new observatory at Alibag, where he was most successful in handling the architectural difficulties of a constant-temperature room.

Moos had all the faithful conscientiousness that is found in Indian officers, and to that he added much of the Parsee energy and enterprise. His training in engineering, as well as in physics, gave him considerable interest in instrumental design, so that he loved to work out new patterns in seismometers. But his outstanding feature was his devotion to the observatory. He was ever on the look-out for new apparatus, and was determined that, if he could bring it about, the equipment of Bombay should not be inferior to that of any observatory in the world. For the financial difficulties of those in administrative charge, his sympathy was, not unnaturally, somewhat restricted; but in spite of an occasional disappointment his loyalty to his work never flagged.

Moos's great opportunity came with the plan for putting together and discussing the complete series of observations of the old Bombay Observatory; and the two volumes of "Colaba Magnetic Data, 1846–1905" are a monument of conscientious and successful labour. They form an indispensable part of the equipment of a magnetic library.

Moos had always taken a keen interest in the university life of Bombay, and after his official retirement in 1919 his active participation was kept up until the end.

G. T. W.

Mr. J. L. Hodgson

MR. JOHN L. HODGSON died on August 14 at his home near Leighton Buzzard, at the early age of fifty-five years. Born at Lincoln and receiving his technical training at Nottingham University College, he leaves a life record of very valuable work in the engineering world. On the practical side, he served with Messrs. William Walker, the Gedling Colliery, Yarrow and Co., where he was associated with the late Sir Alfred Yarrow in research work on speed ships and destroyer design. About 1910 he was appointed to the staff of George Kent Ltd., of London, and became the technical adviser on all matters connected with the metering and control of air, gas and steam. It was he who designed the first Venturi air meters, which were installed by the Victoria Falls Power Co. He was also intimately concerned with the ventilation arrangements of the Mersey Tunnel. For one of his papers dealing with the use of the orifice for the measurement of fluid he was awarded the Telford Medal by the Institution of Civil Engineers.

Throughout his life, Hodgson abhorred waste in all forms, believing that scientific discovery and invention should be used for the service of man, and not for his destruction. He was one of the founders of the Engineers' Study Group, which was formed to study how and why there is "poverty amidst plenty" in our age. His death will be a severe loss to many friends.

WE regret to announce the following deaths:

Dr. Alexander Anderson, formerly president of University College, Galway, on September 5, aged seventy-eight years.

Mr. E. R. Deacon, O.B.E., head of the high explosives branch of the Directorate of Explosives Research, Woolwich, on August 29, aged fifty-four years.

Lord Moynihan, emeritus professor of surgery in the University of Leeds, and president in 1926–32 of the Royal College of Surgeons of England, on September 7, aged seventy years.

News and Views

The British Association and Social Science

THE Report of the Council of the British Association, adopted by the General Committee on September 9 at Blackpool, included two matters of particular interest relating to the development of the activities of the Association in the field of the social sciences. During the year covered by the Report, the Council appointed a Committee to consider how the Association might indicate the importance which it attaches to the development of the social sciences, either by the appointment of a third general secretary or by other appropriate means. As a result, this year's programme includes in a separate section the titles of addresses, papers, and discussions having a special bearing upon the relations between science and the interests of the community. Communications appropriate to this group may be suggested by organizing sectional committees or by sectional presidents. At least one discussion in each annual programme is to deal with the application of science to social problems, and at least one of the evening discourses. By these developments, it is intended to provide the evidence which public opinion now demands that the Association shall carry out one of its original aims, namely, that of "obtaining a more general interest for the objects of science".

Incorporation of the British Science Guild

IN the same spirit, the General Committee accepted the recommendation of the Council for the incorporation of the British Science Guild in the Association. It will be remembered that the Guild was the outcome of Sir Norman Lockyer's presidential address to the Association, at the Southport meeting thirty-three years ago, on "Influence of Brain Power on History". The stated object of the Guild is "to promote the application of scientific method and results to social problems and public affairs". As is pointed out in the Report adopted at Blackpool, the same object is implicit in the aims of the Association; and the programmes of recent meetings have given evidence of a greater concern for these problems than was commonly exhibited in former years. The terms of the incorporation of the Guild in the Association include the transfer of the capital funds of the Guild to the Association, together with contingent bequests from Lady Lockyer and Sir Albert Howard. The Council of the Association will appoint a committee, to be called the British Science Guild Committee, which will be entrusted with arrangements for lectures already initiated by the Guild and for any similar lectures approved by the Council. The Norman Lockyer Lecture is to continue to be delivered annually and to have particular reference to the relations between science and the welfare of the community; and the Alexander Pedler Lecture is to be offered annually to one of the corresponding societies of the Association, or be delivered at a centre outside London. The amalgamation of the two bodies was greatly to be desired, and we are glad that it has now been accomplished. Though, when the Guild was founded, few men of science took active interest in the application of scientific methods to the investigation of social problems, there is now a decided change of attitude in this respect and the columns of NATURE have afforded abundant evidence of such repercussions. The Association has responded to this extended influence, and has thus shown itself to possess the progressive spirit which should be characteristic of every scientific institution.

Jean-Sylvain Bailly (1736-93)

THE bicentenary of the birth of the French astronomer Jean-Sylvain Bailly, who was born in Paris on September 15, 1736, and perished on the scaffold at the age of fifty-seven years, recalls a career of great interest, for Bailly was not only a cultivated and distinguished man of science, but he was also one of the enthusiastic philanthropists who at the coming of the French Revolution adopted with ardour the popular cause and endeavoured to secure for the people sound constitutional reforms. The son of a keeper of the King's pictures, it was intended that he should follow in his father's footsteps as a painter, but literature proved more attractive than art, and science more alluring than either. It was his acquaintance with Lacaille that led him to astronomy, and one of his earliest labours was the reduction of Lacaille's observations on zodiacal stars. He also became known for his researches on Jupiter's satellites, but his greatest work was his "Histoire de l'Astronomie", a work full of animated description, luminous narrative and interesting detail. The correspondent of Voltaire and Buffon, the contemporary of D'Alembert and Diderot, Bailly's versatility was recognized by the unusual honour of his being elected a member of the Academy of Sciences, the French Academy and the Académie des Inscriptions et Belles Lettres.

ALL accounts of Bailly describe him as a man of the highest integrity, generous, courageous and liberal-minded. The popularity he enjoyed led to his election in 1789 as a deputy to the Tiers-Etat and to his being chosen president of the National Assembly. In his capacity of president he dictated to the members the oath taken in the Tennis Court at Versailles on June 20, 1789, "to resist tyrants and tyranny, and never to separate till they had obtained a free constitution". About a month after this, the Bastille fell, and on July 17, when Lafayette was made commander-in-chief of the new National Guard, Bailly was made Mayor of Paris. For two fateful years Bailly held his difficult posts, endeavouring amidst the rising tide of republicanism to serve both King and country. Then came his fall. On July 17, 1791, the demonstration took place in the Champ-des-Mars to secure signatures for a petition demanding the dethronement of the King. There was disorder and violence, Bailly gave the order for the crowd to be dispersed by force, fire was opened, some forty people killed and with the "massacre of the Champ-des-Mars" Bailly's popularity waned. A few months later, he resigned his posts and retired to Nantes. Two more years passed and against advice he visited Laplace at Melun. He was recognized and denounced, and was sent to Paris, where he was tried on November 10, 1793; on the next day he was condemned, and on November 12—a bitterly cold wet day—was taken in an open cart to the ill-fated Champ-des-Mars and there guillotined amidst the execrations of the people he had done his best to serve. Save for Lavoisier, who fell on the scaffold six months later, Bailly was the most distinguished man of science who fell a victim to the Revolution. He had, however, played a conspicuous and honourable part, and to-day his statue stands in the gardens of the Luxembourg.

Vitamin B_1

THE structure of vitamin B_1 was made certain by its synthesis, recently announced from the laboratory of Prof. Williams of Columbia University (see NATURE, Aug. 29, p. 372), and this has now been repeated elsewhere. Grewe (*Hoppe-Seyler's Zeitschrift für physiologische Chemie*, 242, 89; 1936), working in Windaus's laboratory at Gottingen, describes the preparation of the pyrimidine half of the molecule, and completely confirms the latest formula put forward by Williams, though mention is only made of Williams's earlier suggestions which he himself has now modified. Grewe goes on to state that he had intended to work out a synthesis of the vitamin from the new pyrimidine derivative when he learned, through Prof. Windaus, that Andersag and Westphal had already accomplished this in the scientific laboratories of the I.G. at Elberfeld, and that patent protection had been sought. Prof. Williams's work was carried out with the collaboration of Merck and Co., Inc., Rahway, N.J.; it seems, therefore, on the cards that there may be some interesting developments in the patent field, should the synthesis of vitamin B_1 become practicable on a commercial scale.

Half-Castes and World Peace

A NOVEL view of the problem of the half-caste and of the role which might be played by communities of mixed origin in the promotion of world peace is taken by Mr. Cedric Dover in a memorandum which he presented to the International Peace Congress held on September 3–6. In a cursory survey of the figures, he points out that not only are half-castes more numerous than is realized generally, but that they form an appreciable proportion of the populations of the modern world. Mr. Dover, however, does not rely on the mere weight of number. He goes on to argue that half-caste communities, consisting of 'marginal' men, who represent two cultures, and exist under conditions of 'imperialism', owing to the presence of a dominant white population, present parallelisms, due to a common ethnic element derived from their white blood, a common language (English), a common religious belief, and common social and economic conditions. It is suggested, therefore, that the continued growth of ethnic relations and mixed populations should be accepted as part of the machinery of human evolution, of which advantage should be taken to promote the greater ethnic unity and cultural uniformity, which would afford an efficient counter to an aggressive spirit of nationalism, while the creation of a united front of marginal communities would lead inevitably to better international understanding.

IF Mr. Dover's suggestions to this end tend to a more rational attitude towards the half-caste, they will have accomplished much. Miscegenation, however, has not been overlooked as a possible ultimate solution of the colour question; but the world, it would seem, is not yet prepared, on present evidence of the effects of the crossing of widely diverse strains, to foster it deliberately or even to countenance it. The organization of a world-wide front of sufficient strength to make its weight felt demands resources and machinery, of which at present there seems little expectation. Quite possibly local loyalties would prove obstacles stronger than the communal parallelism upon which Mr. Dover would rely.

Roman Leicester

A FURTHER stage in the proceedings which will determine the future of Roman Leicester (see NATURE of August 29, p. 356) was reached on September 3, when an inquiry was held in the city by the Ministry of Health to examine the application of the Leicester Corporation to borrow £135,000 for the purpose of erecting baths on the site adjacent to the Jewry Wall, upon which archæological investigations are being conducted by Miss Kathleen Kenyon. The application was opposed by the Leicester Archæological Society, the Leicester Literary and Philosophical Society and the Leicester Civic Society, bodies co-operating in the excavation. They were represented by Mr. Macgregor Clarkson; and Mr. P. K. Baillie Reynolds, Inspector of Ancient Monuments, was also present, representing the Office of Works. In the course of his evidence, Mr. Clarkson stressed the unique position which the site conferred on Leicester. The recent discoveries, he urged, made it possible to point to the civic centre of the city in three historic periods—the Town Hall of Roman times, the Guildhall of the Middle Ages, and the modern Town Hall. Miss Kenyon's evidence dealt with the important archæological features of the site added by her investigations, including part of the Forum and the ten feet depth added to the Jewry Wall, part of the Roman Town Hall, which, now standing at 35 ft. in total height, is one of the largest Roman walls in Britain. This wall is scheduled as an ancient monument.

THE suggestion put forward by Mr. McEvoy, the Town Clerk, in stating the case for the application, was that excavation should proceed under skilled archæological supervision, the cost entailed over and above the normal cost of excavation to be borne by a local committee representing those interested in ancient remains. Against this, Mr. Colin D. R. Elles, the chairman of the excavation committee, handed in a petition, which had been signed by 3,235 persons in four days only, asking that the remains should be preserved; while Mr. Baillie Reynolds not only stated that his department would look with great favour on any scheme to preserve the remains, but also intimated that the Office of Works would co-operate in laying them out to advantage.

Forensic Medicine

THE Advisory Committee on the Scientific Investigation of Crime, under the chairmanship of Lord Trenchard, recently issued its report (London : H.M. Stationery Office, 1936. *2d.* net), from which it would appear that the teaching of forensic medicine in London is in an extremely backward condition as compared with the teaching of that subject in most of the capitals of Europe, and well behind the standard set in Scotland. As the Committee points out, this is not confined to the restricted sphere of criminal investigation and police practice, but extends to the study of many problems connected with social medicine and to the whole question of medico-legal practice. The Committee recommends the establishment of a medico-legal institute which would act as a training centre for medico-legal experts and as a centre for special pathological research, and it also suggests that facilities should be given for courses of instruction for students of law, coroners and other persons who are associated with medico-legal work.

As to the question of police laboratories, though in certain circumstances it is no doubt advisable to have laboratory facilities under the direction of the police, the proper place for extensive medico-legal investigations is in connexion with departments of universities. If the investigating authorities are to have the facility of obtaining advice on all kinds of scientific subjects, as they must, there is no possibility of so doing if they are restricted to police laboratories. Such advice and assistance can be obtained only through the universities. It is, however, impossible for the police authorities to know what departments to consult, and therefore a department of forensic medicine within the university offers the only means by which full use of the latest advances in science may be obtained. On considering the whole matter, it would appear to be advisable for the authorities in London to concentrate their efforts in founding a Department of Forensic Medicine in connexion with the University of London, and to make the necessary arrangements for the ample material, which is at present largely wasted, to be utilized in the teaching of elementary forensic medicine to medical students and to offer facilities for post-graduate study and research to those who desire to specialize in this subject.

Technical College Equipment

WE have received from an Advisory Committee on Technical College Equipment, British Industries House, Marble Arch, London, W.1, a memorandum on a scheme in progress for setting up an exhibition at British Industries House showing the equipment necessary for technical institutions. This movement is designed to help those responsible for expenditure on these centres in view of the very large outlay anticipated during the next few years by the Board of Education. The Committee represents the three associations concerned with technical teaching and also the Institution of Production Engineers, and hence is an authoritative body. It is pointed out that the present method of deciding on a design, that of visiting recent buildings and utilizing the composite information obtained, wastes time and is unsatisfactory. Technical education in Great Britain is lamentably behind that on the Continent in the matter of material equipment and buildings, hence this scheme is to be commended. The relationships of the pieces of mechanism will no doubt be an important part of the Committee's work, though this must be to some extent subservient to the configuration of the floor space. More difficult will be the presentation of the structural features and service supplies essential as the basis of the equipment. It is stated that the object is to enable full information to be obtained for getting out estimates for building, extending, and equipping institutions. So far as the two former functions are concerned, it seems difficult to see how the exhibition can supply any detailed information, from the province of trained professional advisers and necessarily varying with local conditions; such advisers, however, should be able to learn much from the exhibition.

Geological Survey and Museum: New Activities

A NEW publications stall, where the public may purchase the official guides and geological memoirs, including the series of handbooks on British Regional Geology referred to in NATURE of September 5 (p. 389), has been opened in the entrance hall of the new Geological Museum at South Kensington. The Museum has also published an extensive series of excellent photographic postcards, price *1d.* each, which are likely to be of value to teachers of geology and physical geography. The postcards include reproductions of general views of the Museum, with dioramas and other interesting exhibits; and photographs of British localities of geological interest, with explanatory text, illustrating marine erosion and sea coasts, rock-weathering and denudation, vulcanism, glaciation, and similar subjects. A list is obtainable from the Museum. An experimental series of free public lantern lectures and lecture tours on the geology and scenery of various regions of Great Britain was given last month. The lectures were well attended, and will be continued throughout the winter. Facilities for special parties can be arranged. Recent additions to the exhibited collections include a series of specimens from H.M. Office of Works, illustrating the weathering of the building stone

(Anston stone) of the Houses of Parliament; and a suite of ores illustrating the occurrence of copper at Kilembe, presented by the Geological Survey of Uganda. This occurrence, which is in granulitic rocks, is remarkable for the presence of the cobalt ore linnæite, although arsenic and antimony are absent. Among the donations recently received by the petrographical department there is a valuable series of rock-specimens from the Pre-Cambrian of the Adirondacks, New York State, collected and presented by Dr. A. F. Buddington of Princeton University; and a second fine collection from the Charnwood Forest and Nuneaton areas, presented by Mr. H. H. Gregory of the Leicester Museum.

Empire Fauna at Home and Abroad

THE August number of the *Journal of the Society for the Preservation of the Fauna of the Empire* presents some interesting contrasts in its varied accounts of wild life in different British territories. Capt. C. R. S. Pitman, to whose reports as Game Warden of the Uganda Protectorate NATURE has referred on previous occasions, in a lecture to the Society, explained why organized control of the 21,000 elephants of the Protectorate became necessary. The devastation caused by such great numbers in a limited area (of some 80,000 square miles), where the native population averages forty to the square mile, became intolerable, and yet under organized control, and in spite of the fact that 17,000 elephants have been slain in twelve years, the estimated number remains as it was in 1924. Capt. Pitman is of opinion that organized control is the finest insurance for the adequate perpetuation of the African elephant. From wild Africa we turn to the home of animal protection—and read Miss Frances Pitt's article upon the polecat and pine-marten in Great Britain. The elephants are over-numerous, do serious harm, are deliberately slaughtered, and yet their continued existence is secured; the polecat and pine-marten are rare, are two of the most interesting members of the primitive fauna which survive in Britain, they do no particular harm in any serious degree, and yet—the first is extinct in Scotland and England, and survives only on the Welsh border, and the latter is apparently extinct, or all but extinct, throughout the whole country except in the north-west of Scotland; and almost all because these creatures are liable to find their way into traps set for vermin. It is ironical that while we concern ourselves with the fauna of the Empire abroad, these two creatures should be disappearing in *our* own land under our eyes. Can no step be taken to ensure their adequate perpetuation, as the adequate perpetuation of destructive elephants in Uganda is ensured ?

Marine Biology at Cullercoats

THE Report for the year ending July 31, 1935, of Armstrong College Dove Marine Laboratory, Cullercoats, Northumberland, drawn up by the director, Prof. A. D. Hobson, and published by the Marine Laboratory Committee of Armstrong College, shows a successful period in the history of the Laboratory. Further alterations in the building have given more working space and the library has been extended, with most satisfactory results. Herring observations have been continued in accordance with those of previous years, also salmon investigations, the results of the latter work having been published in the Annual Report of the Tyne Salmon Conservancy Board. Interesting results have been obtained by Dr. Bull in his experiments on conditioned responses in fishes in connexion with changes of salinity, and he has also continued his observations on pollution in the Tyne estuary. Faunistic work, which has been made a speciality of the Laboratory researches, is progressing rapidly, many new additions have been made to the fauna, and a reference collection is in process of formation which will be of great value to future workers. A mussel survey of the Northumberland beds has been completed, and a report prepared and submitted to the Northumberland Sea Fisheries Committee. This report appears in the present publication, showing that the Holy Island and Budle Bay beds are the only areas of importance for bait supplies. Papers on the herring investigations by B. Storrow and Dorothy Cowan, on conditioned responses in fishes (Part 6) by H. O. Bull, and on heterogonic growth in the abdomen of *Carcinus mænas* by J. H. Day (see NATURE, April 18, 1936, p. 669) are also included.

Weed Problems in Australia

As in some other parts of the world, noxious weeds are proving a serious source of trouble in Australia. The problem has been under the consideration of the Standing Committee of Agriculture and independently by several of the bodies represented on it. An arrangement was made in 1934 that as a preliminary to further work an officer of the Council for Scientific and Industrial Research should undertake a survey of the problem, the economic importance of different weeds, methods of control which had been already tried and their results, and so forth; his report to include recommendations for further co-operative work. The survey was undertaken by Mr. G. A. Currie, of the Division of Economic Entomology, assisted in certain aspects by Mr. J. Calvert, of the Division of Plant Industry. The report has been recently drawn up by Mr. Currie, and the more important portions of it are published by the Council for Scientific and Industrial Research of Australia in Pamphlet No. 60, "A Report on a Survey of Weed Problems in Australia" (Melbourne: Government Printer, 1936). Apart from the study made of past records of the activities and damage resulting from weeds, the weed legislation of each State was studied and the methods of administration ascertained. The pamphlet outlines the losses incurred from weeds, and the existing methods of control and the relation of dangerous weed growth to various primary industries. There is much in this pamphlet which could be studied with advantage in Great Britain. Among the sixteen weeds selected as being the most important in Australia are such well-known ones as bracken, stinkwort, thistles, blackberry, St. John's wort, lantana, ragwort, convolvulus and wild turnip.

(*Continued on p.* 459.)

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The Impact of Science upon Society*

By Sir Josiah Stamp, G.C.B., G.B.E., F.B.A., President of the British Association

DURING the past year we have had to mourn the loss of our patron, King George V, but to rejoice in the honour done us by His Majesty King Edward VIII, himself our most illustrious past-president, in taking that office.

Since the beginning of this century the British Association has, till now, added only one new place of meeting in Great Britain to its list. Blackpool can certainly do for science in the North all that Bournemouth achieved in the South: give our record new vigour, and itself a new friend.

The reactions of society to science have haunted our presidential addresses with various misgivings for some years past. In his great centenary address General Smuts, answering the question "What sort of a world picture is science leading to?", declared that one of the great tasks before the human race is to link up science with ethical values and thus remove grave dangers threatening our future. For rapid scientific advance confronts a stationary ethical development, and science itself must find its most difficult task in closing a gap which threatens disruption of our civilization, and must become the most effective drive towards ethical values. In the following year a great engineer spoke as a disillusioned man, who watched the sweeping pageant of discovery and invention in which he used to take unbounded delight, and concluded by deploring the risk of losing that inestimable blessing, the necessity of toil and the joy of craftsmanship, declaring that spiritual betterment was necessary to balance the world. Then came the president of the Royal Society, a supreme biochemist, on the perils of a leisure made by science for a world unready for it, and the necessity for planning future adjustment in social reconstructions. Followed the astronomer, deploring man's lack of moral self-control; in knowledge man stands on the shoulders of his predecessor, whereas in moral nature they are on the same ground. The wreck of civilization is to be avoided by more and not by less science. Lastly, the geologist gloried in the greatest marvel of millions of centuries of development, the brain of man, with a cost in time and energy that shows us to be far from the end of a mighty purpose, and looking forward confidently to that further advance which alone can justify the design and skill lavished on such a task. So the geologist pleads then for scientific attention to man's mind. He has the same faith in the permanence of man's mind through the infinite range of years

"That oft hath swept the toiling race of men
And all their laboured monuments away",

that is shown at the Grand Canyon, where, at the point exposing, in one single view, over a billion and a half years of the world's geological history, a tablet is put to the memory of Stephen Tyng

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* PRESIDENTIAL ADDRESS DELIVERED AT BLACKPOOL ON SEPTEMBER 9.

Mather, the founder of the National Park Service, bearing what is surely the most astonishing scientific expression of faith ever so inscribed :

> "There will *never come an end* to the good that he has done".

We have been pleading then in turn for ethical values, for spiritual betterment, for right leisure, for moral advance, and for mental development, to co-ordinate change in man himself with every degree of advance in natural science in such a harmony that we may at last call it 'progress'. This extension of our deeper concern beyond our main concern is not really new, but it has taken a new direction. I find that exactly one hundred years ago there was a full discussion on the moral aspects, a protest that physical science was not indeed, as many alleged, taking up so much of the attention of the public as to arrest its study of the mind, of literature and the arts ; and a round declaration that by rescuing scientists from the narrowness of mind which is the consequence of limiting themselves to the details of a single science, the Association was rendering "the prevailing taste of the time more subservient to mental culture". A study of these early addresses shows that we are more diffident to-day in displaying the emotions and ideals by which I do not doubt we are all still really moved. But they also show that we are preoccupied to-day with some of the results of scientific discovery of which they were certainly then only dimly conscious. A part of that field, which ought itself to become scientific, is my theme to-day.

IMPACT AS THE POINT OF CONTINUOUS CHANGE

What do we mean by impact ? My subject is *not* the influence or effect of science upon society —too vast, varied and indeterminate for such an occasion. We may consider the position of the average man, along a line of change we call 'progress', at the beginning of a certain interval of time and at its end. We might then analyse how much is due to a change in the average man himself, his innate physical and mental powers, and how much to other influences, and particularly to science. We may debate whether the distance covered is great or small by some assumed standard, and whether progress has been rapid. We might ask whether the direction has been right, whether he is happier or better—judged again by some accepted standard. But our concern here is with none of these questions. I ask whether the transition has been difficult and distressing, in painful jerks and uprootings, costly, unwilling, or unjust ; or whether it has been easy, natural, and undisturbing. Does society make heavy weather of these changes, or does it, as the policeman would say, 'come quietly' ?

The attitude of mind of our order may be either that change is an interruption of rest and stability, or that rest and stability are a mere pause in a constant process of change. But these alternatives make all the difference to its accommodating mechanisms. In one case there will be well-developed tentacles, grappling irons, anchorages, and all the apparatus of security. In the other, society will put on casters and roller bearings, cushions, and all the aids to painless transition. The *impact* of science will be surprising and painful in one case, and smooth and undamaging in the other. Whatever may be the verdict of the past, is society and its institutions now learning that change is to be a continuous function, and that meeting it requires the development of a technique of its own ?

Science itself has usually no immediate impact upon institutions, constitutions, and philosophies of government and social relations. But its *effects* on people's numbers, location and habits soon have ; and the resistance and repugnance shown by these institutions and constitutions to the changed needs may rebound or react through those effects upon scientific enterprise itself, and make it more precarious or more difficult. Thus the effect of applications of electricity and transport improvements is clearly to make the original areal extent of city or provincial Governments quite inappropriate, and the division of functions and methods of administration archaic. If these resist change unduly, they make it more difficult and frictional, and the applications of science less profitable and less readily acceptable. Time makes ancient good uncouth. When two bodies are violent or ungainly in impact, both may be damaged. If the written constitution of the United States, devised for the 'horse and buggy' days, still proves not to be amenable to adjustment for such demands, it will be difficult to overstate the repercussion upon economic developments and the scientific enterprise that originates them. Let any Supreme Court decision of unconstitutionality on the Tennessee Valley experiment in large-scale applied science to natural problems on a co-ordinated plan bear witness. Such unnecessary resistance may be responsible for much of what has been aptly called 'the frustration of science'.

Avoidable friction in the reception given to scientific discovery not only deprives the community of advantages it might otherwise have enjoyed much earlier, or creates a heavy balance of cost on their adoption ; it may also discourage applied science itself, making it a less attractive and worthwhile pursuit. In that sense we are considering also the impact of society upon science. This, too, is not new. The Association had as one of its first objects "to obtain a more general attention to the objects of Science, and a removal of any disadvantages of a public kind which impede its progress". The first address ever offered affirmed that the most effectual method of promoting science was the removal of the obstacles opposing its progress, and the president instanced the very serious obstacles in the science of optics due to the regulations relating to the manufacture of glass. To-day, perhaps the scientist places more stress upon the failure of Governments to encourage than upon their tendency to discourage. So much then for the *idea* of impact. Is the scientist or inventor responsible for impact, and if not, who is ?

THE QUESTION OF RESPONSIBILITY

Elsewhere I have retouched Jeremy Bentham's poignant picture of the inventor of over a century ago, plans and cap in hand, on the doorstep of the rich or influential, waiting for someone to believe in him. From this type of external 'sport' amongst engineers and scientists came much or most industrial innovation, external to the processes of business. To-day, in the older and applied sciences affecting industry, the solo scientist is the exception and, with the large research departments of particular businesses and trade research associations, the picture is quite different—the expenditure higher, but the results much more rapid and numerous, even if for a time they may be kept secret. Although records of finished work may be available over the civilized world, there is much overlapping of current work, but the price of this as a whole is a far smaller fraction of the total result, if we omit from our consideration the first-magnitude discoveries of epoch-making influence. The industrial community is now far more amenable than hitherto to scientific influence ; indeed it is often the instigator in the mass of minor advances.

The new epoch of concerted industrial research dates really from the end of the Great War. During all that time I have held some middle position of responsibility between the research laboratories and institutes on one hand, and the costing and profit and loss accounts on the other, and my impression is that the proportion of work in which the initiation comes from the business end is steadily increasing. In studies of the periods of scientific and industrial gestation respectively, I have elsewhere defined *scientific gestation* as the time elapsing between the first concept of the idea and its public presentation to society in a form substantially that in which it ultimately finds extensive use without important modification ; and *industrial gestation* as the period elapsing from this point to the date when in an economic or industrial sense the innovation is effective. Both periods are difficult to determine exactly in practice, but on a broad view, the period of industrial gestation, with which alone I am here concerned, appears to me certainly to have shortened materially, though possibly at greater social cost. It would obviously be so if industry is actively encouraging research. "Faraday's discoveries came at the beginning of the great steam era, and for fifty years there would have been no difference in transport, even if those discoveries had not been made", for the telegraph was the only material influence upon it, and practical lighting was delayed until 1900.

In nearly every scientific field there is subdivision of labour, and it is rare that the worker who digs out new truth 'at the face', so to speak, is also responsible for bringing it to the surface for the public use, still less for distributing the new scientific apparatus or ideas broadly, and even less for the profitable exploitation of the whole process. These functions are nearly always distinct, even though they are embraced under one general popular description : chemist, engineer, etc. But in few cases is it any part of the professional training in the subject itself, to study how new products or processes affect the structure or welfare of society. I have questioned many scientific workers, and find them, of course, keenly alive to the positive and direct beneficial effects of their work, but they have rarely any quantitative ideas as to negative, indirect and disturbing consequences.

All these discoveries, these scientific infants, duly born and left on the doorstep of society, get taken in and variously cared for, but on no known principle, and with no directions from the progenitors. Nor do the economists usually acknowledge any duty to study this phase, to indicate any series of tests of their value to society, or even of methods and regulation of the optimum rate of introduction of novelty. These things just 'happen' generally under the urge of profit, and of consumers' desire, in free competition, regardless of the worthiness of new desires against old, or of the shifts of production and, therefore, employment, with their social consequences. The economist rightly studies these when they happen, but he is not dogmatic about them not being allowed to happen at all in just that way on account of the social disturbance or degradation of non-economic values which they may involve. It is truly a 'no-man's-land', for it is rarely that the functions of government begin until a vested problem exists. Especially in Britain we do not anticipate—"Don't worry,—it may never happen".

Problems with us are usually called 'academic' until we are 'going down for the third time'. It is a maxim of political expediency not to look too far ahead, for it is declared that one will always provide for the wrong contingency. The national foresight over wireless was exceptional, and it has to be contrasted with the opportunist treatment of the internal combustion engine. In reply, it can, of course, be urged that no one can foresee just how a scientific idea will develop until it is tried out, rough and tumble, in economic society, and to make anticipatory rules may even hinder its development.

THE SCIENTIFIC WORKER IN THE WIDER FIELD

It is rightly stated that the training of the scientist includes no awareness of the social consequences of his work, and the training of the statesman and administrator no preparation for the potentiality of rapid scientific advance and drastic adjustment due to it, no prevision of the technical forces which are shaping the society in which he lives. The crucial impact is nobody's business.

When the research worker lifts his attention from his immediate pursuit and contemplates its hinterland, he has three possible areas of thought. He may dwell upon its practical applications and seek to make them as immediate and realistic as possible ; moved by the desire not to be merely academic, he may return to his task, to focus his attention primarily on what is likely to be of practical utility, rather than on what is intellectually intriguing. Or he may think of its ultimate social consequences, and speculate on the shifts in demand, the unemployment, the loss of capital, the ultimate raising of the standard of life that may result—in other words, he may engage in economic prevision and social and political planning for the results of his efforts. Or, in the third place, he may listen and watch for hints from other fields of scientific study which may react upon his own, and suggest or solve his problems. I do not attempt to give these priority. Economic and political prevision is the most difficult and precarious, because it needs a technique different from his own, and is not given by the light of Nature.

Specialist scientists have no particular gifts for understanding the institutional processes of social life, and the psychology of multiple and mass decisions. It is a tortuous and baffling art to transmute their exact findings into the wills and lives of unscientific millions. But quite a number engage in the pursuit, and have not much greater aptitude as amateur ministers of foresight than statesmen would have in planning research. Fewer are skilled, however, in what should be the most appropriate auxiliary to their work—the synthesizing of scientific knowledge. The more penetrating they are in their main pursuits, the less may they absorb through analogy or plain intimation from outside. We constantly hear that the average clinical application lags much farther behind the new resources of diagnosis from the laboratory than circumstances compel. But it may be the other way round. The strongest hint of the presence of a particular factor—a positive element in beriberi—was given by the clinician to the biochemist, who relied entirely on the *absence* of a particular factor, a negative element, no less than fifteen years before the biochemist took serious notice, looked for it, and found it. Bacteriology and chemistry await the advance of the biochemist before they come effectively to each other's assistance. The cause and prevention of the obstinate degree of maternal mortality are objects pursued *ad hoc*, with scarcely a casual glance at the direct appeal of the eugenist to observe the natural consequences of an improvement in female infant mortality two decades earlier.

I do not then pretend to dogmatize as to how far the scientist should become a social reformer. One physicist welcomes the growing sense of social responsibility, among some scientists at least, for the world the labours of their order have so largely created, though he deplores that in this field they are still utterly unscientific. Then another great authority, Sir Henry Dale, declares that it is the scientists' job to develop their science without consideration of the social uses to which their work might be put.

I have long watched the processes by which the scientific specialist 'makes up his mind' in fields of inquiry outside his own. It seems still a matter for investigation whether the development of a specialist's thinking, on balance, impairs or improves the powers of general thinking compared with what they might otherwise have been. We do not know the kind or degree of truth that may rest in Anatole France's aphorism : "The worst of science is, it stops you thinking". Perhaps this was more subtly expressed in the simpler words of the darkie mother : "If you haven't an education, you've jest *got* to use yoh brains".

My own experience is that when the attempt to deal with social consequences is made, we quickly find ourselves either in the field of larger politics debating the merits of the three prevalent forms of State government, or else performing miracles with fancy currencies and their blue prints reminiscent of the chemical engineer.

HUMAN ASPECTS OF CHANGING INDUSTRY

There are, however, some essential features of the impact which must be dealt with under any form of society and government, and with any machinery for regulating values. They involve man's abilities, his affections, and his tools, all of which have been brusquely treated in the past, and might be scientifically treated in the future. An industrial civilization is unthinkable without division, and, therefore, specialization, of labour, and without tools and capital instruments. Then life itself is not much worth living without social ties and the allegiances of place and kin. These three indispensable elements of the good life bring out defensive mechanisms for their protection. No one likes to see a man, highly trained for a special service or specially fitted by natural aptitudes, cut off from opportunity to use his powers and reduced to the level of an unskilled biped. No one likes to see the results of abstinence and specially directed labour which is embodied in a great machine or factory rendered impotent long before it has given its life's usefulness. Waste of skill and of capital are alike grave faults by which we should judge and condemn an industrial organization. Since man does not live by bread alone, if a ruthless industrial organization continually tears up the family from its roots, transferring it without choice to new surroundings, destroying the ties of kin, home and social life, of educational and recreational environments, it is far from ideal. Human labour can never be indefinitely fluid and transferable in a society that has a soul above consumption of mere commodities.

These three obstructions to change are not final and rigid limitations upon it. Men die, their skill and home associations with them. Plant and equipment wear out. Their successor presents a natural opportunity in each of the three cases for the introduction of change in position, in aptitude, in purpose or design, without waste or human distress. The length of working life and the durability of materials mark the natural phase or periodicity of a smoothly changing society —its quanta, so to speak. But the impetus for change or the irritant has no such intervals. It proceeds from various causes: varying harvests, changes in natural forces; changing human desires and fashions; differences in the rate of growth of population in its different parts; the collective psychological errors of optimism and pessimism in business in an individualistic society; variations in gold supplies and credit policies based thereon. All or any of these, without invoking any disturbances from the impact of scientific discovery, would serve to make adjustments necessary outside the natural phases to which I have referred, in a society with parts that are interdependent through division of labour, and localization of industry, joined by foreign trade and convenient transport. These alone would bring about a changing world with incomplete adaptations, loss of capital, and so-called frictional unemployment.

It is easy to exaggerate the adjustment necessary for the addition of invention and science to these causes of change. But with the intensification of scientific effort, and the greater sub-division of industry, the possible dislocation becomes more frequent, and the ways of meeting such change of greater public importance. This field of inquiry includes widely diverse questions, for example, patent laws, invention clearing, obsolescence accountancy and costing regulation, taxation adjustments, local rating pooling, trade union regulations, price controls, technical education, age and other discriminations in unemployment relief, transfer bonuses, pension rights, housing facilities, and more selective direction of financial support of intensive scientific research. In this neutral field the specialist scientist and the politician are both amateurs. It is to be covered by each extending his studies, and by specialists who treat impact and change as an area of scientific study.

I do not propose to go over all the ground, so old, so constantly renewed, as to the effect of machinery upon employment. It is known as a historical induction that, in the long run, it makes more employment than it destroys, in providing work in making the machinery, in reducing price so that far greater quantities of the commodity concerned may be consumed, and in enabling purchasing power to be diverted to increase other productions. It has even facilitated the creation of a larger population, which in turn has provided the new markets to work off the additional potentiality of the machinery. It does all this in 'the long run'; but man has to live in the 'short run', and at any given moment there may be such an aggregation of unadjusted 'short runs' as to amount to a real social hardship. Moreover, it comes in this generation to a people made self-conscious by statistical data, repeated widespread at frequent intervals, and to a people socially much more sensitive to all individual hardship and vicissitude which is brought about by communal advance.

THE 'BALANCE OF INNOVATION' AND POPULATION

There are two important aspects of the change induced by science which are insufficiently realized, and which make a profound difference to the direction of thought and inquiry. The first I will call the 'balance of innovation' and the second the 'safety valve' of population.

The changes brought by science in economic life may be broadly classified as the 'work creators' and the 'work savers'. The latter save time, work and money by enabling the existing supply of particular commodities to be produced more easily, and therefore at lower cost, and finally at lower prices. People can spend as much money as before upon them and get larger quantities, or they can continue to buy their existing requirements at a lower cost. In this second event they 'save money' and their purchasing power is released for other purposes. By a parallel process, producing or labouring power is released through unemployment. The released working force and released purchasing power can come together again in an *increased* demand for other products which, to this extent, have not been hitherto within effective demand. The supply of this increase may go part or all of the way to absorb the displaced labour. But this process takes time, and the labour displaced is not at once of the right kind or in the right place. More important, however, is the invention of quite new objects of public demand, which may be desired in addition to the supply of old ones. This brings together released labour and released purchasing power in the most decisive way.

The most orderly and least disturbing phases of progress will be found when these two types of innovation are reasonably balanced. Of course, few new objects of purchasing ambition are entirely additive; most of them displace some other existing supplies. Artificial silk displaces some cotton consumption, radio may displace some types of musical instruments. Recently the German production of pianos and guitars has been at a very low percentage of capacity, and part of this has been made good by the demand for radio sets. The dislocations caused by labour-saving machinery can most easily be made good by a due *balance* of new labour-creating commodities.

A natural increase of population is the best shock absorber that the community can possess, especially if accompanied by an extension of territory such as the United States enjoyed in the constant westward movement of the frontier in the nineteenth century, or Britain in the period of overseas emigration. A moment's reflection will show why this is the case. Assume that 1,000,000 units of a commodity are made by 100,000 men, and that there is an increase of population of 2 per cent per annum, so that in five years 1,100,000 units will be consumed and employ 110,000 men. Now assume the introduction of a new invention which enables 1,100,000 units to be made by 100,000 men. There will be no displacement of existing labour, but only a redirection of new and potential labour from that industry to other fields. Again, a considerable reduction in demand *per head* can be sustained without dislocation, if the actual aggregate of production demanded is maintained by increasing numbers. The affected industry can remain static and need not become derelict. New entrants to industry will be directed to those points where purchasing power, released through labour-saving devices, is creating new opportunity with new products. New capital is also naturally directed into the new channels, instead of into additions to the old industry.

Now the problem before all Western industrial countries is the fact that their populations are shortly becoming stationary (and then will begin to decline noticeably) and this safety valve of increasing population will no longer be available. Every transfer of *per capita* purchasing power to new directions must then be a definite deduction from the old directions, no longer made good by the steady increase in the numbers demanding less per head from those old sources. The impact of science upon a stationary population is likely, *ceteris paribus*, to be much more severely felt than upon a growing population, because the changes of direction cannot be absorbed by the newly directed workers. Of course, the effects of a static population can be mitigated if the *per capita* income is increasing, because a new direction of demand can be satisfied out of the additional purchasing power without disturbing the original directions of demand provided by the original purchasing power.

The change from a growing to a static or declining population is only one type of difficulty. While the aggregate is altering but slowly, the parts may be changing rapidly. Thus, in Great Britain, 40·4 millions in 1937 becomes 40·6 in 1942, 40 in 1947, 39·8 millions in 1952, 38·9 in 1957 and 37·5 in 1962. But the children aged sixteen years—which I take because of its influence on schools, teaching and industrial entry—have been estimated, taking those in 1937 as 100, to be 85 in 1942, 73 in 1952 and 62 in 1962. A fall of this magnitude means that industries and institutions dependent upon the present numbers must not be merely static but actually regressive. On the other hand, the old people from sixty-five to seventy-four years will increase in this ratio—100, 113, 127, and 133. These problems of static populations at home are accentuated by the possibility of a similar tendency abroad, and need thought in advance. The Australian farmer is more affected by the British conditions of population than by his own.

We have thus the first difficulty, that of a static total demand, the second, that the safety valve of new industrial entrants is becoming smaller, but a third difficulty comes from the present tendency of that class. A stationary elderly population must be very inflexible to change, but a stream of new young life, even if it is to be smaller, would give the opportunity for just that change of direction, in training and mobility, which society needs. But unfortunately, in practice this does not now seem to be very adaptable. For we learn from certain Unemployment Insurance areas that while the older people will willingly take jobs at wages a few shillings in excess of the unemployment relief, the younger men are more difficult. For every one that will accept training under good conditions to suit them for eligible work, ten may refuse, and the number who will not go any distance to take work at good wages is also in excess of those who do. Attachment to place for older people is understandable, and has been accentuated by housing difficulties—one learns of miners unemployed in a village where the prospects of the pit reopening are negligible, while at the same time, only twenty miles away, new miners are being created by attraction from agriculture to more extended workings in their area. The very social machinery which is set up to facilitate change or to soften dislocation aggravates the evil. The first two difficulties are unalterable. This third difficulty is a subject for scientific examination.

INDUSTRIAL DISEQUILIBRIUM

So much for the effect of change of any kind upon employment. Now let us narrow this to scientific changes. At any given moment the impact of science is always causing some unemployment, but at that same time the constructive additional employment following upon past expired impacts is being enjoyed. But it is easy to exaggerate the amount of the balance of net technological unemployment. For industrial disequilibrium arises in many ways, having nothing whatever to do with science. Changes of fashion, exhaustion of resources, differential growth in population, changing customs and tariffs, the psychological booms and depressions of trade through monetary and other causes, all disturb equilibrium, and, therefore, contract and expand employment in particular places.

Our analytical knowledge of unemployment is bringing home the fact that, like capital accumulation, it is the result of many forces. A recent official report indicated that a quite unexpected amount or percentage of unemployment would be present even in boom times. We know already that there may be a shortage of required labour in a district where there is an 8 or 10 per cent figure of unemployment. So, in Great Britain there may well be a million unemployed in what we should call good times—it is part of the price we pay for the high standard of life secured by those who retain employment. For a level of real wage may be high enough to prevent every one being employable at that wage—though that is by no means the whole economic story of unemployment. Of this number, probably 200,000 would be practically unemployable on any ordinary basis—the 'hard core' as it is called. Perhaps seven or eight hundred thousand form the perpetual body, changing incessantly as to its unit composition, and consisting of workers undergoing transition from job to job, from place to place, from industry to industry, with seasonal occupations—the elements of 'frictional' unemployment through different causes. Out of this number, I should hazard that not more than 250,000 would be unemployed through the particular disturbing element of net scientific innovation.

This is the maximum charge that should be laid at the door of science, except in special times, such as after a war, when the ordinary application of new scientific ideas day by day has been delayed, and all the postponed changes tend to come with a rush. At any given moment, of course, the technological unemployment that could be computed from the potentiality of new processes over displaced ones appears to be much greater. But such figures are *gross*, and from them must be deducted all recent employment in producing new things or larger production of old things, due to science. If we are presenting science with part of the responsible account of frictional unemployment at any moment, it will be the total technological reduction due to new processes and displacement due to altered directions of demand, less the total new employment created by new objects of demand. This has to be remembered when we are being frightened by the new machine that does with one man what formerly engaged ten. Perhaps birth control for people demands ultimately birth control for their impedimenta.

The rate of introduction of new methods and the consequent impact upon employment may depend upon the size and character of the business unit. If all the producing plants for a particular market were under one control, or under a coordinated arrangement, the rate of introduction of a new labour-saving device will be governed by a simple consideration. It can be introduced with each renewal programme for each replacement of an obsolete unit, and therefore without waste of capital through premature obsolescence. But this applies only to small advantages. If the advantages are large, the difference in working costs for a given production between the old and the new types may be so considerable that it will meet not only all charges for the new capital, but also amortize the wasted life of the assets displaced before they are worn out. In neither case then is there any waste of capital, and the absorption of the new idea is orderly in time. But it is quite otherwise if the units are in different ownerships. Excess capacity can quickly result from new ideas. A new ship or hotel or vehicle with the latest attractions of scientific invention, quite marginal in their character, may obtain the bulk of the custom, and render half empty and, therefore, half obsolete, a unit built only a year before. The old unit has to compete by lower prices, and make smaller profits. The newer unit is called upon to bear no burdens in aid of the reduced capital values of the old. It may be that the enhanced profits of the one added to the reduced profits of the other make an average return upon capital not far different from the average that would result in a community where orderly introduction on a renewal basis is the rule. Or perhaps the community gets some of its novelties rather earlier under competitive conditions, and pays a higher rate of interest for them as a net cover for the risks of obsolescence. Waste of capital would be at a minimum if the 'physical' life before wearing out were as short as the 'social' life of the machine. To make a thing so well that it will last 'for ever' is nothing to boast about if it will be out of fashion in a few years.

Scientists often look at the problem of practical application as if getting it as rapidly as possible were the only factor to be considered in social advantage, and this difference in the position of monopoly or single management in their ability to 'hold up' new ideas is treated as a frustration in itself. Thus it has been said "the danger of obsolescence is a great preventative of fundamental applications to science. Large firms tend to be excessively rigid in the structures of production". Supposing that the obsolescence in question is a real factor of cost, it would fall to be reckoned with in the computation for transition, whatever the form of society, and even if the personal 'profit' incentive were inoperative. It cannot be spirited away. A customary or compulsory loading of costs for short-life obsolescence would retard uneconomically rapid competition of novelties and could be scientifically explored.

The Charge for Displaced Labour

Now let us look at displaced labour and the costs of it. If the effect of diversion of demand through invention is to reduce the scope or output of particular industries or concerns in private management, they have no option but to reduce staff. If the pressure is not too great, or the change too rapid, this does not necessarily result in dismissals, for the contraction of numbers may be made by not filling up, with young people, the vacancies caused by natural wastage, through death and retirement. But where dismissals are inevitable, re-engagements may take place quickly in the competing industries, otherwise unemployment ensues. Any resulting burden does not fall upon the contracting and unprofitable industry —it has troubles enough of its own already. Nor is it put upon the new and rising industry, which is attracting to itself the transferred profits. In the abstract, it might be deemed proper that before the net gains of such an industry are computed or enjoyed it should bear the burdens of the social dislocation it causes by its intrusion into society. In practice, it would be difficult to assess its liability under this head, and in fact even if it could be determined, new industries have so many pioneer efforts and losses, so many failures, so many superseded beginnings, that it might well be bad social policy to put this burden upon them, for they would be discouraged from starting at all, if they had to face the prospect of such an overhead cost whatever their results.

It would, of course, be theoretically possible to put a special levy on those new industries that turned out to be profitable, and to use it to relieve the social charges of dislocation of labour. But much the same argument could be used for the relief of obsoletism of capital. The distinction would, however, be that in the case of the capital it could be urged that the investor should have been wide enough awake to see the possibilities of the rival, whereas the worker, induced to take up employment in such a superseded industry, was a victim, and could not be expected to avoid it by prevision. In any event, the prevailing sentiment is rather to encourage developing industries, than to put special burdens upon them, in order that the fruits of science may be effectively enjoyed by society with as little delay as possible.

In the upshot, therefore, the injuries to labour, though not to capital, are regarded as equitably a charge to be borne by society in general through taxation, and to be put upon neither the causing nor the suffering business unit.

It may well be assumed that, taken throughout, the gains of society as a whole from the rapid advance are ample enough to cover a charge for consequential damages. But society is not consciously doing anything to regulate the rate of change to an optimum point in the net balance between gain and damage.

The willingness of society to accept this burden is probably mainly due to the difficulty of fairly placing it, for we find that when it *can* actually be isolated and the community happens fortuitously to have a control, or the workers a power to induce, it will be thrown, not upon the attacking industry, if I may so call it, but upon the defender. Thus in the United States recently, the price of consent to co-ordinating schemes made for the railroads to reduce operating expenses has been an agreement on this very point. If staff is dismissed, as it was on a large scale in the depression, because of fewer operations and less stock in consequence of reduced carriage through the smaller volume of trade, or through road and sea competition, no attempt was made to put any of the social cost upon the railroads, and the dismissed staff become part of the general unemployed. But if the self-defence of the companies against competition takes the form of co-operation with each other to reduce operations and stock and, therefore, costs, any resultant dismissals are made a first charge upon them.

The agreement is elaborate, and has the effect of preventing any adjustments which an ordinary business might readily make when it throws the burden on society, unless those adjustments yield a margin of advantage large enough to pay for their particular special effects. Thus the rapidity of adjustment to new conditions, not to meet the case of higher profits to be made at the expense of workers, but rather to obviate losses through new competition, is materially affected, and a brake is put upon the mechanism of equilibrium in this industry which does not exist in its rivals, or in any others where the power exists to throw it upon the community. A similar provision exists in the Argentine, and it is imposed by Act of Parliament in Canada, but as one of the concerns is nationally owned, and the current losses fall upon the national budget, its charge is really socially borne in the end.

In Great Britain such provisions were part of the amalgamation project of 1923, and of the formation of a single transport authority in London in 1933, and, therefore, did not arise through steps taken to meet new factors of competition. But the opportunity for their imposition came when rights to road powers and rights to pooling arrangements were sought by the railways —both of them adjusting mechanisms to minimize the losses due to the impact of new invention— and this was clearly a specialized case of keeping the burdens off society. In the case of the electricity supply amalgamation of 1933, brought about for positive advantages rather than in defence against competition, similar provision was made, and parliamentary powers for transfers to gas and water undertakings, also not defensive against innovation, have been accompanied by this obligation. In the case of such uncontrolled businesses as Imperial Chemicals and Shell Mex, rationalizing to secure greater profits, rather than fighting rearguard actions to prevent losses, obligations to deal with redundancies have been voluntarily assumed. In such cases the public obloquy of big business operations inimical to society can be a negative inducement, but some freedom from radical competition in prices provides a positive power to assume the burden initially, and pass it forward through price to consumers, rather than back against shareholders. The third case, however, of making it a net charge on the improved profits, is quite an adequate outlet. If the principle of putting this particular obstacle in the way of adjustments to meet new competition (as distinct from increasing profits) is socially and ethically correct, it is doubtful whether it is wisely confined to cases where there is quite fortuitously a strategic control by public will.

It will be clear that the difference between the introduction by purely competitive elements involving premature obsolescence and unemployment, and by delayed action, is a cost to society for a greater promptness of accessibility to novelty. The two elements of capital and labour put out of action would have supplied society with an extra quantity of existing classes of goods, but society prefers to forgo that for the privilege of an earlier anticipation of new things. I estimate this price to be of the order of 3 per cent of the annual national income. But when we speak of social advantage, on balance, outweighing social cost, we dare not be so simple in practice. If the aggregate individual advantage of adopting some novelty is $100x$ and the social cost in sustaining the consequential unemployed is $90x$, it does not follow that it is a justifiable bargain for society. The money cost is based on an economic minimum for important reasons of social repercussions. But the moral effects of unemployment upon the character and happiness of the individual escape this equation altogether, and are so great that we must pause upon the figures. What shall it profit a civilization if it gain the whole world of innovation and its victims lose their souls ?

So far I have treated the problem of innovation as one of uneconomic rapidity. But there is another side—that of improvident tardiness. Enormous potentialities are seen by scientists waiting for adoption for human benefit, under a form of society quicker to realize their advantage, readier to raise the capital required, readier to pay any price for dislocation, and to adjust the framework of society accordingly. A formidable list of these potentialities can be prepared, and there is little doubt that with a mentality adjusted for change, society could advance much more rapidly. But there is a real distinction between the methods of adopting whatever it is decided to adopt, and the larger question of a more thoroughgoing adoption.

In proportion as we can improve the impact of the present amount of innovation, we can face the problem of a larger amount or faster rate. Unless most scientific discoveries happen to come within the scope of the profit motive, and it is worth someone's while to supply them to the community, or unless the community can be made sufficiently scientifically minded to include this particular demand among their general commercial demands, or in substitution for others, nothing happens—the potential never becomes actual. It has been computed that a benevolent dictator could at a relatively small expense, by applying our modern knowledge of diet, add some two inches to the average stature, and seven or eight pounds to the average weight of the general population, besides enormously increasing their resistance to disease. But dictators have disadvantages, and most people prefer to govern their own lives indifferently, rather than to be ideal mammals under orders. To raise their own standard of scientific appreciation of facts is the better course, if it is not Utopian. It has been clear for long enough that a diversion of part of the average family budget expenditure from alcohol to milk would be of great advantage. But it has not happened. If the individual realized the fact, it certainly might happen. It is ironically remarked that the giving of free milk to necessitous children, with all the net social gain that it may bring about, has not been a considered social action for its own sake, but only the by-product emergency of commercial pressure—not done at the instance of the Ministry of Health or the Board of Education, but to please the Milk Marketing Board by reducing the surplus stocks of milk in the interests of the producer!

PLANNING AND ITS LIMITATIONS

Scientists see very clearly how, if politicians were more intelligent, if business men were more disinterested, and had more social responsibility, if Governments were more fearless, far-sighted, and flexible, our knowledge could be more fully and quickly used to the great advantage of the standard of life and health—the long lag could be avoided, and we should work for social ends. It means, says Dr. Julian Huxley, "the replacement of the present socially irresponsible financial control by socially responsible planning bodies". Also, it obviously involves very considerable alterations in the structure and objectives of society, and in the occupations and pre-occupations of its individuals.

Now a careful study of the literature of planning shows that it deals mainly with planning the known, and scarcely at all with planning for changes in the known. Although it contemplates 'planned' research, it does not generally provide for introducing the results of new research into the plan, and for dealing with the actual *impact*—the unemployment, redirection of skill, and location, and the breaking of sentimental ties that distinguish men from robots. It seems to have not many more expedients for this human problem than our quasi-individualist society with its alleged irresponsibility. It also tends to assume that we can tell in advance what will succeed in public demand and what will be superseded. There is nothing more difficult, and the attempt to judge correctly under the intellectual stimulus of high profits and risk of great losses is at least as likely to succeed as the less personally vital decision on a committee. Would a planning committee, for example, planning a new hotel in 1904, have known any better than capitalist prevision that the fifteen bathrooms then considered adequate for social demand ought really to have been ten times that number if the hotel was not to be considered obsolete thirty years later? Prevision thought of in terms of hindsight is easy, and few scientists have enjoyed the responsibility of making practical decisions as to what the public will want far ahead. They, therefore, tend to think of prevision in terms of knowledge and appreciation of particular scientific possibilities, whereas it involves unknown demand schedules, the unceasing baffling principle of substitution, the inertia of institutions, the crusts of tradition and the queer incalculability of mass mind. Of course, in a world where people go where they are told, when they are told, do what they are instructed to do, accept the reward they are allotted, consume what is provided for them, and what is manifestly so scientifically 'good for them', these difficulties need not arise. The human problem will then be the 'impact of planning'.

I am not here examining the economics of planning as such, but only indicating that it does not provide automatically the secret of correct prevision in scientific innovation. When correct prevision is possible, a committee can aim at planning with a minimum disturbance and wastage (and has the advantage over individuals acting competitively), but for such innovation as proves to be necessary it does not obviate the human disturbance or radically change its character. The parts of human life are co-ordinated and some are more capable of quick alteration than others, while all are mutually involved. One may consider the analogy of a railway system which has evolved, partly empirically and partly consciously, as a co-ordinated whole. Suddenly the customary speed is radically changed, and then it may be that all the factors are inappropriate—distance between signals, braking power, radius of curves, camber or super-elevation, angles of crossings, bridge stresses. The harmony has been destroyed. Especially may this be the case if the new factor applies to some units only, and not to all, when the potential density of traffic may be actually lessened. The analogy for the social system is obvious, and its form of government matters little for the presence of the problem, though it may be important in the handling of it.

I have spoken as though the normal span of life of men and machinery themselves provides a phase to which scientific advance might be adjusted for a completely smooth social advance. But this would be to ignore customs and institutions, even as we see in Federal America, Australia and Canada, constitutions which lengthen that phase and make it less amenable as a natural transition. At one time we relied on these to bring about the economic adjustment necessary. But technical changes take place so rapidly that such forces work far too slowly to make the required adaptation. Habits and customs are too resistant to change in most national societies to bring about radical institutional changes with rapidity, and we patch with new institutions and rules to alleviate the effects rather than remove the causes of maladjustments. The twenty mile speed limit long outstayed its fitness, and old building restrictions remained to hamper progress. Edison is reported to have said that it takes twenty-five years to get an idea into the American mind. The Webbs have given me a modal period of nineteen years from the time when an idea comes up as a practical proposition from a 'dangerous' left wing to the date when it is effectively enacted by the moderate or 'safe' progressive party. This period of political gestation may be a function of human psychology or of social structure. We do not know how ideas from a point of entry permeate, infiltrate or saturate society, following the analogues of conduction, convection, or lines of magnetic force.

Our attitude of mind is still to regard change as the exceptional, and rest as the normal. This comes from centuries of tradition and experience, which have given us a tradition that each generation will substantially live amid the conditions governing the lives of its fathers, and transmit those conditions to the succeeding generation. As Whitehead says: "we are living in the first period of human history for which this assumption is false". As the time span of important change was considerably longer than that of a single human life, we enjoyed the illusion of fixed conditions. Now the time span is much shorter, and we must learn to experience change ourselves.

CULTURAL LAGS IN A DYNAMIC SOCIETY

I have so far discussed modification of impact to meet the nature of man. Now we must consider modifying the nature of man to meet impact.

Sociologists refer to our 'cultural lags' when some of the phases of our social life change more quickly than others and thus get out of gear and cause maladjustments. Not sufficient harm is done to strike the imagination when the change is a slow one, and all the contexts of law, ethics, economic relations and educational ideals tend towards harmony and co-ordination. We can even tolerate, by our conventions, gaps between them, while preachers and publicists can derive certain amusement and profit from pointing out our inconsistencies. But when things are moving very rapidly, these lags become important; the concepts of theology and ethics, the tradition of the law, all tend to lag seriously behind changes brought about through science, technical affairs and general economic life. Some hold that part of our present derangement is due to the lack of harmony between these different phases—the law and governmental forms constitutionally clearly lag behind even economic developments as impulsed by scientific discovery. An acute American observer has said that "the causes of the greatest economic evils of to-day are to be found in the recent great multiplication of interferences by Government with the functioning of the markets, under the influence of antiquated doctrines growing out of conditions of far more primitive economic life". It would be, perhaps, truer to say that we are becoming 'stability conscious', and setting greater store, on humanitarian grounds, by the evil effects of instability.

In the United States it would be difficult to find, except theoretically in the President, any actual person, or instrument in the constitution, having any responsibility for looking at the picture of the country as a whole, and there is certainly none for making a co-ordinated plan. Indeed, in democracy, it is difficult to conceive it, because the man in public life is under continual pressure of particular groups, and so long as he has his electoral position to consider, he cannot put the general picture of progress in the forefront. Whitehead declared that when an adequate routine, the aim of every social system, is established, intelligence vanishes and the system is maintained by a co-ordination of conditioned reflexes. Specialized training alone is necessary. No one, from President to miner, need understand the system as a whole.

The price of pace is peace. Man must move by stages in which he enjoys for a space a settled idea, and thus there must always be something which is rather delayed in its introduction, and the source of sectional scientific scorn. If every day is 'moving day', man must live in a constant muddle, and create that very fidget and unrest of mind which is the negation of happiness; always 'jam to-morrow'—the to-morrow that 'never comes'. If we must have quanta or stages, the question is their optimum length and character, not merely the regulation of industry and innovation to their tempo, but also the education of man and society to pulse in the same rhythmic wave-length or its harmonic.

THE BALANCE OF PHYSICAL AND BIOLOGICAL SCIENCES

In some ways we are so obsessed with the delight and advantage of discovery of new things that we have no proportionate regard for the problems of arrangement and absorption of the things discovered. We are like a contractor who has too many men bringing materials on to the site, and not enough men to erect the buildings with them. In other words, if a wise central direction were properly allocating research workers to the greatest marginal advantage, it would make some important transfers. There is not too much being devoted to research in physics and chemistry, as modifying industry; but there is too much relatively to the research upon the things they affect, in physiology, psychology, economics, sociology. We have not begun to secure an optimum balance. Additional financial resources should be applied more to the biological and human sciences than to the applied physical sciences, or possibly, if resources are limited, a transfer ought to be made from one to the other.

Apart from the superior tone sometimes adopted by 'pure science' towards its own applications, scientific snobbery extends to poor relations. Many of the hard-boiled experimental scientists in the older and so productive fields look askance at the newer borderline sciences of genetics, eugenics and human heredity, psychology, education, and sociology, the terrain of so much serious work but also the happy hunting ground of 'viewey' cranks and faddists. Here the academic soloist is still essential, and he has no great context of concerted work into which to fit his own. But unless progress is made in these fields which is comparable with the golden ages of discovery in physics and chemistry, we are producing progressively more problems for society than we are solving. A committee of population experts has recently found that the expenditure on the natural sciences is some eight to ten times greater than that on social sciences. There is scarcely any money at all available for their programme of research into the immense and vital problems of population in all its qualitative and quantitative bearings. An attack all along the front from politics and education to genetics and human heredity is long overdue. Leisure itself is an almost unexplored field scientifically. For we cannot depend wholly on a hit and miss process of personal adaptation, great though this may be.

There must be optimal lines of change which are scientifically determinable. We have seen in a few years that the human or social temperament has a much wider range of tolerance than we had supposed. We can take several popular examples. The reaction to altered speed is prominent. In the "Creevey Papers", it is recorded that the Knowsley party accomplished 23 miles per hour on the railway, and recorded it as "frightful—impossible to divest yourself of the notion of instant death—it gave me a headache which has not left me yet—some damnable thing must come of it. I am glad to have seen this miracle, but quite satisfied with my first achievement being my last". At the British Association meeting of 1836, an address on railway speeds prophesied that some day 50 miles an hour might be possible. Forty years ago we may remember that a cyclist doing 15–18 miles an hour was a 'scorcher' and a public danger. Twenty-five years ago, 30 miles an hour in motoring was an almost unhealthy and scarcely bearable pace. To-day the fifties and sixties are easily borne, both by passenger and looker-on. Aeroplane speeds are differently judged, but at any rate represent an extension of the tolerance. Direct taxation thirty years ago in relation to its effect on individual effort and action seemed to reach a breaking-point and was regarded as psychologically unbearable at levels which to-day are merely amusing. The copious protection of women's dress then would have looked upon to-day's rationality as suicidal lunacy.

One hesitates to say, therefore, that resistances to scientific changes will be primarily in the difficulty of mental and physical adjustments. But there can be little doubt that with the right applications of experimental psychology and adjusted education, the mind of man would be still more adaptable. Unfortunately, we do not know whether education as an acquired characteristic is in any degree inheritable, and whether increasing educability of the mass is a mere dream, so that we are committed to a Sisyphean task in each generation. Nor do we know whether this aspect is affected by the induced sterility of the age. It may not be a problem of changing the same man in his lifetime, but of making a larger difference between father and son. The latest teachings of geneticists hold out prospects for the future of man which we should like to find within our present grasp, and recent successful experiments with mammals in parthenogenesis and eutelegenesis bear some inscrutable expression which may be either the assurance of new hope for mankind or a devil's grin of decadence.

THE NEW ECONOMICS

What is economics doing in this kaleidoscope ?

The body of doctrine which was a satisfactory analysis of society twenty-five years ago is no longer adequate, for its basic postulates are being rapidly changed. It confined itself then to the actual world it knew and did not elaborate theoretical systems on different bases which might never exist. It is, therefore, now engaged in profoundly modifying the old structures to meet these new conditions. Formerly it assumed, quite properly, a considerable degree of fluid or competitive adjustment in the response of factors of production to the stimulus or operation of price, which was really a theory of value-equilibrium. Wherever equilibrium was disturbed, the disturbance released forces tending to restore it. To-day many of the factors formerly free are relatively fixed, such as wage-levels, prices, market quotas, and when an external impact at some point strikes the organism, instead of the effect being absorbed throughout the system by adjustments of all the parts, it now finds the shock evaded or transmitted by many of them, leaving the effects to be felt most severely at the few remaining points of free movement or accommodation. Unemployment is one of these. The extent to which this fact throws a breaking strain upon those remaining free points is not completely analysed, and the new economics of imperfect competition is not fully written out or absorbed. The delicate mechanism of price adjustment with the so-called law of supply and demand governed the whole movement, but with forcible fixation of certain price elements consequences arise in unexpected and remote quarters. Moreover, the search for a communally planned system to secure freedom from maladjustments involves a new economics in which the central test of price must be superseded by a statistical mechanism and a calculus of costs which has not yet been satisfactorily worked out for a community retaining *some* freedom of individual action and choice.

The old international currency equilibrated world forces and worked its way into internal conditions in order to do so. But the modern attempt to prevent any internal effect of changes in international trade, or to counteract them, and the choice of internal price stability at all costs against variable international economic equations, has set economic science a new structure to build out of old materials. At this moment when elasticity is most wanted, stability leading to rigidity becomes a fetish. The aftermath of war is the impossibility of organizing society for peace.

The impact of economic science upon society to-day is intense and confusing, because, addressing itself to the logic of various sets of conditions as the likely or necessary ones according to its exponents' predilections, it speaks with several voices, and the public are bewildered. Unlike their claims upon physics and mathematics, since it is dealing with money, wages and employment, the things of everyday, they have a natural feeling that it ought to be easily understandable and its truth recognizable. Balfour once said, in reference to Kant, "Most people prefer a problem which they cannot explain, to an explanation which they cannot understand". But in the past twenty years, the business world and the public have become economics-conscious, and dabble daily in index numbers of all kinds, and the paraphernalia of foreign exchange and statistics of economic life. The relativity of economic principle to national psychology baffles the economists themselves, for it can be said truly at one and the same time, for example, that confidence will be best secured by balancing the Budget, and by not balancing it, according to public mentality.

The economics of a community not economically self-conscious are quite different from those of a people who watch every sign and act accordingly. Thus the common notion that economics should be judged by its ability to forecast (especially to a particular date) is quite fallacious, for the prophecy, if 'true' and believed, must destroy itself, inasmuch as the economic conduct involved in the forecast is different after the forecast from what it would have been before. The paradox is just here, for example : if a people are told that the peak of prices in a commodity will actually be on June 10, they will all so act that they anticipate the date and destroy it. Economics, thoroughly comprehended, can well foretell the effects of a tendency, but scarcely ever the precise date or amount of critical events in those effects. The necessity for a concentration upon new theoretical and analytical analysis, and upon realistic research, is very great. But so also is the need for widespread and popular teaching. For a single chemist or engineer may by his discovery affect the lives of millions who enter into it but do not understand it, whereas a conception in economic life, however brilliant, generally requires the conformity of the understanding and wills of a great number before it can be effective.

THE SCIENCE OF MAN

But not alone economics: if the impact of science brings certain evils, they can only be cured by more science. Ordered knowledge and principles are wanted at every point. Let us glance at three only, in widely different fields: man's work, man's health, man's moral responsibility. The initial impact of new science is in the factory itself. The kind of remedy required here is covered by the work of the National Institute of Industrial Psychology. Some of this improves upon past conditions, some creates the conditions of greater production, but much of it combats the evils arising from new conditions created by modern demands, speed, accuracy and intensity. It invokes the aid of many branches of science. It is the very first point of impact. Yet its finance is left to personal advocacy, and commands not 10 per cent of the expenditure on research in artificial silk, without which the world was reasonably happy for some centuries. We can judge of the scope of this by the reports of the Industrial Health Research Board.

Again, the scientific ancillaries of medicine have made immense strides. Clinical medicine as an art makes tardy, unscientific and halting use of them. The public remain as credulous as ever, their range of gullibility widened with every pseudo-scientific approach. (We do not know what proportion of positive cases can create the illusion of a significant majority in mass psychology, but I suspect that it is often as low as twenty per cent.) For a considerable range of troubles inadequately represented in hospitals, the real experience passes through the hands of thousands of practitioners, each with too small a sample to be statistically significant, and is, therefore, wasted from a scientific point of view. Half-verified theories run riot as medical fashions, to peter out gradually in disillusionment. If the scattered cases were all centralized through appropriately drawn case-histories, framed by a more scientifically trained profession, individual idiosyncrasy would cancel out, and mass scrutiny would bring the theories to a critical statistical issue of verification or refutation in a few months. This would be to the advantage of all society, and achieve an even greater boon in suggesting new points for central research.

A suggestion has been made for an inventions clearing house, to "co-operate the scientific, social and industrial phases of Invention, and to reduce the lag between invention and application" managed by a committee of scientists and a committee of industrialists and bankers. The proposal came to me from New York, but London was to be the home of the organization, which was to adopt a code of ethics in the interests of inventors, industry and *social progress*. This brings me to my third example, the field of ethics, which needs the toil of new thought. The systems of to-day, evolving over two thousand years, are rooted in individualism and the relations between individuals. But the relations of society to-day are not predominantly individual, for it is permeated through and through with corporate relations of every kind. Each of these works over some delegated area of the individual's choice of action, and evolves a separate code for the appropriate relationship. The assumption that ethical questions are decided by processes which engage the individual's whole ethical personality is no longer even remotely true. The joint stock company may do something, or refrain from doing something, on behalf of its shareholders, which is a limited field of ethics, and may but faintly resemble what they would individually do with all other considerations added to their financial interests. The whole body of ethics needs to be reworked in the light of modern corporate relations, from Church and company, to cadet corps and the League of Nations.

In no case need we glorify change: but true rest may be only ideally controlled motion. The modern poet says:

> "The endless cycle of idea and action,
> Endless invention, endless experiment,
> Brings knowledge of motion, but not of stillness".

But so long as we are to have change—and it seems inevitable—let us master it. T. S. Eliot goes on:

> "Where is the wisdom we have lost in knowledge ?
> Where is the knowledge we have lost in information ?"

My predecessors have spoken of the shortcomings of the active world—to me they are but the fallings short of science. Wherever we look we discover that if we are to avoid trouble we must take trouble—scientific trouble. The duality which puts science and man's other activity in contrasted categories with disharmony to be resolved, gaps to be bridged, is unreal. We are simply beholding ever-extending science too rough round the edges as it grows.

What we have learnt concerning the proper impact of science upon society in the past century is trifling, compared with what we have yet to discover and apply. We have spent much and long upon the science of matter, and the greater our success the greater must be our failure, unless we turn also at long last to an equal advance in the science of man.

Summaries of Addresses of Presidents of Sections[*]

Trends in Modern Physics

IN his presidential address to Section A (Mathematical and Physical Sciences), Prof. Allan Ferguson, after referring to the heavy loss which physical science has suffered in the deaths of Sir John McLennan, Sir Richard Glazebrook, Sir Joseph Petavel and Prof. Karl Pearson, discusses those remarkable changes of outlook which have characterized the development of physical science in the twentieth century. The evolution of molar mechanics along Newtonian lines; the extrapolation of the perceptual facts involved in the behaviour of macroscopic masses down to the dimensions of atomic magnitudes, and the success attendant on this extrapolation; the wave theory of light, which was so successful in co-ordinating old facts and predicting new ones as to draw from Lord Kelvin a noteworthy expression of his belief in the objective reality of the ether; these were outstanding contributions of nineteenth century thought to physical science.

Withal, there was considerable simplicity—not to say confusion—attendant on the definition of such a fundamental concept as that of mass.

With the closing years of the century, the discovery of the electron, of radioactivity, and the investigation of the manner of distribution of energy in the spectrum showed the existence of complexities and contradictions beyond the powers of the classical theory to explain or to resolve; and the last year of the nineteenth century saw the birth of those ideas which have given to our vocabulary a new verb—*to quantize*. The development is sketched of quantum notions as shown in the Rutherford-Bohr atomic model, the vector model of the atom, the dualism of outlook which emphasizes now the wave-aspect, now the particle aspect of matter and of radiation and the resolution of that dualism by the later developments of quantum mechanics.

Discussion of the new concepts introduced by the discoveries of the neutron and positron, and the positing of the neutrino to save conservation processes, leads to consideration in some detail of the development of the doctrine of causality and the definitions of *cause* given by Locke, Hume and Mill, the effect on the doctrine made by the enunciation of the uncertainty principle, and the attempt made by Planck to save the principle of causality.

Is it possible for the plain man of science to order his daily work on a rational basis without of necessity becoming a technical metaphysician? The work of Karl Pearson, amended and extended to meet modern demands, points the way to a possible solution—a solution which, indeed, has some affinities with the endeavour of Prof. Planck to rescue the principle of causality. If the distinction is kept clear between the conceptual model, and the perceptual facts which the model is invented in order to subsume; if it is realized that the world-model, be it built up of billiard-ball atoms or probability-smears, in Euclidean or some esoteric form of hyper-space, remains a model still, and that, until any part of the model emerges into the region of perception, talk of its reality is rather beside the mark; if the twentieth century man of science is as ready to discard a worn-out model as ever Maxwell was, he is not likely to steer wide of the mark.

The man of science of to-day is called upon, more insistently than at any other period of history, to remember that he is a social animal. He can no longer continue to offer sacrifices at the shrine of the Idol of Purity; he must be prepared to consider the social repercussions of his work, whether these repercussions be eugenic or dysgenic. Section A has already initiated the consideration of such implications—it is hoped that the officers of the Section will continue to emphasize and to widen this aspect of the Section's work.

Training the Chemist for Service to the Community

THE place of the chemist in the present-day community, and the manifold ways in which chemistry is involved in the solution of national and industrial problems, is the topic of the presidential address to Section B (Chemistry) by Prof. J. C. Philip. Any society which is intellectually alive will foster the spirit of inquiry, and the prosecution of research is perhaps the fundamental service which the chemist renders to the community. Mere accumulation of knowledge, however, which does not lead to action directly or indirectly is inadequate and unsatisfying, and it is because in the field of chemistry the academic search for new knowledge has led to such abundant practical achievement in the industry of the nation and the health of its citizens that the science deserves fuller recognition by the public.

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[*] The Presidential Address, and addresses by the Sectional Presidents, are being published as "The Advancement of Science, 1936". (Blackpool: B.A. Reception Room. London: Burlington House.) Price 3*s*. 6*d*.

It is a commonplace that discoveries at first of a purely scientific character have frequently turned out to have unexpected applications, and it has become clear that, so far as research and discovery in pure chemistry are concerned, a very long view indeed must be taken in assessing their practical value. Further, it must not be forgotten that a solution of even the most ordinary chemical problems on rational lines is possible only because of our accumulated knowledge of natural phenomena and natural laws. Work, therefore, in the field of pure chemistry builds up a reserve of knowledge and technique on which future generations can draw in attacking practical questions.

It is with this background that so much 'directed' research is prosecuted at the present time—research, that is, which aims at the solution of some specific problem of industrial or national significance. During the last twenty years there has been a notable expansion in the amount of directed research, and in this movement the State has taken a prominent share. Apart from the initiation of industrial research associations, the State has itself organized research on certain chemical problems of national importance, such as those connected with the utilization of fuel, the preservation of food, and the pollution of rivers. Many of these questions require the collaboration of men of science other than chemists, and indeed some of the most fruitful scientific investigations are co-operative in character.

Apart from research, very many trained chemists —the general practitioners of the chemical profession—are engaged in work of a more routine, but highly important, character, and their contribution to the smooth running of industry and to healthy living is far greater than most people realize. A study, indeed, of the occupations of chemically trained men shows that, in the industry of the country, the chemist is ubiquitous. This suggests that those who picture him as concerned mainly with explosives and poison gas have an entirely wrong perspective. The use of chemical substances for destructive purposes is a prostitution of knowledge and skill which chemists would like to see eliminated.

The great variety of the tasks with which the chemical profession is concerned means that the training of the chemist at our universities and colleges must be on broad, fundamental lines. The day, however, has gone by when chemistry could be treated merely as a philosophical discipline; so far as the service of the community is concerned, it is a practical science. The universities must accept the burden, as they have already done in medicine and engineering, of putting the vocational training of chemists on a broad foundation of scientific knowledge.

Palæontology and Humanity

THE biological aspect of palæontology forms the topic of Prof. H. L. Hawkins's presidential address to Section C (Geology). The first part of the address is a re-statement of the basic facts about fossils, and is followed by an appraisement of their value in the attempt to decipher the history of life. Comparison of the records of palæontology and human history shows that fossils, for all their incompleteness, give on the whole a surer basis for historical reconstruction than documents or monuments. A corresponding comparison between the principles of taxonomy in palæontology and neontology shows inevitable differences that may lead to confusion if overlooked. Many of the characters of living organisms, rightly regarded as of specific value by neontologists, are quite inaccessible in fossil material; even when they seem to be recognizable, they cannot be proved to have a truly specific significance. In skeletal structures, differences that would justify taxonomic distinction between fossils can usually be matched with generic or even family differences in living organisms. Hence such terms as 'genus' or 'species' are used in different senses, and should be enclosed in inverted commas when applied to fossils.

Palæontology treats of the history of organic structures, not with that of the organisms themselves. Actually, this proves a distinction with very little difference, since organisms are dependent for their behaviour and welfare on the qualities of their component structures.

Analysis of the time-ranges of fossil groups leads to the conclusion that simplicity of structure, combined with reasonable efficiency, gives hope of longevity; while complexity of structure, in spite of its possibly greater efficiency, is relatively ephemeral. In the sphere of morphogeny, the meek inherit the earth and pride precedes a fall.

A review of the palæontological evidence of morphogeny shows 'orthogenesis' to be the prime factor in evolution, with environment acting as educator or executioner according to the plasticity of its victim. The impression gained may be summarized by stating that "the way life is lived is the way of evolution, whether it be from the Cambrian to the Holocene or from the cradle to the grave".

Mankind, viewed in palæontological perspective, appears in a dual role. He is a highly specialized member of a highly specialized class, and so seems doomed to a brief career. But his mental specialization seems to give him the all-round efficiency that is associated with generalization and its prospect of longevity. However, the historical record of human institutions has been, to date, an illustration of the transience of the complex—typical in all but its speed. Man, when he plays the animal, submits to the fate normal to animals, and his exaggerated capacity only accelerates his doom.

With the mental acumen that enables mankind to be a supreme animal, there has developed a faculty that is different and unique. This faculty, which may be called 'altruistic', seems in many ways independent of, and perhaps triumphant over, environment. To man, the clever animal, palæontology points, albeit despairingly, to the precipice just ahead; but to man, the idealist, it has no message, save to welcome a new experiment that may perchance succeed in justifying the nobility of his aspirations.

Natural Selection and Evolutionary Progress

THE subject of Prof. Julian S. Huxley's presidential address to Section D (Zoology) is the relationship of natural selection and evolution. On a Mendelian planet, such as ours appears to be, evolution is the joint product of mutation and natural selection. Recent work has altered our views as to the details of the process. The action of a particular gene depends on many other genes which act as modifiers; thus selection of the genic background is of great importance. By this means, deleterious effects of an otherwise advantageous mutation can be buffered or even abolished. Dominance and recessivity seem to be due to a similar action on recurrent mutations.

Analysis of this kind, however, only takes us a certain way. We must remember that evolution is a heterogeneous process, which will appear very differently to different groups of workers.

The origin of species is but one of the major problems of evolution: the others are the origin of adaptations and the origin and maintenance of long-range trends.

Species, it is now clear, can originate in several different ways. Their origin may be *unilinear*, when one species is wholly transformed into another; *divergent*, when one species diverges into two or more (as after geographical or physiological isolation); *convergent*, when a new species is formed by hybridization between two species (as in *Primula Kewensis*, *Spartina Townsendi*, etc.); or *reticulate*, when divergence and convergence combine to give a network of forms (as in roses, willows, and man). Furthermore, it may be either gradual or abrupt. The divergent origin of new forms after isolation appears always to be gradual, while their convergent origin (by allopolyploidy) after hybridization is always abrupt.

From the point of view of natural selection, speciation falls into two sharply distinct categories. When the characters distinguishing species arise abruptly, selection can have no part in deciding their nature: when they arise gradually, for example, after isolation, it can, and probably in large part does do so.

The origin of adaptations must be sought mainly in natural selection. Whenever an adaptation involves a number of steps or separate characters, no other agency but natural selection can have been operative. Thus, in the great majority of cases, pre-adaptation is ruled out. Natural selection is a mechanism by which results that otherwise would be in the highest degree improbable are rendered probable.

The origin and maintenance of long-range trends in all the numerous cases where the trend is towards functional specialization or improvement will be due to natural selection in the same measure as is the origin of adaptation. The directive character of such trends is no evidence of internally-determined orthogenesis, but is to be expected on a selectionist interpretation. Trends such as that of the elephants, in which the functional improvement is continuous, but the structural mechanism adopted is altered during the process, are incapable of orthogenetic explanation. A trend towards specialization will cease when certain biomechanical limits are reached to further advantageous advance.

Evolutionary progress may be defined as all-round advance in control over, and independence of, environment, while most long-range trends are one-sided specializations, and therefore blind alleys. Since it confers advantage, biological progress can equally be ascribed to natural selection.

Many evolutionary phenomena are better understood when it is realized that most genes act by controlling the rates of processes. In particular, many otherwise puzzling phenomena of recapitulation and anti-recapitulation at once become comprehensible. Anti-recapitulatory phenomena due to the slowing of early processes and the consequent removal of previous adult characters from the life-cycle are of great importance in evolution, accounting for neoteny, clandestine evolution, and fœtalization. This last process has been essential for the evolution of man: it is interesting that it could not have occurred in a polytocous form, where slowing of early growth would be prevented by intra-uterine selection.

An analysis of evolutionary progress reveals some interesting facts. In the first place, it appears that it could only have pursued the course that it has actually taken. Conceptual thought could only have arisen in a monotocous mammalian type with an arboreal ancestry. Non-arboreal and polytocous mammals are excluded; so are birds and other terrestrial vertebrates; so are insects and all other invertebrate groups. No further biological progress is now possible, except in man. Another feature of progress is that characters essential for one progressive advance may be a handicap for later progress. This must be taken into account in planning further progress—that is, in any eugenic scheme.

The Mapping of our African Colonies

THERE has been talk and correspondence lately on the backwardness of Ordnance Survey revision. Maps and Plans are not kept up-to-date and a great deal of inconvenience has been caused by this fact. It is becoming evident that town planning, building, road programmes and the like make up-to-date maps a necessity and not a luxury. It is not to be wondered at that similar problems have arisen in the African Colonies, the budgets of which have been just as hard hit as that of England. In his presidential address to Section E (Geography), Brigadier H. S. L. Winterbotham deals with this question.

The Ordnance Survey is strictly domestic. It has no duties outside the area for which our own parliamentary estimates are framed. The first step towards colonial mapping and surveying was taken in 1803, when the War Office formed the "Depôt of Military Knowledge" (maps were generally considered "military" in those days). In 1855 Lord Panmure, Secretary of State for War, arranged for a more energetic campaign, and he and the Secretary of State for the Colonies, working together, relied upon the same body, now called the "Topographical Department", to keep in touch with colonial survey departments and to intervene for their assistance, as often as possible. The colonial survey departments are concerned mainly with those property surveys which correspond to the large-scale plans of the Ordnance Survey, and the Topographical Department supplied officers and men for topographical mapping.

This dual arrangement has succeeded in providing a large area of good mapping, but it has failed in these post-War years to secure a proper and progressive programme of triangulation and mapping.

There is no question that comparatively enormous sums of money were squandered in England early in last century for lack of scientific forethought. The expenditure of two million pounds upon the unchecked and uncorrelated tithe maps is a case in point. The Grand Triangulation should, of course, have come first. In India the question was tackled sensibly and energetically in the correct sequence. In Africa the first essential is an arc of triangulation from Cape Town to Cairo, upon which all other surveys can be hung. Sir David Gill, H.M. Astronomer at the Cape early in this century, made a good beginning, and it was due to his personal foresight and vigour that this arc had reached the southern end of Tanganyika by 1914. Sir Charles Close added a portion in Uganda, and his whole-hearted co-operation as head of the "Geographical Section" (the new title of the Topographical Department) secured the skilled observers for the triangulation, and made it possible to map considerable areas at the same time. Before the Great War, more than 2,000 miles of the arc of triangulation had been finished. In exactly the same period (thirteen years), between 1922 and 1935, only 360 miles were added. In thirteen years before the War, 480,000 square miles were well mapped; in the thirteen years after, no more than 170,000 square miles.

The machinery exists, the problem grows more urgent in proportion as the development of local resources becomes more important. What seems to be lacking is the realization of the ultimate economy and wisdom of tackling the job in the proper sequence. Mapping and development are bound to go hand in hand.

Problems of Plantation Economy

IN his presidential address to Section F (Economics and Statistics), Dr. C. R. Fay, who has just returned from a visit to the East, discusses the problems of plantation economy with special reference to the tea industry. The evolution of the plantation can be traced from the early tobacco and sugar plantations of North America, through the indigo plantations of nineteenth century India to the tea and rubber plantations of to-day in India, Ceylon and Malaya; and tea can be compared as a commodity with tobacco, sugar, coffee, rubber and forest produce in order to show the scope and method of the plantation form.

The tea estate usually has upon it a tea factory; and thus plantation economy presents two classes of production problems: (*a*) cultural problems connected with the growing of the leaf; and (*b*) industrial problems connected with the processing of the leaf into tea. Growing embraces the clearance and planting of the land, the cultivation of the plant and conservation of the soil, the plucking of the leaf. Processing involves the factory sequence of withering, rolling and breaking, fermenting, firing, sifting and packing. In the main, plantations are financed and managed by

Europeans; and there are four types of plantation to-day: the proprietary planter (now rare), the small company, the large company and the consumer company. In the last class, the English and Scottish Joint Co-operative Wholesale Society, Ltd., is important. The 'optimum' size of the estate is increasing; and the productive unit is in process of integration along two lines: (*a*) the combination of estates into 'groups' and (*b*) the association of estates with coastal agency houses, which have functions of buying, selling, technical supervision and financial control.

The tea estate carries an important labour force, and its labour problems are threefold: recruitment, wages, health and housing. These vary according to the district, and the conditions in Assam, South India and Ceylon differ. Ceylon in 1934–35 was visited by a malaria epidemic, which attacked a large section of the tea area and created conditions of famine in villages adjacent to the estates. It was caused by a period of prolonged drought, and the measures by which it was fought are revealed in the official documents of 1935 and 1936.

Since 1933 South India and Ceylon have participated in the international scheme of tea export control. Regulation of export means restriction of production. It presents difficult problems, but it came in an industry which was already accustomed to joint action in other fields—in the regulation of labour, the provision of medical services and the undertaking of technical research, which in Ceylon is conducted at the St. Coombs Research Institute. In effect, the new control regulation is voluntary group effort, endorsed by the State. Tea control (1933) was followed by rubber control (1934), and both schemes are distinguished by the fact that, unlike the post-War rubber scheme, they include the Dutch East Indies.

The nature of regulation in plantation commodities can be compared with that in forest produce, where the problem of conservation is uppermost.

The Engineer and the Nation

IN his presidential address to Section G (Engineering), Prof. W. Cramp avoids technical matters, and confines himself to a review of the relationship between the engineer and the nation. The engineer shares with the devotee of pure science the detached pursuit of truth, but his work, like that of the doctor, is practical in its aspect, and entails not only daily contact with humanity, but also an understanding of human desires and of human psychology. This dual role gives him a greater opportunity both for the development and for the loss of character, but it also makes him more balanced and adaptable than his colleague in pure science.

Engineering at its best is the greatest instrument of civilization that the world has ever seen, because it is so largely concerned with the development of means of communication. Its natural tendency is to promote a closer contact between individuals and nations, but when deflected from this path of peace, it may equally become a terrible agent of destruction and death. For these reasons the activities of the engineer and the uses to which they are put are matters of supreme importance. To what extent does the nation recognize its responsibility towards the engineer, and how does the engineer respond ?

The attitude of the nation towards the engineer is reflected in the status, protection and remuneration that are accorded to him. A sharp contrast exists between his position and that of the medical man, whose period of training is only a little longer and whose responsibility is probably less. By means of his professional organization with statutory powers, the doctor has acquired a proper status with perhaps too much protection. At present the engineer has liability, without appropriate status, remuneration or protection.

The responsibilities of the engineer are emphasized by the charges brought against him by pulpit and press. Of these the first is the statement that engineers lend themselves too willingly to works of destruction. The answer is that pure science recognizes no moral distinctions, so that this is a matter of individual conscience in which the engineer is on a par with the rest of mankind The second is the suggestion that a moratorium should be imposed upon scientific development; to which the answer is that the invention of a machine does not compel its use. The third charge against the engineer is his lack of fertility in producing inventions which might lead to new industries. This is explained by the clumsy, costly and ineffective protection of patentees and by the absence of scientific representatives upon governing bodies in the State and in industry. In both directions reforms are needed.

The attitude of the engineer towards the nation involves professional conduct, both individual and collective. There have been engineers whose opportunities of acquiring a high standard of values were ideal, yet they surrendered integrity to self-interest when temptation arose. Among collective activities, mention may be made of the growth and development of trade associations; and of the dangers inseparable from powerful monopolies. The action of such groups in developing and maintaining a high standard of quality is gratefully acknowledged, but it is suggested that there is also some evidence of a tendency to exploit the nation for the benefit of a particular industry. This, if not checked, will react to the detriment of the associations themselves.

Conclusions drawn from the whole analysis suggest a number of reforms. These are : (1) The establishment of an engineering body with statutory powers to prevent unqualified persons from jeopardizing life and to check unprofessional conduct ; (2) the proper representation of science in State and municipal departments ; (3) a drastic revision of patent procedure in the law courts ; (4) voluntary renunciation by trade associations of any advantage unfair to the nation ; (5) an inquiry by educational experts into the best means of inculcating a higher scale of integrity among members of the profession. Of these reforms, it is suggested that the British Association might lend its aid in connexion with the second, third and fifth.

Cultures of the Upper Palæolithic

MISS D. A. E. GARROD deals in her presidential address to Section H (Anthropology) with the Upper Palæolithic in the light of recent discovery. The last twelve years have seen a new impetus given to prehistoric studies by the multiplication of researches outside Europe. This has led to a partial revision of the classification of Palæolithic cultures associated with the name of de Mortillet. In particular, it is becoming clear that the old division into Lower, Middle and Upper Palæolithic has a chronological value only, and that for purposes of typology the fundamental division is into hand-axe, flake and blade cultures.

In considering the present state of our knowledge of the blade cultures one point emerges clearly—the diversity of the strains which have hitherto been grouped together under the heading of Aurignacian. This is borne out by Peyrony's researches in the Dordogne and by recent work in the Near East, which lead to a distinction between the industries characterized by the blunted-back blade, formerly classified as Lower and Upper Aurignacian, and the Middle Aurignacian, in which the type-implements are steep and rostrate scrapers. Peyrony suggests that the first group should be labelled Perigordian, and that the old name of Aurignacian should be kept for the second.

A study of recent excavations, more especially in Russia, the Near East and North Africa, suggests that the problem is extremely complex, and a new system is tentatively put forward. The former Lower Aurignacian is named Chatelperronian, the Middle Aurignacian remains as Aurignacian proper, and the former Upper Aurignacian is divided into Lower and Upper Gravettian, corresponding to the La Gravette and Font-Robert levels respectively. The origins of the Chatelperronian can be traced back into the Lower Palæolithic, both in Palestine and East Africa, and it is suggested that its centre of origin lies somewhere in south-west Asia. It may have given rise to the Capsian, by way of the Kenya Aurignacian, and may also have passed northward to develop into the Gravettian, which is abundant in Russia. The Aurignacian proper, on the other hand, shows a remarkable development in the Near East, and the Iranian plateau is suggested as a possible centre of dispersion.

We thus have three major provinces for the blade-cultures : the Capsian in Kenya and Little Africa, and the Gravettian in north-west Asia and eastern Europe, both possibly derived from the earlier Chatelperronian, but cut off from each other by the great Aurignacian province of the Near East. From the Gravettian and Aurignacian centres migrations pour into central and western Europe, and cultures which in their homelands tend to remain distinct succeed and influence each other until at the extreme limit of their journey we get the classic French sequence. The industries which mark the extreme end of the Pleistocene, such as the Magdalenian, etc., appear to be local developments of one or other of these stocks, while the Solutrean is an intrusive element, of Hungarian origin.

Circulation of the Blood

THE control of the circulation of the blood, which is such an important problem in relation to surgical shock, forms the subject of the presidential address of Prof. R. J. S. McDowall to Section I (Physiology). Only a few years ago the subject consisted of a large amount of little-related data, but gradually this is being pieced together. For example, the well-known and dramatic fact that stimulation of the vagus nerve will slow up or even stop the heart, is now recognized as indicating part of a mechanism by which the normal heart at rest is constantly subjected to restraint, the release of which results in cardiac acceleration such as occurs in exercise.

The requirements of physical exercise probably give the best indication of most of the mechanisms of the circulation. In the active muscles a number of chemical and nervous mechanisms bring about a dilatation of blood-vessels locally. That the sympathetic vasodilators are in part responsible for the dilatation is a recent development. At the same time, largely as a result of psychical activity, blood-vessels are shut down in less active parts such as the alimentary canal and the skin. This has hitherto been considered to be due to the action of the vasoconstrictor nerves, but it is now shown that probably there is a reduction of the general vasodepressor reflexes which arise from the carotid sinus and the cardio-aortic region. The evidence rests on the fact that severance of the reflex arcs results in increased venous flow and cardiac output, while circumstances which reduce vagus activity also reduce the activity of the general vasodepressor reflexes. Thus just as the vagus may be looked upon as determining the range of cardiac activity, so the depressor reflexes determine the amount of blood available for the heart.

Hitherto, it has been considered that these two mechanisms are concerned primarily with the maintenance of a mean arterial pressure, but several facts suggest that in exercise the loss of their sustained activity is of more importance than their maintenance. These are their great variability in different animals and under different experimental conditions, the profound effect of loss of the vagus on efficiency in exercise and the fact that the arterial blood pressure rises in spite of these mechanisms.

The Patterns of Experience

THE controversies in which psychologists are now engaged are a sign of life and progress in the science, but an eclectic position is reasonable, provided that one maintains a point of view sufficiently unifying to avoid the danger of becoming a mere collector of odds and ends of fact and theory. Such a point of view appears to be afforded by the hypothesis of mental schemata, originally suggested by Sir Henry Head, and since advanced in other connexions by Prof. F. C. Bartlett and Mr. A. W. Wolters, who has chosen this topic for his presidential address to Section J (Psychology).

At the Norwich meeting of the British Association; Prof. E. Rubin demonstrated that there are predetermined 'ways of seeing', and that perception can be shaped by factors extrinsic to the material experienced. Under the influence of such factors, the mind actively patterns its experience, so informing the sensory material as to make the percept consistent with certain subjective principles. This implies that the patterns of experience are already latent in the subject's mind as he confronts the world. How they can so exist is partly explained by a consideration of the patterns of behaviour as exhibited in instincts and skills. The first necessity of every organism is to remain alive, and this task requires that it should master its environment and make it manageable. To this end it develops skills, which are qualities of the organism in virtue of which it is prepared to deal more adequately with situations of a particular kind, though prepared only in an outline, flexible manner. Such a preparation for reaction, dependent upon the integrated effects of previous experience, has been termed a *schema*, and it now appears that Rubin's 'ways of seeing' can be brought under the same conception. Thus perception, memory and conceptual thinking have been brought under common principles. They are reactions preliminary to further behaviour, and depend upon the existence of pre-formed schemata.

The same conception can be applied to problems of social psychology, for society is only actualized in its impact upon individual lives. Society becomes a psychological datum because it exists immanently in the minds of its members. A social group exists as such in virtue of conative tendencies developed by individuals in the course of accommodating their behaviour to each others', so that an observable group pattern is the product of the skill-characters, or behaviour schemata, of the constituent members. Often the schemata are not open to inspection or description, having been developed for other purposes. The difficulty of stating the principles underlying the English Common Law is psychologically explicable if it is considered that they are the ways of living together developed by a nation.

The subject-matter of psychology is taken to be the activities of the individual organism striving to maintain its full integrity. To obtain control of its universe it must organize the material of experience into patterns manageable by it. To this end it develops skills which we have termed schemata, and the system of a person's schemata embodies all his experience up to the present moment, and determines the direction and pattern of his future experiencing. Thus in outline the 'ways of seeing' and the 'ways of living' are reducible to a common psychological genus.

Uses of Fungi

IN his address to Section K (Botany), Mr. J. Ramsbottom deals with many of the ways in which fungi have proved useful to man.

Edible fungi have been known from the earliest times, but only three species have been successfully grown on a large scale—the common mushroom (*Psalliota campestris*) in Europe and America, shiitake (*Cortinellus Shiitake*) in Japan, and *Volvaria volvacea* in many parts of the tropics.

Wood infected with fungi is used for various purposes, the green wood of Tunbridge Ware being the best known—the colour being due to the mycelium of the discomycete, *Chlorosplenium aeruginosum*; 'brown oak', much valued by wood-workers, has recently been shown to be due to infection by the beef-steak fungus (*Fistulina hepatica*), and wood rotted by *Mucor racemosus* is used as cattle food (*palo podrido*) in Patagonia.

The lack of chlorophyll imposes upon fungi their peculiar physiology, which has many consequences important to man. Every nation has its fermented drinks or foods, mostly dating back to antiquity. Sometimes the fermentation is brought about by one or more yeasts, sometimes by a 'symbiotic' combination of yeast and bacteria. Many of the processes which were formerly left to chance are now controlled to a greater or less extent, and pure cultures of yeasts are employed. Similarly in cheese-making the appropriate species of the mould *Penicillium* is used for ripening blue-streaked cheeses (Stilton, etc.) and cream cheeses of the Camembert type.

While yeasts are the chief agents of fermentation in the West, Mucoraceæ and species of the *Aspergillus flavus-Oryzæ* group are mainly concerned in the East. The importance of *Aspergillus* in the preparation of soy sauce (the basis of many table sauces), saké and other products is shown by the estimated annual value to Japan as £40,000,000.

Recently there has been considerable development of the use of fungi in industry. Takadiastase produced by *Aspergillus Oryzæ* and its allies has many commercial uses as well as in medicine. Citric acid is now manufactured in many countries on a large scale by the action of dark-spored Aspergilli on sucrose, nine acres of mycelium being said to be held in commission by one American firm for use in cheese-making alone. Gluconic acid, now being used in increasing amounts as the calcium salt, which is more satisfactory for many purposes than is calcium lactate, is obtained on a commercial scale by the action of *Penicillium* species, for example, *P. chrysogenum* on commercial glucose.

During the Great War, Germany obtained her supplies of the glycerol necessary for the production of high explosives by trapping the intermediate products of sugar fermentation by yeasts; other countries developed similar methods. To supplement her inadequate bread ration, Germany employed *Torula utilis*, "mineral yeast", which is a poor fermenter but which grows readily on molasses, 100 gm. of this producing 130 gm. of yeast in eight hours. Russia also used a non-fermenting yeast, *Endomyces vernalis*, 'fat yeast', for food, the fat formed reaching 15–28 per cent of the dry weight in 10–15 days.

Many processes in which fungi play a part have been patented, and specifications cover the making of leather substitutes by tanning gelatinous growths, the artificial ageing of green coffee, the production of ergosterol, acetone, fumaric acid and so on. Substances which have not previously been obtained have been produced by the action of moulds, and it is evident that compounds of almost every type known to organic chemistry can be synthesized.

The Future in Education

If we consider that the goal of education is the making of men and citizens, that body, character and (in the widest sense) reason make the man, and need to be developed and trained, and that human beings cannot live intelligently in the world without some knowledge of literature, history and science, then we must admit that in spite of great achievements during the past sixty years in elementary, secondary, technical and university education, we have not produced an educated nation. We have provided opportunities for the minority who attend secondary school and university. Most of the rest have had no regular instruction after they leave school at fourteen years, an age when education in the real sense is about to begin, and this, according to Sir Richard Livingstone's presidential address to Section L (Education), is our great educational scandal and problem.

To solve it, two principles, commonly ignored, must be observed. First, it is useless to teach a subject before the mind can digest it. A liberal education cannot be given at the age of fourteen, fifteen or sixteen years. Secondly, the humanistic subjects—literature, history and philosophy—cannot be properly appreciated without some experience of life. In this they are unlike physical science and mathematics, which need no such experience. But if these principles are sound, our problem will not be solved by raising the school age to fifteen years; indeed, even an education which stops at the age of seventeen or eighteen is quite incomplete. Unless we are content to have a largely uneducated nation, we must establish part-time compulsory education to the age of eighteen years, and follow this up by adult education. Thus and thus only can we secure that the whole nation has a chance of being educated.

The great successes of adult education in England are the Workers' Educational Association and the university extension movement. The former provided for the working-class intelligentsia, but left the masses untouched. If we are to reach them, we must develop a different, less academic, technique in adult education. In particular, we need to study the intellectual digestion of the average man (which is different from that of the intelligentsia), and also to develop the social, corporate element in education. On these points we can learn from the Danish folk high-schools and from the women's institutes, both of which reach a class which our adult education has largely failed to touch.

The future lies with adult education. Without it the masses will remain uneducated. But it is also needed for the 'educated classes', and an attempt should be made at the universities to provide opportunities for regular study by professional men, civil servants, politicians and others, whose systematic study and thinking is apt to end when they take their degree. Summer schools, doctors' 'refresher' courses, etc., are rudimentary forms of such study, which have evolutionary possibilities.

Soil Science

THE advances which have been made in soil science in the twentieth century are discussed in his presidential address to Section M (Agriculture) by Prof. James Hendrick. At the beginning of this century, agricultural research was in a low state in Great Britain, where there was only one great research station, a private institution, Rothamsted. That has now been altered and, under the guidance of the Development Commission, a system of agricultural research stations has grown up covering all the leading branches of agricultural inquiry. The development of the system of agricultural education has led to increase and improvement of agricultural research.

In the great advance which has taken place in agricultural investigation, the fundamental subject of soil science has received much attention, especially since the Great War. A great part of the inspiration has come from foreign sources. In all parts of Britain the climate is temperate and humid with a rainfall distributed over all parts of the year, but in a great country like Russia the climate varies from arctic to sub-tropical and from humid to arid and desert. The Russians studied soil formation and classification from the point of view of climate, and showed how greatly the character of the soil depends upon climate. Cut off as the British were from Russia by linguistic, political and geographical barriers, nothing was learned of this until after the Great War. Though the British Empire extends through an even greater range of climatic conditions than Russia, little account was taken of the influence of climate on soil formation, and classification was based more on geology. A revolution has taken place in our views since the development of international soil congresses has established contact with the soil scientists of Russia and other countries, and attention is no longer confined to the comparatively narrow range of soils found in the British Isles.

Another field in which great advance has been made in recent times is in our knowledge of base exchange and soil acidity, and in the application of colloid chemistry to the study of the soil. Calcium carbonate has lost, to the exchangeable bases associated with the soil colloids, much of the high place it used to occupy in agricultural chemistry.

The two great classes of colloids found in the soil are the mineral colloids of the clay and the organic colloids of the humus. Much advance has been made in unravelling the structure of the clay colloids, but the exact nature and structure of the humus colloids is still obscure.

Another sphere in which great advances have been made during the present century is in the manufacture of, and trade in, fertilizers. In the case of nitrogenous fertilizers, this has amounted almost to a revolution.

Preservation of Native Floras

THE preservation of native floras with special reference to the British flora is the topic of Dr. A. B. Rendle's presidential address to the Conference of Delegates of Corresponding Societies. The preservation of native floras is of high importance from a scientific point of view. The cases of St. Helena and the Bermudas are examples of interesting natural floras that had been largely destroyed by man's action, especially by the destruction of the trees and the introduction of alien plants which had proved superior in competition with the natural flora. But efforts should be made to preserve what remains. It will be a reproach to us if the only material for study by future students of a flora is that found in herbaria.

Our British flora is worth preserving. We cannot regard it as merely a part of the west European flora that invaded Britain after the disappearance of the glacial ice before we were cut off by sea. There is evidence for the survival of fragments of the original flora in sheltered unglaciated spots during successive periods of glaciation, and various elements of special interest may be associated with special areas that presumably remained open. Intensive work on British genera and species indicates that there is still scope for investigations of taxonomic, distributional and ecologic interest. Apart from an æsthetic point of view, there is good reason for efforts to preserve our flora, even though it has already been much changed by the action of man and his crops and herds.

Various means to ensure conservation can be used. The Plant Conservation Board of the Council for the Preservation of Rural England, in particular, does important work. Three methods of promoting conservation are available: legislation, education and Nature reserves. The last was fully discussed by Sir David Prain in his address to the Conference at the York meeting of the British Association. Its value in the preservation of areas of special types of vegetation such as an alpine flora, that of a Yorkshire dale, or a fenland such as Wicken or Chippenham, or smaller special areas, is inestimable. But the Nature reserve will not preserve the flora of the countryside as a whole, and here we are concerned with legislation and education. The former is only the next best thing, but until the community is educated to leave for the enjoyment of all that which appeals to the individual, some form of legislation seems necessary. The Conservation Board has enlisted the help of local Councils throughout the country and their response has been encouraging. Posters appealing for the preservation of wild plants have been very widely distributed, and the by-law approved by the Home Office forbidding uprooting on land to which the public have right of access has been adopted and copies have been posted in prominent places. Lists of species demanding special protection in individual counties, on account of beauty or rarity, have been prepared and circulated.

Up to the present it has not been found possible to frame a by-law for the protection of wild plants growing on private property.

Plants may be studied as growing; uprooting is rarely necessary, and, if it is desirable, permission from the owner of the land may be obtained.

The introduction of our native species by planting or sowing in places in which they have never been known to grow wild is strongly to be deprecated. A natural harmony is disturbed and the introduced species may oust other species or even increase to become a nuisance. Introduction of alien plants in wild localities, and indiscriminate seed scattering are thoroughly reprehensible.

Education of the adult is difficult. He is not interested, but may be reached by appeals or occasional talks by the B.B.C. and by helpful articles and notes in the public Press. The botanical collector who wants rare species for his herbarium or for exchange purposes is even more difficult to convert. Education of the children, instilling a love and respect for our wild flowers, seems the most hopeful method. A pamphlet on "The Protection of Wild Flowers" has been widely distributed by the Conservation Board among school teachers. Every school should, where possible, have a garden in which the children are encouraged to grow wild plants from seed and note their development. Flora's League publishes an admirable booklet by Mr. T. A. Dymes with full instructions for growing wild plants from seed.

The active co-operation of everyone interested is necessary if the movement is to succeed.

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Dartford-Purfleet Tunnel

BELOW Blackwall tunnel, which is thirty-five miles from the mouth of the Thames estuary, there are no facilities for crossing the Thames either by bridge or tunnel. The construction has now been approved of a tunnel, which will be called the Dartford-Purfleet tunnel and will connect the Purfleet-Grays Road on the north side of the river with the Dartford Southern by-pass, and a connexion will then be made with the London-Folkestone and the London-Hastings roads. As a first step (*Roads and Road Construction*, September 1), a pilot tunnel will be constructed 900 yards in length and with an internal diameter of 12 feet. Two ventilating shafts with diameters of 18 feet will be constructed on the Kent and Essex banks of the river. They will be approximately 100 feet in depth. The pilot tunnel will cost £300,000 and will provide information as to the strata under the river at this place. This will be very helpful in connexion with the construction of the main tunnel. The tunnel will be rather more than a mile in length. The cost of the whole scheme is estimated to be about three million pounds, the pilot tunnel costing about a tenth of this. The Ministry of Transport, which will be directly responsible for carrying out the work, has made, in conjunction with the county councils of Essex and Kent, all the necessary arrangements. This tunnel, which will be twelve miles down the river from the Blackwall tunnel, will form a much-needed link between the north and south sides of the Thames Estuary.

Electrical Accidents in 1935

THE report on electrical accidents in 1935 by H.M. electrical inspector of factories (London: H.M. Stationery Office. 9*d*.) is of special value to all who design and operate electrical apparatus. The total number of accidents reported under the Acts was 447, of which 23 were fatal. Although the use of electricity has doubled during the last ten years, the annual total of the number of accidents has varied very little. The total number, twenty-three, of fatal accidents on factory premises is eight less than last year. This is probably due to the much larger use now made of artificial respiration when attempting to revive the victims of electric shock. In successful cases the time of application necessary varied from a few minutes to half an hour. Last year there were nine successful cases, but if it had been tried in every case there would doubtless have been more, as signs of life in some of the cases which ended fatally were evident after the shock. The inspectors specially mention the very rapid growth of electric arc welding to structures of all kinds. Although there were thirty-six electrical accidents to electrical welders, none of them was fatal. This is probably largely due to the attention now being paid to the personal equipment of the operator. Gauntlets, hand screens and helmets are made of suitable insulating materials, and are standardized. In addition, the harmful effects produced on the eyes of workmen not concerned in the welding processes, but liable to flashes from an arc in their vicinity, are considered. It has been found that plain glasses cut off a large proportion of the harmful ultra-violet rays. Until they had experienced the painful effects of eye flash, workmen were reluctant to wear them; in works where they are used, eye trouble has been eliminated.

New Conceptions of a Rock Garden

ENGLISH gardens have been enriched with many beautiful herbaceous plants from South Africa, but the succulent and xerophytic species of that region are not yet common in England. The rockery which is being made in Johannesburg for the Empire Exhibition of September, 1936–January, 1937 should provide an adequate portrayal of South Africa's wonderful endowments in these sections of its flora. Prof. John Phillips, professor of botany in the University of the Witwatersrand, describes the rockery in the *Journal of the Royal Horticultural Society* of August, 1936. It is planned upon a scale which is somewhat gigantic when judged from most English standards. Summits are broken with plantings of *Aloe Marlothii*, *A. dichotoma*, and other species, whilst the most striking effects are produced by the mesembryanthemums, the euphorbias, members of the genus *Encephalartos*, the pelargoniums, and by *Aster capensis*, *Dimorphotheca Ecklonis* and *Euryops athanasia*. A stream, rushing from the rock garden into the lake below, affords opportunity for the planting of indigenous hygrophilous plants, and lawns of *Cynodon* sp. and *Pennisetum clandestinum* have been laid. Large woody shrubs, and even small trees, such as *Chilianthus arboreus*, *Rhus lancea*, *Dombeya rotundifolia*, *Cussonia spicata*, *Tecomaria capensis*, *Plumbago capensis*, and other species, are employed for certain effects. Mr. Frank Frith, an expert on succulents, is supervising the making of the rockery.

Early Man in Colorado—Further Investigations

EARLY in June, Dr. Frank H. H. Roberts, jun., of the Smithsonian Institution, Washington, D.C., resumed excavations on the Lindenmeier site in northern Colorado for the third consecutive summer (see NATURE, Oct. 5, 1935, p. 535). While this habitation or camp site of Folsom man, the only known site of its kind and the only source of more than isolated specimens of the characteristic grooved stone Folsom point, has produced an abundance of evidence of the mode of life of Folsom man, hitherto no human skeletal remains have been found in association with this culture. Dr. Roberts's investigations during the coming season, therefore, will be devoted especially to the search for human skeletal remains. That early man was a contemporary of the extinct forms of bison found on the Lindenmeier site and dating possibly from the last stages of the Ice Age, is incontestable, as the tip end of a point was discovered in the foramen of the spinal column of a bison, of which a considerable portion of the skeleton was uncovered with the bones still articulated. A further matter of interest is that the palæontological evidence obtained by Dr. Roberts points to a climate somewhat warmer than that of the present day, some of the invertebrates represented by fossils being considerably north of their present range.

Bureau of Human Heredity

THE object of the Bureau of Human Heredity, which has recently been founded (see NATURE, **137**, 795; 1937), is collection on as wide a scale as possible of material dealing with human genetics. Later, the tasks of analysis of material and distribution of the information available will be added. It is affiliated to the International Human Heredity Committee, which ensures co-operation in all areas where research is proceeding. The Council would be grateful to receive all available material from institutions and individuals, furnishing well-authenticated data on the transmission of human traits whatever these may be. Pedigrees are particularly desired; twin studies and statistical researches are also relevant. Announcements in regard to the services undertaken by the Bureau will be published from time to time. The address of the Bureau is 115 Gower Street, London, W.C.1.

Announcements

DR. H. R. MILL has been elected a member of the German Academy of Naturalists at Halle "in recognition of his original contributions to geographical science and particularly to Oceanography and the furtherance of Polar research". This Academy, the full title of which is the Kaiserlich Leopoldinisch-Carolinisch Deutsche Akademie der Naturforscher, was founded at Schweinfurth in 1652 by a group of medical men who called themselves the Argonauts, as their object was to explore new realms of science in order to bring back the 'gold of knowledge' for the benefit of mankind, an aim which it now defines as the study of Nature for the good of humanity.

MR. R. A. WATSON WATT has been appointed superintendent of the Air Ministry Research Station, Bawdsey Manor, Suffolk. Mr. Watson Watt began his Civil Service career in the Meteorological Office, and later was appointed superintendent of the Radio Research Stations of the Department of Scientific and Industrial Research at Aldershot and Slough. He became superintendent of the Radio Department of the National Physical Laboratory when it was formed in 1933. In this post he has been responsible for an increasing amount of important work for the Air Ministry, especially in connexion with radio direction finders and beacons. His present appointment arises from a decision by that Department to establish a research station to continue this work.

PROF. FRANZ FISCHER, of the Kaiser-Wilhelm Institute, Mulheim-Ruhr, will deliver the Melchett Lecture of the Institute of Fuel at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1, on October 15, at 3.30 p.m. The subject of Prof. Fischer's lecture will be "Production of Synthetic Motor Spirit".

THE Prussian Academy of Sciences has awarded the gold Leibniz medal to Prof. Heinrich Lotz, of Berlin, and the silver Leibniz medal to Dr. Ludwig Kohl-Larsen, of Allensbach a. Bodensee.

PROF. REINHOLD RIECKE, director of the Chemico-Technical Experimental Institute of the German Porcelain Factory of Berlin and scientific director of the German Ceramic Society, has been nominated an honorary member of the American Ceramic Society.

IN connexion with the research item in NATURE of July 11, p. 83, on the Netherland's Meteorological Institute's publication, "Oceanographic and Meteorological Observations in the China Seas", Mr. H. Keyser, of De Bilt, writes that for the English text very valuable assistance was given by Mr. E. W. Barlow, of the Marine Division of the Meteorological Office in London, who took much trouble in correcting the manuscript, etc. Mr. Barlow has also given assistance, "on behalf of international co-operation", in the preparation of Part 2 of the work.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

An inspector of agriculture in the Department of Agriculture and Forests, Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S.W.1 (September 15).

Two junior investigators for the Royal Commission on Historical Monuments—The Secretary, 29 Abingdon Street, London, S.W.1 (September 19).

An assistant horticultural instructor for the Hampshire County Council—The Clerk, The Castle, Winchester (September 21).

An assistant lecturer in electrical engineering in University College, London—The Secretary (September 23).

An instructor in engineering workshop practice and production engineering in the Borough Polytechnic, London, S.E.1—The Principal (September 23).

A head of the Production, Engineering and Trades Course Section of the Department of Mechanical Engineering, and a lecturer in metallurgy, in the Central Technical College, Birmingham—The Chief Education Officer (September 26).

An assistant conservator of forests in the Department of Agriculture and Forests, Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S.W.1 (September 30).

A biologist for research in the eastern Canadian lobster fishery—The Director, Atlantic Biological Station, St. Andrews, N.B., Canada.

A temporary assistant engineer in the Experimental Section of the Ministry of Transport—The Establishment Officer, Ministry of Transport, Whitehall Gardens, London, S.W.1.

Architectural and structural engineering assistants in the Design Branch of the Directorate of Fortifications and Works at the War Office—The Under-Secretary of State (C. 5), The War Office, London, S.W.1 (quote 8314).

An assistant master to teach zoology in the Swansea Technical College—The Director of Education, Education Offices, Guildhall, Swansea.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 469.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Conservation of Energy in Radiation Processes

AT the beginning of this year, R. Shankland[1] reported experiments on the Compton effect which, indicated a breakdown of the conservation laws in radiation processes and a reversal to the type of theory put forward by Bohr, Kramers and Slater in 1924. According to the latter, light-quanta have no existence, and energy is only statistically conserved in the interaction of matter and radiation. In view of the difficulties of accepting Shankland's results—it was pointed out by one of the present writers in an earlier note[2] that they "run counter to the Uncertainty Principle"—we have carried out certain experiments with a view of testing further the points at issue.

In these experiments, which were referred to in the above-mentioned note, a narrow beam of X-rays ($h\nu \sim 20{,}000$ volts) is passed through a Wilson chamber containing argon, thus producing photo-electrons. Of the photo-electrons which come from the K-level, the great majority are accompanied by Auger electrons, the latter being produced by the process of internal conversion (the combination of the two tracks will be called a P track and represented in Fig. 1 by $/\!\!\wedge$). The remainder of the k-photo-electrons—about 1 in 13—are not accompanied by Auger electrons (Q_1 tracks, denoted /). On the light-quantum theory, and strict conservation, the ionized atoms which do not give Auger electrons emit a k fluorescent quantum, which, if absorbed in the surrounding gas, produces a photo-electron (F track, denoted $\backslash$). This state of affairs is represented in Fig. 1, the dotted line being the path of the light-quantum.

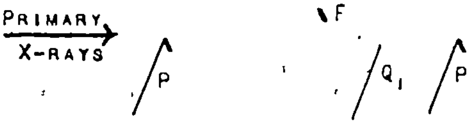

FIG. 1.

Now the ionized atoms have *exactly the same durations in the excited state* whether they give rise to an Auger electron or not, and on the theory of statistical conservation such as the Bohr-Kramers-Slater theory, they 'emit' fluorescent radiation to exactly the same extent, and *are equally responsible for the production of the fluorescent F tracks*. The latter would therefore not be associated with a Q_1 track any more than with a P track, while if there is strict conservation an F track has nothing to do with a P track. A test of the points at issue may therefore be made by seeing whether a track of the Q type is systematically associated with a fluorescent track or not. A statistical examination is necessary, especially in view of the fact that the photo-electrons coming from the L level (Q_2 tracks) are not distinguishable in the photographs from the Q_1 tracks, and are about equal in number.

Out of about 350 photographs (about 10 tracks per photograph, effective length of chamber $\sim$ 14 cm.) 21 were found with F tracks within 2 cm. of the primary X-ray pencil, in approximate accordance with the value of the absorption coefficient of argon for argon k-radiation, the argon being at a pressure of about 14 cm. A general inspection of the photographs showed a distinct association of Q and F tracks, indicating strict conservation. One of the photographs is reproduced above (Fig. 2), the short track by itself being that of a fluorescent photo-electron (F track) and the middle long track that of a primary photo-electron without an Auger electron (Q track).

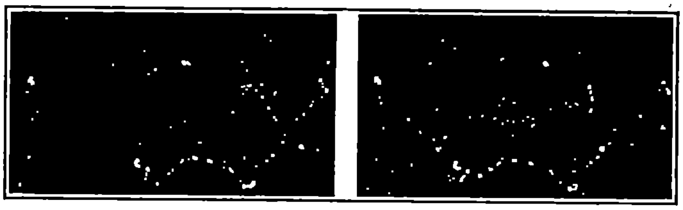

FIG. 2

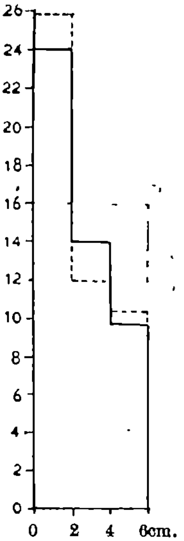

FIG. 3.

The distribution of the distances (x), measured parallel to the X-ray pencil, of the Q tracks from the F tracks for all the photographs is shown by the full line in Fig. 3, for x up to 6 cm. The calculated distribution according to strict conservation is represented by the broken line (– – –). The peak for small x represents the association of Q_1 and F tracks. The background is to be attributed mainly to the photo-electrons from the L-level (Q_2 tracks). The statistical fluctuation comes almost entirely from this background and is about $\pm 1\frac{1}{2}$. The total number of tracks per photograph is such that on the statistical theory the Q tracks have practically a random distribution with respect to the fluorescent photo-electrons. This is represented by the dotted line (......). The observed distribution is seen to have a peak in good agreement with the calculated distribution assuming strict conservation.

In view of Shankland's results, other workers have also recently carried out experiments on the conservation of energy and momentum in radiation processes[3]. In these investigations the counter coincidence method has been used. In all cases the results obtained, in conformity with the present results, confirm the light-quantum theory and the strict applicability of the conservation principles.

E. J. WILLIAMS.
E. PICKUP.

Physical Laboratory,
Manchester.
Aug. 7.

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[1] *Phys Rev.*, 49, 8 (1936).

[2] NATURE, 137, 614 (1936).

[3] Bothe and Maier-Leibnitz, *Gottingen Nachr.*, 10, 127 (1936).

[4] C Jacobsen, NATURE, 138, 25 (1936) Present results were reported at Physics Conference, Zurich, July 1.

Influence of Temperature on the 'Groups' of Slow Neutrons

WE have investigated the influence of temperature on the activation of silver by slow neutrons, separating the effects due to the groups *A*, *B* and *C* as defined by Amaldi and Fermi[1]. The arrangement used is shown in plan in Fig. 1. Absorbers of cadmium (0·258 gm./cm.^{2}) and silver (0·077 gm./cm.^{2}) were employed to separate the groups, and the use of a thicker absorber of silver (1·023 gm./cm.^{2}) enabled changes in the absorption coefficients of groups *B* and *C* in silver to be measured. For the low temperatures the paraffin wax was cooled with liquid nitrogen or hydrogen. The results obtained were as follows:

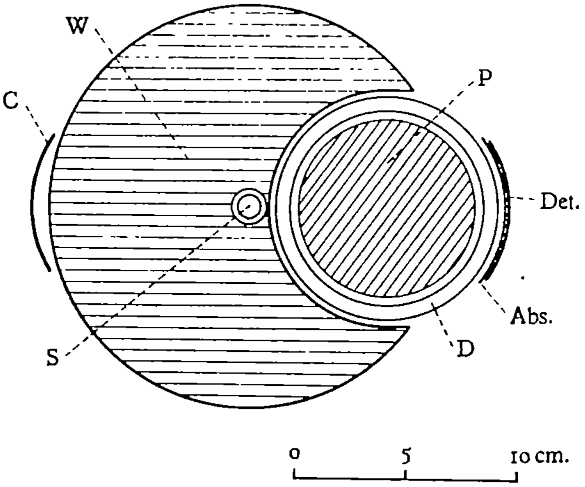

FIG. 1 *S*, neutron source (beryllium and radon); *W*, tin containing water; *D*, Dewar vessel; *P*, paraffin wax; *Det*, silver detector; *Abs.*, cadmium and/or silver absorbers; *C*, position of detector for comparison runs.

	Group	290° K.	77° K.	20° K.
Activity induced	*C* *B* *A*	100·0 ± 1 4 100·0 ± 2·0 100·0 ± 5·0	83·7 ± 1·3 101 4 ± 2·0 75·3 ± 5·6	96·4 ± 1 2 88·5 ± 1 6 72·0 ± 5·4
Absorption coefficient	*C* *B*	100 0 ± 4 5 100·0 ± 7 0	117·8 ± 5·2 123 1 ± 7 0	160·8 ± 5·0 110·6 ± 6 7
'Number of neutrons' $\left(=\frac{\text{activation}}{\text{abs. coeff.}}\right)$	*C* *B*	100·0 ± 4 7 100·0 ± 7 3	71·1 ± 3·2 82·4 ± 5 0	60 0 ± 2·2 80 1 ± 5·1

N.B. Each row has been scaled to make the first figure 100, and figures in different rows are not comparable. The errors shown are the mean square errors due to statistical fluctuations.

Some measurements using ice instead of paraffin wax in the Dewar vessel have given similar results.

It will be seen that groups *A* and *B*, as well as *C*, are affected by changes of temperature. This is in contradiction with the estimates of the energies of the former groups hitherto accepted[2], which gave values of several electron-volts, compared with the 0·037 e.v. or less corresponding to the temperatures used. For other reasons it appears unlikely that the energies of groups *A* and *B* have values lying in the region of thermal equilibrium, but according to our experiments they cannot be greatly in excess of such values. It follows from this that the assumption that the absorption coefficient of boron varies inversely as the velocity of the neutrons must be in error.

We desire to thank Lord Rutherford for putting the facilities of the laboratory at our disposal, and Dr. M. L. Oliphant for helpful discussions. It is hoped to continue experiments on these lines, and a fuller account will be published in due course.

A. ARSENJEWA-HEIL.
O. HEIL.
C. H. WESTCOTT.

Cavendish Laboratory,
Cambridge.
Aug. 10.

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[1] *Ric. Scient.*, (ii), 6, 344 and 443 (1935); (i), 7, 454 (1936).

[2] Amaldi and Fermi, loc cit; Frisch and Placzek, NATURE, 137, 357 (1936); Weeks, Livingstone and Bethe, *Phys. Rev.*, 49, 471 (1936).

Mechanism of Carbohydrate Breakdown in Early Embryonic Development

DURING the past twelve months, we have been engaged in a systematic study of the intermediary mechanisms of carbohydrate breakdown in the chick embryo in the first week of its developmental period. Although we have not yet brought our work to a conclusion, we wish to give an interim summary of it.

Attention has been concentrated throughout on the embryo of 4–6 days' incubation, and the first experiments done were measurements of anaerobic glycolysis with different substrates. It is found that glucose and mannose are the only sugars which give a steady long-continuing glycolysis; disaccharides, even when phosphorylated (such as trehalose-phosphate), and pentoses, are unattacked; as also is fructose. Chemical estimations show that lactic acid is formed quantitatively during glycolysis. Various parts of the embryo separately give the same result as the whole embryo, so that the relatively large proportion of nervous tissue present cannot be held accountable. Addition of inorganic phosphate does not increase the glycolytic rate of glucose or mannose, or cause the breakdown of other sugars. Glycogen is not glycolysed by pulped or minced embryo any more than it is by intact embryos, and even fairly active acetone powders prepared according to the method applied to brain by v. Euler, Gunther and Vestlin[1], will not glycolyse glycogen. With intact embryos, embryo-*Brei* and acetone powders, there is often an induction period of a few minutes in the glycolysis of mannose and glucose; this initial lag may be abolished by the addition of co-zymase or adenyl-pyrophosphate.

The trisaccharide of Levene and Mori[2] (2 mannose plus 1 glucosamine), contained in egg proteins, is not attacked by intact embryos; but when the mannose has been made available by hydrolysis, embryos can glycolyse the product. Probably the yolk-sac hydrolyses it *in vivo*. Glucosamine itself is not glycolysable, and another trisaccharide, raffinose, is also unattacked.

Chick embryo resembles mammalian brain in that its glycolysis, whether of glucose or mannose, can be almost completely abolished by the addition of glyceraldehyde. The autoglycolysis, however, cannot be inhibited in this way.

Study was also made of the appearance of bisulphite-binding compounds during embryonic glycolysis. By the methods of Clift and Cook[3], it was found that a considerable accumulation of pyruvic acid occurs both ærobically and anærobically. Of the carbohydrate glycolysed, some 60 per cent appears temporarily in the form of pyruvic acid, if no substrate is given, but if glucose is present the relative amount is much reduced (to less than 10 per cent) although more pyruvic acid appears. The accumulation of pyruvic acid occurs in embryo tissues of 10 days incubation also. In view of the work of Peters and his collaborators[4], on avitaminous bird brain, it was conjectured that the embryo might be physiologically B_1-deficient, but on the contrary the addition of crystalline vitamin B_1 had no effect on the pyruvic acid accumulations.

Next, the rates of anærobic and ærobic glycolysis of the embryo were compared with the rate of oxidative disappearance of lactic acid. In embryo, the Pasteur effect is extremely marked. If Meyerhof's resynthesis theory were the correct explanation of this, the rate of disappearance of added lactate (in the absence of glycolysable substrate) should be equal to the observed difference between ærobic and anærobic glycolysis in the presence of glucose. But in fact it is far less than that. Some explanation of the Pasteur effect in embryo, other than the Meyerhof cycle, must therefore be found.

In this respect, chick embryo resembles mammalian brain (Dixon[5]). The effect of potassium in increasing respiration and anærobic glycolysis observed by Ashford and Dixon[6] was, however, looked for, and found not to exist in the case of embryo. In this respect, it differs from brain.

Another line of attack which we have used is that of analysing the distribution of phosphorus among the various fractions of the aqueous trichloracetic acid extract. Chick embryo differs widely from muscle or brain in that no less than 60 per cent of its water-soluble phosphorus is found in the 'hexosemonophosphate' fraction unprecipitable with barium. This phosphorus-containing material cannot be the Robison ester and is probably not hexose-monophosphate at all, since it is not fermentable by yeast and contains too little phosphorus in the elementary analysis. It is very resistant to acid hydrolysis. Embryo is therefore similar to tumour, where, as Outhouse[7] has shown, a large amount of the same fraction is present, perhaps as hexosamine-phosphate or amino-ethyl-alcohol-phosphate; and with blood where, according to Kerr and Daoud[8], half the whole amount of phosphorus may be in the form of diphosphoglyceric acid.

The distribution of the phosphorus was further investigated after treatment of the embryos at 37° for some time with fluoride in a dosage just sufficient to inhibit glycolysis 90 per cent. The medium contained inorganic phosphate. Contrary to what would be expected if the embryo followed the example of muscle, there was no accumulation of difficultly hydrolysable esters; on the contrary, there was a piling up of inorganic phosphate at the expense of the phosphagen and the adenyl-pyrophosphate. This is not a specific effect of the fluoride, but happens also when the embryos are suspended in Ringer-bicarbonate anærobically without the addition of any substance. Upon the fraction not precipitable by barium, fluoride has no effect; this remains constant. It persists, moreover, in about the same relative proportion until at least the fifteenth day of development.

One of the main points of interest in this work is, of course, the question whether the embryo's carbohydrate breakdown is entirely, partially, or not at all effected by means of a phosphorylation system. At present we only wish to record that apparently neither intact embryo nor embryo-*Brei* will glycolyse any combination of the phosphorus-containing intermediates, for example, sodium glycerophosphate with sodium pyruvate, sodium phospho-pyruvate, or sodium phospho-glycerate. Dihydroxyacetone is not broken down, whether inorganic phosphate is present or not. As we expected from the work of Neuberg, Kobel and Laser[9], methyl-glyoxal is converted to lactic acid at a rate about half that of glucose, which under certain conditions may be increased by added sulphydryl. The embryo will not form lactic acid from hexose-diphosphate, glucose-monophosphate, or mannose-monophosphate. But on the other hand, inactivated embryo-*Brei* forms a dihydroxyacetone-phosphate fraction from added hexose-diphosphate to the same extent as mammalian muscle extract, and forms phospho-glyceric acid from phospho-pyruvic acid. It also transfers phosphorus from phospho-pyruvic acid to adenylic acid (the first part of the Parnas reaction). We hope that our experiments will shortly permit of final decision regarding the question of phosphorylation in the embryo.

JOSEPH NEEDHAM.
W. W. NOWIŃSKI.
R. P. COOK.
KENDAL C. DIXON.

Biochemical Laboratory,
Cambridge.
July 20.

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[1] v. Euler, Gunther and Vestlin, *Z. physiol. Chem.*, **240**, 265 (1936).

[2] Levene and Mori, *J. Biol. Chem.*, **84**, 49 (1929).

[3] Clift and Cook, *Biochem. J.*, **26**, 1788 (1932).

[4] Peters *et al*, *Proc. Roy. Soc.* B, **110**, 431 (1932).

[5] Dixon, *Biochem. J.*, **29**, 973 (1935).

[6] Ashford and Dixon, *Biochem. J.*, **29**, 157 (1935).

[7] Outhouse, *Trans. Roy. Soc. Canada*, v, **29**, 77 (1935); and *Biochem. J.*, **30**, 197 (1936)

[8] Kerr and Daoud, *J. Biol. Chem.*, **109**, 301 (1935).

[9] Neuberg, Kobel and Laser, *Z. Krebsforschung*, **32**, 92 (1930).

Reliability of Seismograph Stations

IN a recent paper, Dr. H. Jeffreys[1] works out a 'reliability' factor for seismograph stations throughout the world, using information from the International Seismological Summary for 1930 January to 1931 March. Reliability results based on this information do not, however, represent present conditions. Seismology has made rapid headway since 1931, and a number of stations have improved both their recording equipment and their timing.

The characteristic which Jeffreys terms 'reliability' is obtained by expressing the number of P residuals not exceeding ±4 seconds, as a decimal of the total number of P residuals; so that the 'reliability' values vary between 0·0 and 1·0. A table of such values for each station is given, the stations being grouped into five regions. Of the seventeen stations in the 'Pacific' group, we find Wellington, with readings from two Milne-Shaw seismographs, taking thirteenth place; and Christchurch, with readings from a single Milne seismograph, taking fifth place. The 'reliability' values given are as follows :

$$\text{Wellington} \quad \frac{8}{24}=0\cdot3\,;$$

$$\text{Christchurch} \quad \frac{4}{8}=0\cdot5.$$

This surprising result led me to make a detailed examination of the data for Wellington and Christchurch. Working on the same lines as Jeffreys, and using the same data, I obtained the following values for the 'reliability' :

$$\text{Wellington} \quad \frac{11}{27}=0\cdot4\,;$$

$$\text{Christchurch} \quad \frac{3}{9}=0\cdot3.$$

The above results differ from those obtained by Jeffreys, but they are more in accordance with the instrumental equipment at the two stations. However, if more recent observations were used, both stations would undoubtedly have higher values.

The P residuals at Wellington are nearly all negative. Of the eleven not exceeding ±4 seconds, eight are negative, two are zero, and one is positive ; giving a mean residual of nearly -2 seconds. This suggests that the deviations found for this station are not random errors, and that the station should be classed with those showing systematic errors. These observations giving negative residuals refer to Pacific earthquakes with epicentres to north or north-west of Wellington, and it is possible that these need some readjustment, as there is generally a lack of near stations in eastern azimuths as compared with western azimuths. It seems certain, as suggested by Jeffreys, that sufficient weight has not been given to Wellington and Christchurch in the determination of Pacific epicentres.

In dealing with the utility of his results, Jeffreys selects a number of stations of good 'reliability' for each of the five regions. As 'Pacific' stations, those selected are : Riverview, Palau, Manila, with Melbourne and Adelaide to check Riverview.

This cannot be considered a complete list for years following 1931, since both Wellington and Christchurch would almost certainly be included as stations of good 'reliability'. Also, the standard errors of P should now be less than the value of 4 seconds, which Jeffreys applies to these stations.

R. C. HAYES.
(Acting Director.)

Dominion Observatory,
Wellington,
New Zealand.
July 17.

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[1] "A Comparison of Seismological Stations", *Mon. Not. Roy Ast. Soc., Geophys Suppl*, 3, No. 9, 423 (April, 1936).

I SHOULD agree with Mr. Hayes that not much importance should be attached to the difference between Wellington and Christchurch. The standard error of a reliability r based on n observations is $\sqrt{\{r(1-r)/n\}}$; then with my data the results are Wellington $0\cdot33\pm0\cdot10$, Christchurch $0\cdot50\pm0\cdot18$. This is for all earthquakes recorded at the stations. For Pacific earthquakes alone, I get Wellington $0\cdot36\pm0\cdot13$, Christchurch $0\cdot56\pm0\cdot19$. The difference is therefore not more than might be attributed to random sampling. On the other hand, we may notice that there were three times as many readings of P at Wellington as at Christchurch, though in most cases the amplitude of the motion of the ground must have been about the same, and many of the inferior observations at Wellington refer to earthquakes when Christchurch failed to record P at all.

The data as presented in the International Seismological Summary do not indicate the clearness of the movement, and it is probable that the clearer movements at Wellington correspond to a much higher reliability. I also directed attention in my paper to the fact that in some cases too little weight seems to have been given to the near stations in determining the epicentres, and that for this reason the reliabilities found for both stations may be too low for earthquakes in the South Pacific ; but to remove this error would mean recalculating the whole of the epicentres.

Support can be found for the higher reliability of Wellington in strong or fairly near earthquakes from the residuals at the British stations with Milne-Shaw instruments in the series of deep-focus earthquakes that I have discussed recently[1]. Oxford is excluded because it has already been found to have a high reliability. The residuals for the others together have the following distribution :

Residual (seconds)	−2	−1	0	1	2	3	4	5	6	7	8
Number	2	2	6	2	2	1	0	1	1	0	1.

These correspond to a mean reliability of $15/18=0\cdot83\pm0\cdot09$; but the mean for these stations for general work was only $0\cdot50\pm0\cdot08$.

The results in my paper do not place the stations in a definite order of merit, since the sampling error is appreciable ; but they serve to indicate approximate weights to use in the determination of epicentres. I should recommend using for Wellington, when within 30°, the weights for reliability $0\cdot6$ until further information is available.

HAROLD JEFFREYS.

St. John's College,
Cambridge.

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[1] *Mon. Not. Roy. Ast. Soc., Geophys. Suppl.*, 3, 310 (1935)

"A Treatment of Modern Physics"

UNDER the above title, E. N. da C. A., in NATURE of June 13, has subjected my co-worker, Mr. N. K. Saha and myself, to a vigorous 'strafing' for writing "A Treatise on Modern Physics", Vol. 1, published by the Indian Press of Calcutta and Allahabad. In fairness to the large number of readers (not merely Indian) who, between the publication of the book in November, 1934, and its review in NATURE, have wasted, according to the reviewer, thirty shillings on a book advocating a "method of teaching" which he holds "to be pernicious", I, as the senior author, seek permission to publish the following apologia in NATURE.

Reviewers have their own right, which I do not propose to question, but they are expected to give a short *résumé* of the subject matter of the book, point out mistakes or misstatements of facts, find out possible errors in the presentation of current ideas and to deal with important omissions, as has been done in NATURE by Prof. R. H. Fowler in a review of another work by me. In no case have we come across a review in which the reviewer finds faults with the author for not including matter which is expressly stated to be reserved for subsequent treatment.

In the present case, the reviewer has followed an original line in his review. He does not give a *résumé*, does not point out a single mistake, and does not say that the presentation of ideas has been marked by any serious error or bad style. He deals only with *omissions*, in spite of the fact that the authors themselves noted these omissions in the following passage which occurs in the preface:

"It was first intended to include chapters on Molecular Physics, interaction between matter and light, wave-mechanics and Nuclear Physics, but as the book has already become bulky, it was decided to incorporate these chapters in a second volume."

Most of the omissions to which the reviewer devotes three-quarters of his criticism, namely, failure to give an account of the correspondence principles, selection rules, principles of wave-mechanics and also some advances on positive rays fall under the chapters mentioned above. The reviewer's remarks regarding the omissions are, therefore, not only irrelevant but also extremely ungracious to the authors.

As to the other minor charges—omission in Chapter iii (Positive Rays) of mention of Aston's and Bainbridge's precision mass-spectrograph and of the results obtained therefrom—the explanation is very simple. The present volume, being confined solely to discussion of atomic structure, the authors were justified in omitting all references to such works, which have a bearing on nuclear physics. This has been expressly mentioned on page 99. Further, at the time of writing, Aston and others (Rutherford, Oliphant, Kempton, Bethe) were engaged in revising the mass-scale. The authors did not, therefore, feel justified in including such matter as would become obsolete before the ink had dried. Probably if the results had been included, the reviewer would have found fault for their inclusion.

Regarding the chapter on magnetism, the authors were aware of the current theories of ferromagnetism, but on perusal of these had come to the conclusion that these theories were only 'phenomenological' and had better be omitted from a text-book. The wisdom of such a step was justified in Simon's recent discovery that, near the absolute zero, all paramagnetic substances tend to become ferromagnetic. This probably necessitates a revision of the current theories of ferromagnetism, which trace it to exchange resonance amongst the *d*-electrons of the transitional elements of the first group. I do not think that such matter as magneto-caloric effect or of magnetostriction need be incorporated in a book dealing mainly with atoms. It is possible to have legitimate differences of opinion on this question.

The reviewer complains that there has been too much of complex spectra in this treatise. In this connexion the following passage in his well-known text-book published in 1927 ("The Structure of the Atom") may be quoted:

"A discussion at Danzig in September, 1925, between some of the most celebrated workers in the field of quantum analysis of spectra, at which the writer had the pleasure of being present, foundered, if the expression may be used, on the question of notation, none of the speakers being able to understand the notation of the others and each having also apparently difficulties with his own."—(Footnote, p. 569.)

In spite of this situation nine years ago, the writer of this text-book, who according to his own admission did not at the time understand the subject, devoted 79 pages of his text-book to multiplet structure. The reviewer admits that the difficulties of a lucid exposition of the subject of complex spectra have largely disappeared as a result of advance of knowledge within the last ten years, but he puts forward the very curious view that the necessity of giving a full exposition of the subject, in the circumstances, no longer remains.

It is rather difficult to understand the reviewer's remarks about the inner quantum number and the spinning electrons. The writer's point of view has been the approach of the subject from the side of spectroscopy, while the reviewer would like to develop it from the mechanical side. The two views being divergent, the criticisms are rather ungracious. In one case he has misrepresented the actual language used about the rotating electron. I may add that Goudsmit and Uhlenbeck used the term "Rotierende Elektron". He writes "the perephral velocity is even worked out on these lines and the absurd value which results is said to be unexplained". The mathematical results, for quoting which fault is found, have been taken from Goudsmit and Uhlenbeck's original note to *Die Naturwissenschaften*, and the words used by these authors are as follows: "The linear velocity at the periphery of the electron thus comes out to about 308 times the velocity of light, a deduction which has still to remain *incomprehensible*."

The authors at any rate may be expected to know the methods of teaching, pernicious or otherwise, which prevail in India, and they do not propose to bother about the *ex cathedra* remarks of the reviewer on this question.

M. N. SAHA.

IT is now more years than I care to think of since books were entrusted to me for review in NATURE, but it is the first time that I have seen a letter anything like that which Prof. Saha has sent for publication, and in the original and longer form in which the Editor showed it to me it was even more individual. I can scarcely be expected, at this time of day, to take lessons from Prof. Saha as to how to review a book, or to deal with his letter point by point, especially as a great deal of it is, to speak mildly, disingenuous. I may remark, however, that it is not correct to say that I did not point out a single mistake, and, further, that I was less concerned with details than with general principles. It was owing to a delicacy which I now realize to have been misplaced that I did not remark on the style in which the book is set down. Perhaps Prof. Saha's letter furnishes comment on that point.

My criticism was mainly directed to the fact that the book contains masses of detail, much of it unnecessary and some of it out of date, omits matters of prime importance for the subject under discussion, and provides little or no explanation of the principles on which the complicated calculations printed in the book are based. I have made my point of view perfectly clear, as I am entitled to do, and have not misrepresented that of the authors, and, in my experience, misrepresentation and ambiguity are the sole grounds which are held to justify a reply to a review. Those who hold that the points raised are trivial will set me down as mistaken, as in the case of the spinning electron, where all the relevant matter is before the reader.

What I gather to be the point of Prof. Saha's present communication is, first, that all the missing matter which one might have expected to find in this book—

some description of the method of anode rays and of the work of Bainbridge in the chapter headed "Positive Rays"; some explanation of the general methods of quantization before, for example, fourteen pages are devoted to the calculations on the Stark effect; some mention of the work of Hartree and others where the old work on electron distribution is discussed; and, in short, all the other fundamental points which, as I point out in my review, are completely neglected—is going to be described in a second volume; and secondly, that I ought to have known this from the passage which he quotes from the preface. The answer is, first, that the passage which he quotes does not say this, and, secondly, that even if it did, this is, *in my opinion*, a bad way of writing a book, especially as Prof. Saha's disciples are still awaiting the second volume which shall explain the first. In my opinion—but Prof. Saha says that my opinion is not worth much. For all I know he may be right, but there his quarrel is with the Editor, who invited me to give it, and not with me. In any event, Prof. Saha's remark that the authors "do not propose to bother about the *ex cathedra* remarks of the reviewer" on methods of teaching absolves me from the distasteful task of spending further time on Prof. Saha's favourable review of this volume of his book. I look forward, however, to reading his review of the second volume.

E. N. DA C. ANDRADE.

'Lines' on the Surface of Moving Water

SINCE reading the interesting accounts of this phenomenon by Prof. W. Schmidt[1] and Prof. H. Stansfield[2], I have noticed several striking instances which yield a clue to their cause. They occurred on the surfaces of clear country streams bridged by planks that touched the water, obstructions which, mechanically, resemble the mill-stream example described by Prof. Stansfield. Evidently the macroscopic agent causing the sudden change in velocity need penetrate only to a very small depth.

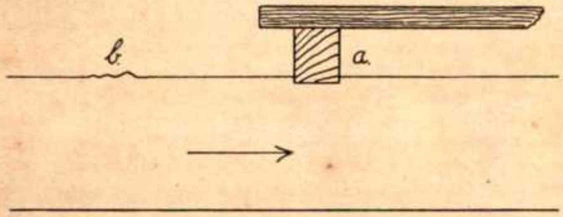

FIG. 1. Schematic diagram of stream (vertical longitudinal section); *a*, beam penetrating surface; *b*, surface line and secondary waves.

In the case illustrated, the 'line' was remarkably stable at an average distance of about 40 cm. from the bridge, and the conditions such as to be easily reproducible in a laboratory. The stream was about 1·3 m. wide and 40 cm. deep. The water flowed without visible turbulence and with a mid-stream surface velocity of about 25 cm. per sec. Fig. 1 represents a vertical, longitudinal section of the stream and foot-bridge, which touched its surface across the full width. Close to the line on the up-stream side was a series of parallel waves of diminishing amplitude and stationary with respect to the line. These secondary waves are clearly visible in the photograph (Fig. 2), and the reflections of overhanging foliage demonstrate the relative tranquillity of the surface between the line and the obstruction causing it.

In a wider and more slowly moving portion of the stream, a similar bridge had collected a band of scum. Here the line occurred nearly a metre above the scum, and secondary waves were visible only when the line was disturbed by winds, to which it was more sensitive than the line photographed.

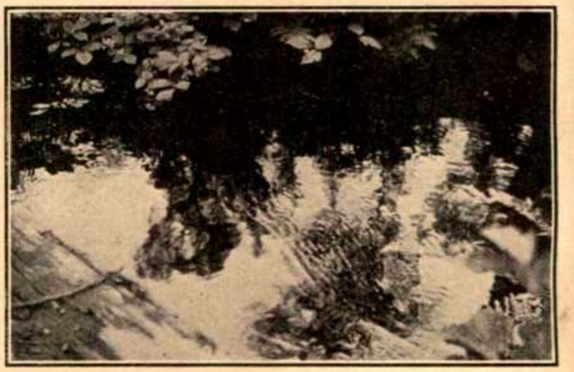

FIG. 2. Photograph of a particularly stable 'line'.

The experiments recorded in previous letters concerning the behaviour of floating particles and the effect of soap were repeated. The initial position of the line depends on the velocity of the stream, whilst the extent of its temporary displacement up-stream caused by substances affecting the surface tension depends on the velocity of the stream, and on whether the addition is made up-stream or down-stream relative to the line. Qualitatively, the observations, including the 'oil-patch' effect, are consistent with the idea that the line marks the boundary of a surface film of colloidally dispersed material under lateral compression caused by movement of the water.

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[1] NATURE, **137**, 777 (1936).
[2] NATURE, **137**, 1073 (1936).

Habit and Shell-shape in the Portuguese Oyster, *Ostrea angulata*

IT is known that the form of the shell of Portuguese oysters (*O. angulata*) living on the shore is different from that of individuals living permanently below tide-marks[1]. In the latter the shell is relatively very broad, in the former long and narrow, almost in the shape of a shoe-horn with the hinge at the narrow end. No explanation of this difference in shape could formerly be offered, but in a recent inspection of extensive inter-tidal beds of Portuguese oysters in the River Blackwater, to which I was courteously invited by Mr. Louis French, a probable explanation of the prevailing elongate-shaped shell suggested itself.

The oysters were lying on the normal muddy bed and had recently put on extensive new shell growth which was concentrated mainly at the end of the shell remote from the hinge; in almost all cases, the new growth was turned up from the substratum, whichever way the oyster was lying, so that in crossing the beds one walked on the sharp protruding shell-edges. As increments in shell-area are laid down by the mantle, this organ must be protruded mainly at the end of the shell, at least during growth, in a foreshore habitat. It seems probable that on the usual muddy foreshore bed the mantle is normally extended upwards in this part for feeding and respiration. Such a habit would give the advantage of an intake of clearer or less muddy water than is available around the more anterior edges of the shell which lie more or less in the mud, while if muddy water is inhaled the particles of foreign matter can readily be got rid of from a restricted region. If the normal habit is to extrude the mantle from the broad end of the shell as stated above, then it would follow that shell would be laid down with the mantle extended in this way and an elongate form of shell results. The sensory equipment of the bivalve is doubtless adequate to determine the most suitable region for intake of water.

On the other hand, in deep water where broad shells were found, the beds tend to be less muddy and the direction of the currents of water more regular; it is therefore reasonable to suppose that there is less need for restriction of the mantle opening in this habitat, and that the mantle will normally be more uniformly extended. In that event, new growth will not be concentrated at the broad end of the shell and a broader shell will result.

It seems, therefore, that a difference in habit of controlling the extension of the mantle in the two habitats may account for the difference in the shape of the shell. At least two factors appear to be concerned, namely, the nature of the substratum, and the simplicity or complexity of the water-currents in the respective habitats. Further researches on shell-shape of this and *O. virginica*, the allied American species, living on different types of substratum below low water, would be interesting; for the American species resembles the Portuguese form to a considerable extent in habitat and shell-modifications[2].

The variable sinuous or irregularly twisted elongate form of the shell seen more commonly in the cultivated Portuguese oyster is clearly due to the habit of adding large new shell-shoots mainly from the upturned broader end.

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Aug. 14.

[1] J. H. Orton and P. R. Awati, *J. Mar. Biol. Assoc.*, **14**, 227 (1926).

[2] Dean Bashford, *Bull. U.S.F.C.*, **10**, 367, 1890 (1892).

Life in the Dead Sea

THE remarkably high salt tolerance of unicellular organisms, which have been found in a saline lake of salt concentration so high as 19–26 per cent sodium chloride by Ruben Tschik, T. Hof, Baas-Becking and others, caused us to doubt the accuracy of the reputation of lifelessness, which tradition imputes to the Dead Sea. Accordingly, samples of Dead Sea water were taken under sterile conditions at a distance of 3–4 km. from the mouth of the Jordan at various sea depths up to 7 metres. The total salt concentration of the water samples was 28–29 per cent. Bacterial organisms could be grown in 1 per cent peptone sample water media at temperatures of 21°–23° C. and 30° C. from all the samples taken.

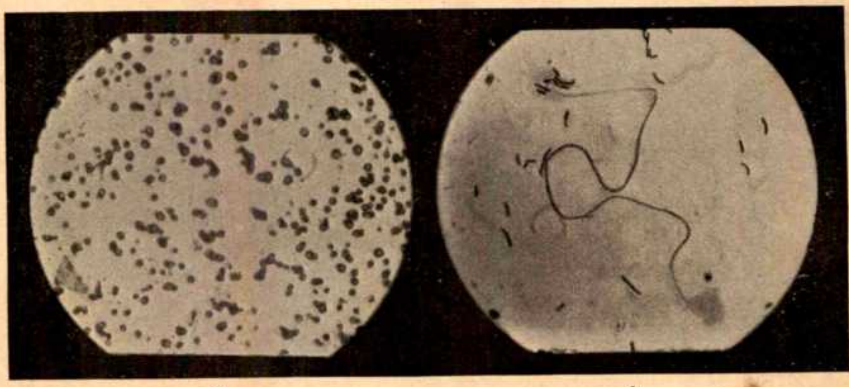

FIG. 1. Dead Sea micro-organisms. × 550.

In addition, microscopic examination of a hanging drop of the water revealed the presence of a living phytoflagellate 13μ long, which we believe is either a *Chlamydomonas* or a *Dunaliella*. Three micro-organisms have so far been distinguished: a yeast-like, Gram negative orange pigment producer $1 \cdot 6 \times 1 \cdot 6\mu$ (Fig. 1*a*), a Gram negative small rod-like organism $1 – 4 \cdot 8\mu \times 0 \cdot 8\mu$, and a Gram positive long filamentous organism (Fig. 1*b*) $3 \cdot 3 – 9 \cdot 9\mu$ to $170\mu \times 0 \cdot 8\mu$. The investigations are being continued.

We take this opportunity of expressing our thanks to Mr. M. A. Novomeysky, managing director of the Palestine Potash Co. Ltd., for his most kind assistance.

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A New Blowfly attacking Sheep in Western Scotland

IT is now generally accepted that *Lucilia sericata* is the only species of blowfly which causes primary 'strike' of sheep in Britain. Although MacDougall (1909)[1] recorded instances of sheep being struck by *Calliphora erythrocephala* alone, the more recent investigations of Davies (1934)[2] in Wales, and of Ratcliffe (1935)[3] in Aberdeenshire, failed to reveal any primary species other than *Lucilia sericata*. The following record is, therefore, of interest.

In the course of an investigation of the blowfly problem, I have obtained, from Mull and western Argyllshire, several collections of larvæ taken from field cases of strike. The larvæ were in each case transferred directly from the sheep into metal containers filled with a sand-sawdust mixture. On arrival they were placed in breeding jars, of a type which prevented the possibility of contamination of the cultures by ovipositing flies. Out of thirteen batches bred out to the adult stage, seven were found to be pure collections of *Phormia terræ-novæ R.-D.*

I am indebted to the Natural History Museum for the identification of the species from specimens submitted. The batches were all obtained from blackfaced sheep in long wool; the strikes occurred on various parts of the body, for example, the throat, loins, tailhead, breech, etc. Each batch yielded anything from a dozen or so to more than three hundred individuals.

It would appear, therefore, that in western Scotland at least, this species acts as a primary blowfly, initiating strike on relatively clean-woolled areas.

The closely related species, *Phormia regina*, is the principal sheep blowfly of North America, but *Phormia terræ-novæ* has not been recorded previously, from any country, as attacking sheep. In view of its wide European and North American distribution, and of the newly emerged fact that it is able to strike sheep, the absence of any such records is a matter of considerable interest.

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Aug. 21.

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[1] MacDougall, R. S., *Trans. Highl. Agric. Soc. Scot.*, **21**, 135 (1909).
[2] Davies, W. Maldwyn, *Ann. App. Biol.*, **21**, 267 (1934).
[3] Ratcliffe, F. N., *Ann. App. Biol.*, **22**, 742 (1935).

Temperature Coefficient of the Electrolytic Separation of the Hydrogen Isotopes

IN the course of an experimental study of the electrolytic separation of the isotopes of hydrogen at current densities of one milliamp./cm.^{2} and less with rigorous exclusion of oxygen, grease and other contamination, we have measured the temperature variation of the separation at mercury and silver cathodes with somewhat unexpected results.

The electrolyte was $0 \cdot 5N$ hydrogen chloride (with $0 \cdot 5N$ potassium chloride added in the experiments with mercury), and the anode consisted of the same metal as the cathode. The deuterium content of the cathode gas was determined by the micro-thermal conductivity method of Farkas[1]. The following values for the electrolytic separation coefficient (α) were obtained at 15° C. and 98° C.:

Cathode	15° C. (i)	15° C. (ii)	98°	98° (calc.)
Mercury	2·8	3·35	3·25	2·3
	3·1	3·25	2·95	2·5
Silver	7·0	6·5	4·6	4·6
	7·0	6·6	4·4	4·6

The two columns for the lower temperature relate to measurements made respectively before and after the high temperature measurements. The last column gives the separation factor that would be expected at 98° C. from the relation

$$\ln \alpha = \frac{\triangle E}{RT},$$

where $\triangle E$ is the difference in activation energy necessary to account for the separation factor (i) at 15° C. The probable error in the values of α is 2–3 per cent. The anomalous behaviour of mercury is remarkable, but might perhaps be accounted for by assuming that both of the alternative mechanisms ('catalytic' and 'electrochemical') of Horiuti and Okamoto[2] contributed to the cationic discharge, and that at the higher temperature the relative participation of the two mechanisms became more nearly equal.

With the view of testing this possibility, small quantities of α-naphthoquinoline, which might be expected to inhibit the 'catalytic' mechanism, were added to the electrolyte with the following results:

Cathode	Concentration of inhibitor	15° (i)	15° (ii)	98°
Mercury	2 millimols/litre	1·25	1·4	1·7
	0·3 ,, ,,	1·55	1·55	2·2
Silver	0·3 ,, ,,	1·7	3·0 falling to 2·3	3·7

The results for mercury, which incidentally show the lowest separation yet recorded, do not seem to fit in with the provisional hypothesis outlined above. The possibility that isotopic discrimination in cathodic reduction of the catalytic poison would account for the anomalous temperature variation seems to be excluded by the duration of the electrolysis.

The experiments are being continued and their possible interpretation will be discussed in detail elsewhere.

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Oxford.
August 8.

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[1] A. and L. Farkas, *Proc. Roy. Soc.*, A, **144**, 467 (1934).
[2] Horiuti and Okamoto, *Sci. Papers Inst. Phys. Chem. Research, Tokyo*, **28**, 231 (1936); *Brit. Chem. Abstracts*, 430 (1936).

Raman Spectrum of Thiophosphoryl Chloride

THE Raman spectrum of phosphorus oxychloride has been explained by assuming an asymmetric tetrahedral structure for its molecules. The molecules of thiophosphoryl chloride may, by analogy with those of the oxychloride, be supposed to have a similar tetrahedral structure; and the Raman spectra of these two compounds should then be similar.

The following table gives the prominent shifts that I have observed in the Raman spectrum of thiophosphoryl chloride:

	$PSCl_3$	$POCl_3$[1]
A	171 cm.$^{-1}$	192·85 cm.$^{-1}$
B_1	246 ,,	267·39 ,,
B_2	382 ,,	337·44 ,,
C	432 ,,	486·24 ,,
D_1	543 ,,	581·2 ,,
D_2	750 ,,	1289·9 ,,

The data for the oxychloride are taken from Langseth's work[1]. The slight reduction in the values of the Raman shifts in thiophosphoryl chloride is presumably due to the substitution of the oxygen atom in the oxychloride by an atom of sulphur.

FIG. 1. Raman spectra of thiophosphoryl chloride ($PSCl_3$).

The shift $\Delta\nu = 1{,}290$ has been assigned to the P—O bond in the oxychloride[2]; the shift $\Delta\nu = 750$

in thiophosphoryl chloride can then be assigned to the P—S bond. The shifts $\Delta\nu = 171$; 246; 432 are very strong and the corresponding anti-Stokes lines excited by $\lambda = 4046$ can be seen in the spectrum.

A further study of the Raman spectrum of these two compounds as regards polarization and structure of the Raman lines is in progress, and the results of these studies will be published elsewhere.

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July 28.

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[1] Langseth, *Z. Phys.*, **70**, 350 (1936).
[2] Venkateswaran, *Ind. J. Phys.*, **6**, 275 (1931).

Scientists and War

AT a meeting of prominent scientists held at Bangalore on August 22, under the joint auspices of the Institute of Chemistry of Great Britain and Ireland (Bangalore Branch) and the Society of Biological Chemists (India), to discuss the question of the moral responsibility of scientists in modern warfare, which has recently attracted much attention in these columns[1] and elsewhere, the following resolution was carried:

"This meeting while pledging its support to every united effort which can be made to abolish methods of warfare which are repugnant to the common instinct of humanity, recognizes that the more important objective is the abolition of war itself. To attain this end it would urge constant and strenuous activity on the part of thinkers and men of science. In particular, it records its opinion that more attention should be given by them to the study of the new economic conditions which of necessity accompany the advance of scientific research. Of equal or greater importance is the study of means for controlling the evil effects of mass suggestion by the more powerful agency of widely disseminated right ideas through the adoption of an international system of education."

C. N. ACHARYA.

Bangalore.
August 23.

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[1] NATURE, **137**, 757 (1936); **137**, 829 (1936); **138**, 80 (1936); *J Inst. Chem.*, Pts 1 and 2 (1935).

Points from Foregoing Letters

FURTHER experiments on the production of photoelectrons in argon gas by X-rays, carried out by Dr. E. J. Williams and E. Pickup, support the quantum theory and the principle of conservation of energy, the applicability of which to X-radiation processes had been disputed, following upon the results of Shankland's experiments.

The radioactivity induced in silver at 20°, 77° and 290° K. by slow neutrons of different energies (groups *A*, *B*, and *C* of Amaldi and Fermi) has been determined by Drs. A. Arsenjewa-Heil, O. Heil and C. H. Westcott. They are led to conclude that the energies of groups *A* and *B* must be much lower than had been supposed, and that the absorption of boron is not inversely as the velocity of the neutrons.

The changes which sugar-like substances undergo in, or under the influence of, chick embryos of 4–6 days' incubation have been studied by Dr. J. Needham, W. W. Nowiński, R. P. Cook and K. C. Dixon, and compared with those effected by brain and muscle tissues. They find that the embryo does not glycolyse phosphorus-containing intermediate compounds; that glucose and mannose are the only sugars which give steady, long-continuing glycolysis; that the Pasteur effect is extremely marked; that the phosphorus distribution in various fractions is different from that obtained with muscle and brain preparations.

Referring to the reliability of different earthquake-registering stations deduced by Dr. H. Jeffreys, R. C. Hayes recalculates the values for the Pacific stations at Wellington and Christchurch; he finds that Wellington has a slightly greater reliability factor and considers that, in view of recent improvements, both stations should be included among those of good reliability. Dr. Jeffreys agrees that the order of reliability of Christchurch and Wellington stations cannot be definitely determined owing to the probable error involved in the calculations; he recommends that, for the time being, a 'weight' of 0·6 be accepted for Wellington observations.

Profs. W. Schmidt and H. Stansfield have described instances of the capillary wave that often appears when flowing water encounters an obstacle. Further observations are recorded by Dr. R. O. Hall, who suggests that the line marks the boundary of a compressed surface film of colloidal matter.

The difference in the shape of the shell of the Portuguese oyster, *O. angulata*, living on the shore, as compared with that of oysters permanently below tide-marks, is accounted for by Prof. J. H. Orton in terms of the surroundings. In deeper and less muddy water, the 'mantle' of the oyster, which secretes the shell, is uniformly extended and produces a broad shell; in the muddier tidal water of the foreshore, the mantle is probably protruded mainly at the end of the shell and an elongated form results.

Photographs of micro-organisms (three bacteria and a phytoflagellate) from the Dead Sea, where the total salt concentration is 28–29 per cent, are submitted by Dr. B. Wilkansky.

Dr. John MacLeod records *Phormia terræ-novæ R.-D.* as a hitherto unsuspected agent in the causation of cutaneous myiasis (attack on the skin by larvæ of flies) in sheep in Scotland (western Argyll and Mull).

H. F. Walton and J. H. Wolfenden have measured the temperature variation of the electrolytic separation of the hydrogen isotopes at mercury and silver cathodes, and find that the separation coefficient at silver falls with rising temperature while that at mercury is almost unaltered. Addition of a catalyst poison lowers the separation coefficient considerably and alters the sign of its temperature coefficient.

A reduction in the values of the shifts in the Raman spectrum of thiophosphoryl chloride, $PSCl_3$, as compared with phosphorus oxychloride, $POCl_3$, is found by Prof. V. N. Thatte.

Research Items

Blood Group Investigation

RECENT advances in blood group investigation have been reviewed by Prof. R. Ruggles Gates as a contribution to a volume commemorating the work of Miss van Herwerd on blood groups and eugenics in Holland (*Genetica*, 18, 1936. Manuscript received for publication, May 29, 1935). All the evidence indicates that in man the blood groups are mutations forming the mechanism of species modification of the non-adaptive category. The distribution of the blood groups in the anthropoids, when compared with that in man, on the hypothesis that *O* is the primitive condition in man, suggests that the development of the blood groups in both must be regarded as a case of 'convergent evolution'. It seems probable that a particular race in man in a particular locality developed the ability to produce the *A* mutation with sufficient frequency for it to spread without the aid of selection, but through a change in the mutation rate, which would be either gradual or marked and decisive, probably the latter. Recent developments have strengthened the view that the *A* mutation is much older than *B*, of which the occurrence is so low in peripheral peoples as to suggest that it is due to interbreeding with adjacent peoples. This view increases the difficulty relating to the *O* character of the American Indians, unless it be held that they are derived from primitive peoples who were isolated on the chain of islands from Sakhalin to Formosa and the Philippines, while *A* and *B* were spreading on the mainland of Asia. The aboriginal tribes of Formosa are still strikingly high in *O*. The occurrence of a high percentage of *A* in a group of "Blackfeet" can only be accounted for as an independent island of *A* mutations; and the *B* of the Caraja Indians and the Yahgans of Tierra del Fuego must be accounted for in the same way. Recent investigations in Africa suggest the probability that there have been three independent centres of *B* mutation, namely, the African negro, the Hindu and the Mongolian.

Arminghall Timber Monument

THE prehistoric monument at Arminghall, near Norwich, discovered by aerial photography in 1929, and excavated by Dr. J. G. D. Clark immediately before the Norwich meeting of the British Association last year, proves, like "Woodhenge" in Wiltshire, excavated by Mrs. M. E. Cunnington, to have been a circle in which the place of stone uprights was taken by wooden posts. The character of the monument in detail, its purpose, dating, and affinities, have now been made the subject of close study by the excavator (*Proc. Prehist. Soc.*, N.S. 2, 1; 1936). The monument consists of two concentric ditches separated by a bank, and surrounding a central portion, in which had been erected eight wooden uprights in U-shaped formation, and approached by a causeway interrupting the inner ditch. In this central area there was no sign of disturbance, excepting the post-holes and the ramps, by means of which the posts had been erected. The size and depth of the post-holes and the size of the ramps indicate that the posts were of considerable height—oaks, as shown by the charcoal found in the holes, probably of about a hundred years old. The absence of any burial precluded the idea that the purpose of the monument was sepulchral. The primary material obtained from the inner ditch consisted of 107 flints of indeterminate age, and fragments of hand-made 'rusticated' pottery, that is, pottery decorated with pinches or jabs, of a type to which the specific name 'Arminghall' is here given. On archæological evidence, this pottery is shown to date the monument as belonging to the Beaker period, as do other 'henges' in Britain which so far have been satisfactorily dated. Two hypotheses as to the origin of this class of monument are current—one that they are derived from the palisade barrows of the Low Countries, the other that they are degenerate megalithic cairns; but at present there is no decisive argument in favour of either.

Coloration of Nest Linings and Nestlings

DR. JEAN M. LINSDALE has noted a correspondence between the colour and tint of the linings of birds' nests and of the down of the nestlings themselves, especially in the Great Basin of the western United States. Further, these are both correlated with the kind of cover at the nest side and with the general climatic ranges of the birds (*Condor*, 38, 111; 1936). Apparently these species of birds which nest in exposed situations and live in hot regions have pallid nestling plumages and nest linings which reflect and counteract the harmful effect of the sun's rays. Species which live in the opposite conditions have dark colours in down and nest, so that they are able to absorb and take advantage of the warmth of the sun's rays.

Habits of American Sunfishes

THE American sunfishes excavate nests in shallow places, usually on sandy shores, which are familiar objects in late spring and early summer. Mr. C. M. Breder in his paper "The Reproductive Habits of the North American Sunfishes (Family Centrarchidæ)" (*Zoologica*. Scientific Contributions of the New York Zoological Society. Part I, Nos. 1 and 2, 21, 1936) brings a large amount of material together with special reference to reproductive behaviour of these fishes, which is closely similar in all genera. The male constructs the nest and guards the eggs. The female is only concerned with their deposition, her behaviour being very characteristic as she approaches the nest when sex recognition takes place. The primitive forms make the most elaborate nests, and there is more parental care in these than in the higher forms, the nests of which are much simpler. Broadly speaking, the annual cycle of habit in the family shows an interesting series of items of behaviour largely controlled by temperature, and the position and form of the nest depend on a variety of purely physical factors in the environment which include temperature, sunshine, depth of water, rate of flow, nature of bottom and proximity of protecting objects. This is a very interesting study embracing much previous work as well as a great deal of first-hand information.

The Chordate Head

THE problem of the constitution of the head region in the Chordates is discussed in a fully illustrated article by de Lange (*J. Anat.*, July 1936) based upon three lectures delivered at King's College, London. The vertebrate embryo is regarded as consisting of two portions: a non-metameric part, the gut, splanchnopleura, ventral body wall, brain region and the anterior cephalic mesoderm, arising in a similar manner to the three-layered, unsegmented larva of the invertebrates; and a dorsal, more or less segmented portion, the episome, having no homologue in invertebrates. The episome is pushed in a caudal direction in the Urochordata, in an anterior direction in the Cephalochordata, and in the true vertebrates it penetrates into the posterior part of the head region. This superimposed, axial episome has arisen and become segmented in conjunction with the need for locomotor efficiency. The axial musculature spreads over the trunk and into the head region. The branchial mechanism is afterwards formed, but it is in no way dependent upon the original metamerism of the episoma. As the head constitutes a structure for the gathering of sense organs, for presenting a firm front to the resistance of the water during locomotion and as a base from which the undulatory locomotor movements can take origin, its episomatic constituents lose their segmental structure. Some evidences of it remain, however, in the histological and functional character of the musculature. The hypobranchial muscles retain the metameric character of the invading episomatic mesomeres and of their cranial nerves.

A New Type of Apospory in Ferns

MISSES I. ANDERSSON-KOTTÖ and A. E. Gairdner (*J. Genetics*, 32, No. 2), investigating the inheritance of apospory in the hart's tongue fern, describe a form known as *peculiar* which arose from spores of the variety *crispum muricatum*. This peculiar type of sporophyte only attains a height of 8 cm. and may bear twenty-five fronds at one time. There is a complete absence of sori, sporangia and spores, the fronds producing aposporous prothalli which bear sex organs and undergo fertilization. As there is no meiosis, the chromosome number increases from $n = 30$ (normal) to a maximum of about 110. Various lines of evidence indicate that the chromosome number is frequently diminished in some way at the formation of the sex organs, but no cytological indication has yet been found as to how this takes place. In crosses between peculiar and normal, the former type of life-cycle is shown to be controlled by a single recessive gene. Heterozygous sporophytes are thus normal in appearance, but they sometimes show a feature which is new in ferns, namely, sori containing some normal sporangia and others which produce spermatozoids. The heterozygotes thus show incomplete dominance as regards the time of sex differentiation, which takes place both in sporangia and in the gametophytes. The conclusion is reached that the sporangial stage in normals is represented by the sexual stage in peculiars, and that a reduction division is therefore attempted at the sexual stage in the peculiar. These results have a bearing on various questions of apogamy, apospory and life-cycles in plants.

Properties of Oak

No. 11 of *Research Records* (Timber Series No. 3) contains a pamphlet on "The Properties of Home-grown Oak" (London: H.M. Stationery Office, 1936). It is stated in the pamphlet that in the past there has been much difference of opinion as to the merits of the timber, and this is largely attributable to its properties varying considerably with the conditions under which the trees are grown. The writer of the pamphlet appears to consider that there is little difference between the timber of the pedunculate and sessile oaks. By the purely practical test of felling and conversion in the forest, many hold the opinion that the timber of the sessile oak is more easily workable than that of the pedunculate. During the Napoleonic Wars, the finer lines of the French ships captured and the more artistic nature of their fittings were attributed to their having been constructed of the sessile oak, whereas the English ships were most usually constructed of the pedunculate or robur oak, a more stubborn and rugged grower. The pamphlet deals with the general properties and structure of the wood, seasoning, mechanical properties, durability and working qualities. A comparison of home-grown oak and American oak is made, and insect and fungus pests are discussed.

Inheritance in Cotton

INHERITANCE of form and size play a large part in the improvement of commercial cottons. Dr. J. B. Hutchinson (*J. Genetics*, 32, No. 3) has summarized some of these results. He finds in Asiatic cottons a series of five multiple allelomorphs affecting leaf shape. Broad, laciniated and narrow leaf types occur in *Gossypium arboreum* in different crops, narrow leaf being absent from South India and rare in Burma; it occurs in Assam. Leaf shape is associated with corolla colour. Broad leaf is primitive, and two allelomorphic genes have arisen causing progressive narrowing of the leaf lobes. Both are widely distributed in the species, and in some circumstances one of them has a selective advantage over the broad. Another set of genes affects all foliar organs and not merely the leaves. The habit of the plants is determined by the length of the vegetative period, that is, the number of nodes on the main stem. This is followed by the formation of sympodia with a flower at every node. Wild cottons have a high primary node number, with late flowering. Interaction is indicated for various node number factors, some of which are linked with corolla colour and some with anthocyanin production.

Carolina 'Bays'

THE 'bays' of the Carolina coastal plain are great oval depressions, usually well-timbered, each of which is rimmed with a sand-ridge that is highest on the south-east side. Their peculiar and uniform shape, the prevalent orientation of their longest axes in a north-west to south-east direction, and the immense number of examples, suggested to Melton and Schriever that the bays had been caused by the fall of an immense shower of meteorites, during or possibly before the Pleistocene. In a recent issue of *Science*, Prof. D. Johnson has pointed out several objections to this hypothesis. The rims of the 'bays' are not composed of material thrown out of the bottoms by explosive impact, but consist of clean sand, such as might border a lake-beach. The major axes of some of the depressions follow a north to south direction, and at least a few trend from north-east to south-west. Such departures from the prevailing orientation are inconsistent with the meteoritic hypothesis. The area is underlain by thick beds of limestone in which caverns and sink-holes are common. Johnson considers that the 'bays' started as lakes in sink-hole basins; these afterwards drained, leaving their old beach-ridges where the prevailing winds had piled them. A book on the 'bays' from the pen of Prof. Johnson is in course of publication.

The British Earthquake of April 6, 1580

LITTLE has so far been known about this earthquake, one of the strongest ever felt in Great Britain, and in some ways not unlike the North Sea earthquake of June 7, 1931. Mr. R. E. Ockenden, however, has lately reprinted "Thomas Twyne's Discourse on the Earthquake of 1580" (Pp. 40+1 plate. Oxford: Pen-in-Hand Publishing Co., 1936. 5*s*.), the original of which is now very rare, though copies are to be found in the British Museum, Bodleian and Emmanuel College libraries. He has also given a most useful introduction and a bibliography of contemporary pamphlets and other works. From these, it appears that the earthquake was felt throughout the south-east of England, and so far at least as Oxford and Norwich, also in Flanders and the north-east of France. In Great Britain, several churches near the coast of Kent were damaged. Even in London, stones were shaken from St. Paul's Cathedral and the Temple Church, and an apprentice was killed by the fall of a stone from the roof of Christ's Hospital Church. Except perhaps at Calais, little damage to buildings occurred in France and Belgium. The sea was greatly disturbed, and it is probable, as Mr. Ockenden remarks, that the earthquake was of submarine origin, and that its epicentre was not far from the east coast of Kent.

Radio and the Sunspot Cycle

L. C. YOUNG and E. O. Hulburt (*Phys. Rev.*, 50, 45) have examined the correlation of radio transmission with sunspot activity over the years 1923–36. They find that the optimum radio-frequency for short-wave daylight transmission over a given long distance increases with the sunspot activity, and they derive a semi-empirical formula connecting these quantities. The correlation of the radio data with sunspot number is much better than with terrestrial magnetic activity or with the solar constant. The last fact suggests that the visible and infra-red radiation from the sun, on which the solar constant is based, does not vary in close accord with the ultra-violet radiation which ionizes the upper atmosphere.

Structure of Benzene

ALTHOUGH the essential correctness of Kekulé's hexagon formula for benzene, with alternate single and double linkages, has been established by intensive chemical and physical investigation since its enunciation in 1867, and crystal analysis has shown that the ring is very approximately a plane, yet there are several other alternative formulæ (Dewar, Claus, Ladenburg, Thiele, Baeyer). The quantum-mechanical treatment of the problem has been dealt with by Hückel (1931–32) and by Pauling and Wheland (1933). Certain difficulties, however, were encountered in the comparison of the results with those of lines of experimental investigation. One of the most important was the apparent discrepancy between theory and experiment in the comparison between infra-red and Raman spectra. In a series of eight papers (*J. Chem. Soc.*, 912–987; 1936), C. K. Ingold and several collaborators have re-examined the matter in the light of the results of long-wave spectroscopy, which includes a study particularly of the infra-red and Raman spectra and the vibrational structure of bands arising from electron transitions. An important extension of the experimental method consisted in the substitution of hydrogen by deuterium, which does not alter the electron wave functions, so that the effect on vibration frequencies arises solely from changes of mass. Most of the coincidences in frequency in the infra-red and Raman spectra are shown to be the result of using liquids, in which cohesive forces disturb the conditions of symmetry, and the conclusion is reached that there is no need to assume the absence of a centre of symmetry in the benzene and hexadeuterobenzene molecules. The D_{6h} model (plane regular hexagon) is supported, whilst the D_{3h} (Kekulé) model fails to show itself in any spectroscopic features, and there is no indication of the D_{3d} (puckered) model.

Automatic Control of Road Traffic

IN the *G.E.C. Journal* of August, F. A. Downes gives a brief exposition of the elements of traffic flow and the requirements of automatic mechanism for controlling traffic. In the United States, traffic engineers have recently formed an Engineering Institution to study traffic problems. In Great Britain, the problems are studied by the engineers of the Ministry of Transport and by the staff of engineering works manufacturing traffic control apparatus. Of these engineers, there is probably no one who devotes his whole time to a theoretical and mathematical study of the subject. The design of modern traffic integrators requires a special knowledge of the mathematics of probability, and much useful work is being done in this direction. Theoretically, the only limit to the amount of traffic that can be dealt with by a single lane of traffic is that set by the limiting speed of the vehicles. For given road friction, and for a given average brake-power, it can be shown that there is a clearly defined optimum speed at which the greatest amount of traffic will be passed in a single lane per hour. The generally accepted figures lie between 12 and 18 miles per hour. At the lower speed, vehicles have 15 feet headway, but at the higher speed of 18 m.p.h. a headway of so much as 30 feet may be required. An optimum speed of 15 m.p.h. is often given, but this refers to dry roads of average surface. Unless a non-skid road surface is provided, this figure may be considerably increased. At intersections the first essential is a means of indicating 'stop' and 'go'. Interesting suggestions are made for indicating how soon change-over of colour may be expected. The full green indication, for example, consists of three concentric luminous rings; when one third of the time of the green signal has elapsed there are only two rings visible, then after two thirds only one. Another device embodies a dial divided into two portions, one of which is painted red and the other green, the indication being given by a large hand travelling in the clockwise direction.

Hydrogenation of Coal: a French Process

THE hydrogenation of coal to produce liquid fuel is, as is known, a process now in technical operation. The French process as carried out at Béthune has been described by F. Vollette (*Bull. Soc. d'Encouragement pour l'Industrie Nationale*, 135, 353; 1936).

The coal and hydrogen must be brought into intimate contact by intense agitation, and the temperature must be increased progressively by passing the mixture through zones, sufficient time being allowed at 350° for pasty fusion and solution in the oil, and at higher temperatures up to 470° for the absorption of hydrogen. The apparatus consists of a bundle of long narrow tubes (*faisceau tubulaire*) united to one another by interior pipes like gas washing bottles, through which the hydrogen bubbles. The whole is heated in a cell of a coke furnace. The finely powdered coal is suspended in heavy oil and pumped at 200 kgm. pressure into the apparatus, where it meets a current of hydrogen from a compressor.

The volatile product, by cooling under pressure and removal of gas, is automatically divided into gas, heavy oil (at 300°) and light oil (atmospheric temperature). Very light petrol (5 per cent of the total light oil) is removed from the gas by adsorption on active carbon. Part of the gas is used for heating and part is mixed with the hydrogen. The heavy oil is used for the suspension of coal. The non-volatile product is partly hydrogenated with the heavy oil and partly carbonized to coke for making water-gas. The hydrogen is obtained from water-gas and steam and need not be pure: even coke-oven gas (50 per cent H_2) may be used.

The overall yield of light oil is given as 660 kgm. per metric ton of coal, and it contains 25–30 kgm. of phenol and cresols. Of this oil, 87·5 per cent distils below 300° and 27·5 per cent below 200°. The heavier fraction is further hydrogenated in the vapour phase under pressure in presence of a catalyst to give petrol, which is principally aromatic and hydro-aromatic. Lignite hydrogenates more easily than coal. From 660 kgm. of light oil, 460 kgm. of petrol are obtained, or 1 ton per 2·175 tons of coal. This requires 3,500 cu. m. of hydrogen, in making which 2·2 tons of coke are used. The steam used requires 1 ton of coal per ton of petrol and the electrical energy for compression of gas and works service consumes a further 2 tons of coal. Thus 7·375 tons of coal are used in making 1 ton of petrol, the calorific value of which is 20·75 per cent of the total fuel used.

Biology of *Tridacna* and its Relatives

THE largest bivalves in the world belong to the Tridacnidæ. They have always aroused much interest in conchologists although little was known of the living animals. Size is not the only distinction in the family, for Prof. C. M. Yonge[*] shows that they are unique among the Lamellibranchiata in the relation of the mantle and shell to the other organs, and in the universal presence of zooxanthellæ in the tissues. In his peculiarly interesting monograph, there is a large amount of new matter clearing up much that was puzzling in these gigantic molluscs, which are among the most conspicuous members of the fauna of coral reefs in the Indo-Pacific region. *Tridacna derasa*, the giant clam, may be 4½ ft. long: the largest lamellibranch ever evolved, and may weigh about 4 cwt. The largest specimens personally examined were a little more than 3 ft. in length, and were so heavy that the combined efforts of two men failed to raise them.

There are two groups in the Tridacnidæ, the smaller boring forms, living in coral rock, and the larger species lying free on the surface of the reefs. All these clams normally rest on the hinge side of the shell with the edges of the valves pointing upwards. The pedal aperture, when present, lies close to the umbo. Thus, "as a result of a turning movement in the longitudinal plane, the dorso-ventral relations of the visceral mass and associated organs, on the one hand, and of the mantle and shell on the other, have become . . . the exact opposite of those in other lamellibranchs". This has given rise to much controversy as to whether the visceral mass has moved relative to the shell or whether the mantle has moved relative to the visceral mass. Prof. Yonge is now in the position to prove that the latter supposition is correct, and in this he is in agreement with Lacaze-Duthiers.

It is, however, in the amazingly efficient partnership with the zooxanthellæ that these molluscs are of outstanding interest. On this depends the whole problem of feeding, structure and evolution. Immense numbers of these zooxanthellæ always occur in the Tridacnidæ, housed primarily in the blood cells of the inner lobes of the mantle edges on the dorsal side where they are fully exposed to the light. In *Tridacna* these lobes extend far over the free edges of the shell valves in life, exposing a broad sheet of highly pigmented tissue. In the allied *Hippopus*, where there are fewer zooxanthellæ, the mantle edges do not extend in this way, but the shell valves open to a greater extent. The zooxanthellæ are confined to the blood sinuses, and are invariably contained within amœboid blood cells. Conical protuberances on the mantle edge, carrying lens-like structures, hitherto regarded as eyes, are here shown to be means whereby the internal illumination of the mantle tissues is increased for the benefit of the zooxanthellæ. The phagocytes, carrying the zooxanthellæ from the mantle, surround the reduced diverticula and other regions of the gut and contain these algæ in all stages of digestion. *Tridacna*, and to a less extent *Hippopus*, consumes a number of these, so obtaining a significant amount of food.

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[*] British Museum (Natural History). Great Barrier Reef Expedition, 1928–29. Scientific Reports, Vol. 1, No. 11: Mode of Life, Feeding, Digestion and Symbiosis with Zooxanthellæ in the Tridacnidæ. By Prof. C. M. Yonge. Pp. 283–321+5 plates. (London: British Museum (Natural History), 1936.) 5*s*.

The mouth is small, there is no sorting mechanism in the stomach, and the selective action of the gills and palps is highly developed, particles 14 µ in diameter being rejected. Assimilation and intercellular digestion take place in the much-reduced digestive diverticula and also in the phagocytic blood cells which may pass through the lumen of the gut. Indigestible material remaining in the phagocytes is presumably carried to the kidneys, which explains the abnormal size of these and the presence within them of a great number of large concretions.

The Tridacnidæ are profoundly modified for the housing and final digestion of the zooxanthellæ, and *Tridacna* may be considered the supreme example of the exploitation of associated algæ by an animal, although unlike *Convoluta roscoffensis* it never loses the power of holozoic nutrition, and so only the surplus zooxanthellæ are consumed. Experiments failed to reveal any significant production of oxygen or removal of carbon dioxide by the zooxanthellæ in the light, but they automatically remove all phosphorus excreted by the animal and even the phosphorus present in the water around. This may be the limiting factor controlling their abundance.

In no case known where there is a partnership of algæ with an animal has it been so highly evolved as in *Tridacna*, resulting in the actual farming of the zooxanthellæ by the mollusc. Every stage in the evolution shows a step towards this end. In a *Cardium*-like ancestor, it is suggested that the zooxanthellæ first settled in the region of the siphons, having been taken in with the food and so ingested by wandering phagocytes. This partnership being of advantage to both alga and mollusc, but especially to the latter, the mollusc became so modified in structure that the largest possible surface might be exposed in which the algæ could dwell near the light, whilst with a larger consumption of these the ordinary digestive organs were more and more reduced, a very good combined method of feeding being the result, the boring forms having evolved after this adaptation of structure and functions. It is found that boring is entirely mechanical and that the byssus takes an essential part in this process.

Bacterial Epidemiology and Nutrition

A TEAM of statisticians and bacteriologists who for many years have been investigating experimentally the spread of epidemics of bacterial diseases caused by *Bacterium aertrycke* and *Pasteurella muriseptica* in herds of mice under controlled conditions, have now summarized the results of their published work with the addition of some new observations, including an account of epidemics of ectromelia, a virus disease of mice[1].

To the epidemiologist the work is of great interest and value, and many important conclusions emerge from it. It is found that the average resistance of surviving mice increases with survival in a herd, but never becomes absolute, and in the long run the great majority eventually succumb to the reigning disease, nor will the disease ever normally die out provided the herd does not become too small. The increased average resistance displayed by surviving mice is attributed to natural immunization.

It is considered proved that artificial immunization does confer a high degree of resistance, being more effective in a virus condition like ectromelia than in a bacterial disease like mouse typhoid. Experiments on the influence of 'bacteriophage' on mouse typhoid yielded entirely negative results. It is considered that a major importance may be attached in the genesis of epidemics to the evolution or importation of 'epidemic strains' of particular bacteria or viruses, and that association of two infecting agents may play a part in determining the character of an epidemic.

It seems to be clear that the amelioration or disappearance of an endemic or epidemic infection is more often the result of a summation of effects, many of them unidentifiable, than of any single known factor.

Mr. Knight has recently brought together in convenient form the available information respecting bacterial nutrition[2]. Knowledge of the conditions favouring or inhibiting bacterial development is of importance in bacteriological technique and in the study and control of infective diseases and morbid states, as well as indicating relationships which suggest the possible evolutionary scheme of the bacteria, particularly as it relates to parasitism.

The report is divided into three parts, of which the first and longest gives a systematic survey of the known facts, and summarizes the chemistry of bacterial metabolism and the nutritional requirements of bacteria. In the second part, these nutritional observations are co-ordinated, a brief attempt is made to develop an evolutionary scheme, and the parallelism between nutrient requirements and the development of pathogenic properties and parasitism is illustrated. In the final part, methods are described by which bacteria may be 'trained' and 'adapted' to a simpler mode of life, and the mechanism of nutritional variation is discussed.

There is much in Mr. Knight's report of interest to the general bacteriologist, such as his critical review of the gaseous requirements of bacteria, the various methods that may be employed for the study of bacterial metabolism, and the differentiation of essential from accessory food substances in relation to bacterial growth.

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[1] Medical Research Council. Special Report Series, No. 209: Experimental Epidemiology. By Dr. M. Greenwood, Dr. A. Bradford Hill, Dr. W. W. C. Topley and J. Wilson. Pp. 204. (London: H.M. Stationery Office, 1936.) 3*s*. 6*d*. net.

[2] Medical Research Council. Special Report Series, No. 210: Bacterial Nutrition; Material for a Comparative Physiology of Bacteria. By B. C. J. G. Knight. Pp. 182. (London: H.M. Stationery Office, 1936.) 3*s*. net.

German Chemists at Munich

NEARLY three thousand delegates representing thirteen different German societies took part in a national congress of German chemists held at Munich on July 7–11. Prof. P. Duden of Frankfort presided at the general meeting, which was welcomed by Staatsminister Herr Adolph Wagner. Dr. O. Nicodemus of Frankfort delivered an address on the development of the chemistry of acetylene and its national importance as a source of raw materials. From acetylene many derivatives of the vinyl group can be made, which can be developed by polymerization to a great variety of valuable synthetic products. Amongst these may be mentioned the unsaturated hydrocarbons isoprene and butadiene, from which synthetic rubber is made, and a chlorinated derivative, chloroprene, which polymerizes seven hundred times as fast as isoprene and gives rise to an oil-proof synthetic rubber. By varying the conditions of polymerization, it is possible to plan the synthesis of products possessing specified physical properties, so that the range of application of these products is increasing rapidly.

Prof. Noack of Berlin then addressed the meeting upon the chemistry and physiology of plant structures. Afterwards the Congress broke up into twenty sections, which met for the discussion of special subjects, full reports of which will be found in the August number of *Angewandte Chemie*.

Although the main interest of the Congress was in applied chemistry, we find that one section was devoted to the history of chemistry, and a proposal was made to undertake the complete documentation and collection of publications (or copies) relating thereto. In a paper by Dr. Theis of Mannheim, the discovery of catalytic activity was credited to Döbereiner, who described in 1823 the ignition of hydrogen at atmospheric temperatures in the presence of spongy platinum.

Reference can only be made here to a few of the subjects discussed during the sectional meetings. Prof. Hedvall of Göteborg and Prof. Jander of Frankfort discussed reactions between substances in the solid state, Prof. W. Kuhn of Karlsruhe the properties of thread-molecules in solution and Prof. Staudinger of Freiburg the chemistry of macromolecules. Dr. Bredereck of Leipzig described his work on the constitution of the nucleic acids and Dr. Seidel of Munich his synthesis of urobilin. In the sections on applied chemistry will be found numerous papers dealing with fuel-oils, colours, paints, dyes, foodstuffs, building materials, leather, photographic materials, agricultural chemistry and many other subjects.

A whole section has been devoted to the consideration of the rapidly increasing number of *Kunststoffe* or artificial products. Among those of practical importance we may mention the 'organic' glass of Dr. O. Röhm. This substance, which is free from silicates, is derived from α-methylacrylic acid. Esters of the acid are colourless liquids, which polymerize, under somewhat difficult conditions, to vitreous solids, possessing a very high degree of transparency and a low coefficient of expansion. These glasses can be bent and moulded into shape at high temperatures and can be used for making windows for motor-cars and aeroplanes. They can also be used for optical purposes and for the manufacture of apparatus, such as filter-presses.

Another artificial product of first-rate importance is the substance trolitul, formed by polymerization of the hydrocarbon styrene, which is distinguished from most other artificial resins by reason of its excellent insulating properties, resistance to wear and impermeability to water. Thus it can be moulded into insulators and is suitable for employment even where high frequencies are used. The growing use of artificial products in industry has given new interest to the scientific study of complex polymers.

Science News a Century Ago

Schönbein and Faraday

IN 1836, the long and interesting series of letters began between Schönbein and Faraday which extended over twenty-six years and was afterwards published with notes and comments by G. W. A. Kahlbaum and F. V. Darbishire. The first two letters were from Schönbein, who was then professor of physics and chemistry at Basle. The first was dated May 17 and the second September 12, 1836. Both dealt with experiments on the action of nitric acid on iron and the protective influence of a film of oxide of iron. The most curious thing Schönbein said he had observed was that iron wire could be made indifferent to nitric acid. Previous to this second letter, Faraday had communicated an account of Schönbein's investigations to the *Philosophical Magazine*, and in his letter of September 12 Schönbein wrote: "I feel much obliged to you for the kind manner in which you mentioned my late researches on iron in the philosophical Magazine. It is this kindness which encourages me to address to you a second letter on the same subject".

Worcestershire Natural History Society

UNDER the above heading, the *Analyst*, 5, 160 (1836), records: "The ceremony of opening the museum of this Society took place on the 13th of September; on which occasion upwards of eight hundred persons attended, including a large proportion of the inhabitants of the county and city distinguished for their literary and scientific attainments. The Bishop of Worcester entered the room about twelve o'clock accompanied by the members of the council and at the request of the Hon. and Rev. J. S. Cocks took the chair". His lordship in a short speech congratulated the members of the Society upon the completion of the building and then called upon Dr. Hastings to deliver the inaugural address, "which was listened to with marked attention, and frequently elicited very considerable applause". About a hundred members and friends afterwards dined together, some admirable speeches were made and it was gratifying, said the *Analyst*, "to observe the interest which the prosperity of the Society appeared to excite".

De la Rue on Voltaic Electricity

THE first scientific paper of Warren De la Rue (1815–89) was a communication to the editor of the *Philosophical Magazine* dated September 15, 1836, and entitled "On Voltaic Electricity, and on the Effects of a Battery charged with Sulphate of Copper". "The greatest effect," the author said, "being always produced in those voltaic arrangements where the chemical agent exerted an action on only one of the metals constituting the battery, it occurred to me to use a saturated and perfectly neutral solution of the electro-negative metal, provided the other was capable of effecting its decomposition. I therefore tried the effect of a saturated solution of sulphate of copper in an elementary voltaic battery of the ordinary construction". After describing various experiments with his battery, he said, "It is worthy of notice, that after the batteries have been in action some time, a large proportion of the sulphate of copper is expended, and replaced by sulphate of zinc, *yet the action continues the same*. This naturally suggests using a saturated solution of any neutral salt, common salt, for example, and adding merely as much as the solution of copper as will serve for the time required. . . . I intend trying this, as I am still pursuing my inquiries on this subject, the object of which is to simplify as much as possible the voltaic battery. . . ."

Death of Antoine-Laurent de Jussieu

On September 17, 1836, the celebrated French botanist, Antoine-Laurent de Jussieu, died in Paris at the age of eighty-eight years. The nephew of the three brothers Antoine, Bernard and Joseph de Jussieu, who all contributed to botanical science, Antoine-Laurent was born at Lyons on April 17, 1748. On leaving school at the age of seventeen years, he joined his uncle Bernard de Jussieu (1699–1777) who was then a demonstrator at the Jardin du Roi in Paris, and after taking a degree in medicine became an assistant in the same institution. The collection of plants at that time was arranged according to the system of Tournefort. It becoming necessary to rearrange them, Jussieu adopted a new system suggested by what his uncle had done at Trianon, and from this grew the natural system described by Jussieu in his book "Genera Plantarum" published in 1789, the year in which the Revolution broke out.

As with so many other men of science, Jussieu for a time found his labours interrupted by the political upheaval, and in 1790 he became a member of the municipality of Paris, of which Bailly was Mayor, and was charged with the direction of the hospitals and charities of the city. In 1793, when the Jacobins came into power, the Jardin du Roi was reorganized as the Jardin des Plantes and Muséum d'Histoire naturelle, and Jussieu was made professor of rural botany. His colleagues included Lamarck, Daubenton, Saint-Hilaire, Fourcroy and Brongniart. He afterwards became director and treasurer of the museum and a professor in the faculty of medicine. In 1822 he severed his connexion with the school of medicine and four years later resigned his chair at the Jardin des Plantes, and was succeeded by his son, Adrien de Jussieu (1797–1853).

The natural system of classification of plants introduced by Jussieu was not appreciated at first as it ought to have been, and it was not until the writings of Robert Brown (1773–1858) that it made any headway in Great Britain. Besides his "Genera Plantarum" Jussieu wrote many memoirs, in 1796 published his "Tableau synoptique de la méthode botanique" and in 1800 his "Tableau de l'école de botanique du Jardin des Plantes". A statue of him now stands in the vestibule of the botanical gallery of the gardens. His son, who also was director of the museum, died leaving no male heirs, and the family, which for a century had been an ornament of science in Paris, became extinct.

Societies and Academies

Paris

Academy of Sciences, July 20 (*C.R.*, 203, 217–288).

LUCIEN CAYEUX: The coproliths of the North African phosphates. These coproliths consist of calcium phosphate, almost entirely free from organic or mineral inclusions.

LOUIS BLARINGHEM: The temperature of the spadices of *Arum italicum*. The temperatures are higher than the surrounding air: possible reasons for this are discussed.

LOUIS BOUVIER: Observations from the crayfish on the constitution of the side of the body-wall in the Crustacea.

ALEXANDRE GUILLIERMOND and MLLE. N. CHOUCROUN: An attempt at electrophoresis in the interior of plant cells.

MENDEL HAIMOVICI: Integral geometry on curved surfaces.

NORBERT WIENER and SZOLEM MANDELBROJT: Lacunar Fourier series. Inverse theorems.

JEAN MANDEL: The crumpling of a tube in a resistant elastic medium.

ALBERT PORTEVIN and LÉON GUILLET, JUN.: The elastic modulus of certain definite intermetallic compounds. Of the six compounds studied, CuZn, Ag_3Sb and $MgZn_2$ obey the rule of mixtures, the others, $Cu_{31}Sn_8$, Cu_9Al_4 and $CuZn_3$ give elastic moduli 20–40 per cent higher than those calculated from the mixture rule.

CHOONG SHIN-PIAW: New systems of bands of selenious anhydride, SeO_2, of selenium, Se_2, and of tellurium, Te_2, in the ultra-violet.

NY TSI-ZE and CH'EN SHANG-YI: The displacements of the higher members of the principal series of rubidium by the rare gases. Study of the displacement of the lines of the spectrum of rubidium by helium (up to 12·75 atmospheres), neon (up to 13·59 atmospheres) and argon (up to 7·12 atmospheres).

ANDRÉ LALLEMAND: The application of electronic optics to photography.

JEAN REBOUL: A possible correlation between the intensity of the cosmic radiation and the velocity of certain chemical reactions.

PIERRE AUGER and MME. GRIVET-MEYER: Analysis of cosmic ray bundles by utilization of their divergence.

RENÉ DUBRISAY and JACQUES LEFOL: Study of the saline hydrates. The salt and a direct reading balance are placed under a bell-jar over a hygroscopic substance under reduced pressure, and the loss of weight studied as a function of the time. With crystallized copper sulphate over phosphoric anhydride, the curve of loss shows a sharp angle at $5H_2O$, and after ten days the weight is constant at $1H_2O$. Over dilute sulphuric acid (pressure of water vapour 0·85 mm.), $CuSO_4,3H_2O$ is the final product.

RENÉ DALMON: Heats of mixture of sulphuric and nitric acids free from water.

MLLE. VALÉRIE DEUTSCH: The adsorption of proteins. The serum albumen of the horse.

E. RINCK: Diagram of solidification and electrical conductivity of the potassium-cæsium alloys.

HENRI MOUREU, MICHEL MAGAT and GEORGES WETROFF: The two forms of phosphorus pentachloride. From a study of the melting and solidification curves of phosphorus pentachloride there would appear to be a modification in the molecular structure. This is in agreement with the results of the study of the Raman spectrum: the latter shows that dissociation into phosphorus trichloride and chlorine does not take place under the conditions of the experiment.

J. JARROUSSE: Oxidation of diphenylpyruvic acid.

RAYMOND QUELET and MAURICE ANGLADE: The synthesis of 1-methoxy-2,4-dimethylolbenzene and of some of its derivatives.

ANDRÉ MEYER and PAUL HEIMANN: The products of halogenation and of oxidation of 2,4-dihydroxyquinoline.

PIERRE CHATELAIN: The geometrical and optical study of the crystals of *p*-azoxyphenetol.

EDMOND ROTHÉ and MME. ARLETTE HÉE: Study of a zone of contact of granite-gneiss by the observation of penetrating rays.

HENRI JEAN MARESQUELLE and RAYMOND SCHNELL: Experimental study of the phases of cecidogenic action in a gall.

MME. SIMONE BELLUC, JULES CHAUSSIN, JEAN COTTET, HENRI LAUGIER and MME. THÉRÈSE RANSON: Urinary yield, total molecular diuresis and diuresis of the elaborated molecules.

NICOLAS BEZSSONOFF and MME. MÉLANIE WOLOSZYN: The reversible oxidation of vitamin C present in a biological medium or in pure solution.

ACHILLE URBAIN and R. CAHEN: The amount of protein compounds in the serum of some ungulates.

A. and R. SARTORY, J. MEYER and MLLE. M. J. MERGLEN: Thermostable activating factors of cryptogamic origin favouring the growth of bacteria.

JEAN LAIGRET and ROGER DURAND: Virus isolated from mice and refound in man in the course of vaccination against yellow fever.

ANDRÉ BOIVIN: The comparative behaviour of the endotoxins and exotoxins towards trichloracetic acid.

BARUCH SAMUEL LEVIN and IWO LOMINSKI: Attenuation of the virus of bird plague by X-rays.

Moscow

Academy of Sciences (*C.R.*, 2, No. 3, 1936).

N. KOSHLIAKOV: Integral for the square of Riemann's function.

S. U. UMAROV: The Brownian movement of a supported girder and the transverse vibrations of bridges.

S. A. ARCYBYSHEV, M. N. BOGOMOLOVA, N. V. BORISOV and I. CH. REPSHE: Penetration of copper and gold ions into transparent crystals of sodium and potassium chloride.

V. ANTONOV-ROMANOVSKIJ: Direct proof of the bimolecular scheme of the luminosity of zinc phosphate.

V. RASUMOVSKIJ: Intensity of the valence and the structure of molecules.

J. G. RYSS and N. P. BAKINA: Complex fluorides (2). Hydrolysis of boro-fluoride ions.

I. I. CHERNIAJEFF and A. M. RUBINSTEIN: Interaction of pyridine with the chloride and the bromide of blomstrand salt.

K. V. KOSIKOV: The influence of the age and sex of the germ cells on the frequency of mutations in *Drosophila simulans*.

N. I. SHAPIRO: Is there germ cell selection in *Drosophila melanogaster*?

P. O. VELTISHCHEV: The plant mites (*Tyroglyphidæ*, Acari) as the main cause of failure of root-caoutchuc plants in Transcaucasia.

P. S. CHANTURISHVILI: Experiments in changes of sexual cycle in certain tail-less Amphibia.

Sydney

Royal Society of New South Wales, July 1.

D. P. MELLOR and F. M. QUODLING: Optical properties and crystal structure of some compounds of the type R_xMX_4. The marked double refraction of many compounds of the type R_xMX_4 where M = Pt, Pd, Ni or Au, is attributed to the existence of strongly anisotropic square co-ordinated ions. As yet, the structure of relatively few of these compounds have been analysed, but where this has been carried out the crystal optics agree qualitatively with those to be expected from the structures proposed.

Tokyo

Imperial Academy, June 12 (*Proc.*, 12, 147–177).

T. KAWATA: Regular analytic functions in the half plane.

A. KAWAGUCHI: (1) Some intrinsic derivations in a generalized space. (2) Certain identities in a generalized space.

H. HOMBU: (1) Invariant theory of the integral $\int F(x, y, y', y'', y''')dx$. (2) Geometry of the integral $\int(Ly''' + M)dx$.

N. WATANABE and M. IMAIZUMI: Possibility of measuring a distance of 500 m. in terms of the wave-length of light.

T. KUME: Saturation of non-volatile substances in aqueous solution.

H. YABE and M. EGUCHI: Deep-water corals from off Owasi, Mie Prefecture.

Y. INAI: *Discosiphonella*, a new ally of *Amblysiphonella*.

S. ENDÔ: New fossil species of *Sequoia* from the Far East.

T. KOBAYASHI: Proparian genus of the Olenidæ, and its bearing on Trilobite classification.

Vienna

Academy of Sciences, June 18.

JOSEF SCHINTLMEISTER: Origin of α-rays of 2 cm. range. The α-rays of this range, which have been found by several authors, do not come from any known element with atomic number greater than 44; they are probably due to element 61.

H. MARK and G. SAITO: Fractionation of highly polymerized substances by colorimetric adsorption analysis (1).

H. DOSTAL and R. RAFF: Mechanism of polycondensation reactions.

E. BARONI and W. KLEINAU: Nitration of phenols in chloroform.

O. BRUNNER and W. KLEINAU: The material forming the retina (3).

O. BRUNNER and E. BARONI: The material forming the retina (4).

Forthcoming Events

British Association for the Advancement of Science (Blackpool Meeting)

Monday, September 14

At 10 a.m.—Prof. H. L. Hawkins: "Palæontology and Humanity" (Presidential Address to, Section C).

Prof. J. Hendrick: "Soil Science in the Twentieth Century" (Presidential Address to Section M, followed by discussion).

Dr. T. E. Allibone, Dr. G. W. C. Kaye, Prof. W. M. Thornton, R. Davis, Dr. S. Whitehead, C. W. Marshall: "Production and Technical Application of High Voltages" (Discussion: Section A).

Dr. D. A. Allen, Prof. W. J. Dakin, Dr. A. C. Stephen, J. A. S. Stendall: "Function of the Museum in Zoology" (Discussion: Section D).

At 10.45 a.m.—Dr. Ll. Wynn Jones, Prof. H. R. Hamley, W. A. F. Hepburn, Prof. J. Drever: "The Reform of the Examination System" (Discussion: Section J).

At 2.15 p.m.—W. Hammett, Dr. A. W. Greenwood, E. T. Halman, Dr. E. L. Taylor, A. J. Macdonald, J. Wilson, Dr. A. L. Romanoff: "Poultry Industry" (Joint Discussion: Sections D and M).

At 2.30 p.m.—E. H. Fryer: "Traffic Safety" (Discussion: Section G).

At 7.30 p.m.—P. A. Francis: "Applications of Science to Poultry Farming" (Public Lecture at Poulton-le-Fylde).

Tuesday, September 15

At 10 a.m.—Sir Frank Smith, Dr. L. J. Harris, Dr. L. H. Lampitt, Dr. F. Kidd, T. Herbert, Prof. H. A. Denham, Dr. A. J. Smith: "Chemistry and Food Science" (Discussion: Section B).

The Right Hon. Lord Horder, Dr. R. D. Gillespie, Dr. E. P. Poulton, E. M. Killick: "The Strain of Modern Civilisation" (Discussion: Section I).

At 7.30.—Prof. C. M. Yonge: "Common Shore Animals" (Popular Lecture at Fleetwood).

Prof. D. Fraser-Harris: "Joy in Scientific Discovery" (Public Lecture at Thornton Cleveleys).

At 8.15.—Capt. F. Kingdon Ward: "Plant-Hunting in Tibet" (Evening Discourse).

Wednesday, September 16

At 8 p.m.—Prof. Allan Ferguson: "Splashes and what they teach" (Public Lecture at Preston).

Royal Meteorological Society, Wednesday, September 16, at 8.15—(in the Lecture Hall of the Royal Society of Edinburgh, 22 George Street, Edinburgh)

Prof. F. Linke: "Moving Cloud Pictures"

R. H. Weightman: "Stratosphere Flight in America".

Institute of Metals, September 14–18.—Annual Autumn Meeting to be held in Paris.

September 14, at 8.—Prof. P. A. J. Chevenard: "The Scientific Organization of Factories" (Autumn Lecture).

Association of Special Libraries and Information Bureaux, September 18–21.—Annual Conference to be held in Balliol College, Oxford.

September 18, at 8.30 p.m.—Dr. Cyril Norwood: "The Library in the School" (Presidential Address).

September 19, at 9.30 a.m.—Symposium on "Library Instruction for University and Research Students in America".

September 19, at 11.30 a.m.—W. H. Johnston: "The Collection of Information for the Commercial Pages of a Great Daily Newspaper".

September 19, at 2.30.—Colonel L. Newcombe: "Union Catalogues, National and Regional. Their Preparation and Utilization".

September 19, at 8.30 p.m.—Prof. A. M. Carr-Saunders: "The Need for the Centralization of Information on Social and Economic Surveys".

September 20, at 9.30 a.m.—B. M. Headicar: "Government Publications, British and Foreign. Their Collection, Classification and Utilization".

September 20, at 11.30 a.m.—Dr. J. Edwin Holmstrom: "A System for Card-indexing Abstracts and Research Data, with Instantaneous Cross Reference".

September 20, at 8.30 p.m.—J. Grierson: "The Film in Industry: the Development of the Documentary Film and its Growing Use in Research and Advertising".

Official Publications Received

Great Britain and Ireland

Norman Lockyer Observatory. Director's Annual Report, April 1, 1935–March 31, 1936. Pp. 6. Council's Report and Accounts, and List of Council, Staff, Members, etc. Pp. 10. (Sidmouth: Norman Lockyer Observatory.) [178

The Manchester Museum. Museum Publication 109 (Notes from the Manchester Museum, No. 36): New Greek Antiquities in the Manchester Museum. By Prof. T B. L. Webster. Pp. 8+3 plates. 6*d*. Museum Publication 110 (Notes from the Manchester Museum, No. 37): Decorated Textiles from Yunnan (in the Museum) collected by Augustine Henry, 1896–98. By Laura E. Start and Mabel C. Wright. Pp. 26. 6*d*. Museum Publication 111 (Notes from the Manchester Museum, No. 38): Contributions to the Archæology of the Manchester Region. By Dr. J. W. Jackson. Pp. 10+2 plates. 6*d*. (Manchester: Manchester Museum.) [178

Rubber Growers' Association. Rubber and Agriculture Series, Bulletin No. 3: Rubber for Roadless Tractors and Trailers. By Alexander Hay. Pp. 14. (London: Rubber Growers' Association.) [218

Leeds University: Department of Pathology and Bacteriology. Annual Report, by Prof. Matthew J. Stewart and Prof. J. W. McLeod, with Abstract Report on Experimental Pathology and Cancer Research, by Prof. R. D. Passey. Pp. 16. (Leeds: The University.) [228

Other Countries

Conference of Governors of British East African Territories: Research Conferences. Conference on Co-ordination of Tsetse and Trypanosomiasis (Animal and Human) Research in East Africa, held at Entebbe, 29th to 31st January 1936. Pp. 87. (Nairobi: Government Printer.) [188

Polska Akademja Umiejętności. Starunia, Nr. 8: Pleistoceńskie jezioro pod Jasłem (Pleistocene Lake near Jasło in Poland). By Władysław Szafer and Bronisław Jaroń. Pp 20. 1 zł. Starunia, Nr. 9: Interglacjał w Samostrzelnikach pod Grodnem (Interglacial in Samostrzelniki bei Grodno in Polen). By Jan Trela. Pp. 8. 1 zł. (Kraków: Nakładem Polskiej Akademji Umiejętności.) [188

Republique Polonaise: Institut National Météorologique. Tables crépusculaires: donnant l'altitude au zénith des rayons rasants du soleil pour toutes les latitudes de degré en degré. Par Jean Lugeon. Pp. xxxix+438. (Varsovie: Państwowy Instytut Meteorologiczny.) 25 zł. [188

Nigeria. Annual Report on the Geological Survey Department, 1935. Pp. ii+27. (Lagos: Government Printer; London: Crown Agents for the Colonies.) 2*s*. 6*d*. [208

Survey of India. Geodetic Report, 1935. Pp. v+101+20 plates (Dehra Dun: Survey of India) 3 rupees; 5*s*. 3*d*. [248

Review of Agricultural Operations in India, 1931–32 and 1932–33. Pp. vi+408. (Delhi: Manager of Publications.) 5.12 rupees; 9*s*. 6*d*. [248

Trinidad and Tobago: Forest Department. Administration Report of the Conservator of Forests for the Year 1935. Pp. 18. (Trinidad. Government Printer.) 16 cents. [248

Fiskeridirektoratets Skrifter. Serie Havundersøkelser, Vol. 5, No. 1: Sydøstgrønland Jan Mayen; Fiskeriundersøkelser. Av Thor Iversen. Pp. 171+8 plates. (Bergen: A.s. John Griegs Boktrykkeri) [248

Union of South Africa. Report of the Research Grant Board, 1918–1935. Pp. 35. (Pretoria. Government Printer.) 1*s*. 6*d*. [258

Colony and Protectorate of Kenya: Forest Department. Annual Report for the Year ended December 31, 1935. Pp. 40. (Nairobi. Government Printer; London. Crown Agents for the Colonies.) 1*s*. [278

Canada: Department of Mines: Mines Branch. The Canadian Mineral Industry in 1935. (No. 773) Pp. iv+100. (Ottawa: King's Printer.) 25 cents. [278

South Australia: Department of Mines. Mining Review for the Half-Year ended December 31, 1935. (No. 63.) Pp. 87+5 plates. (Adelaide: Government Printer.) [278

Catalogues

Kodak X-ray Manual. Pp. 56. (London: Kodak, Ltd.)

Cressall Field Discharge "Shunt-Break" Switch-Fuses (for D.C. Inductive Circuits). (List No. 61.) Pp. 4. (Birmingham: The Cressall Manufacturing Co., Ltd.)

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Science and Culture

THE part played by science in modern life, and the greater part it should play, are themes that offer appetizing food for thought to those engaged in scientific pursuits; but most laymen "look up and are fed not", regarding science as something abstruse and esoteric, and remaining content to enjoy its benefits without inquiring into their past or future. All devotees of science will therefore welcome the renewed efforts which the British Association is making to bring home to the public the nature and magnitude of the services rendered by science to the community, and the ways in which science enters into, and maybe colours, their daily life.

The most obvious effects of science upon man are the directly material: food, clothing, shelter, and so on. Less obvious are its effects upon social and economic conditions, due largely to developments in the use of steam, water, electricity and mineral oil as sources of power. The least obvious influence of science upon man is the way in which it has revolutionized his general intellectual outlook (*Weltanschauung*). It is to this last aspect that we would here direct attention, our reflections thereon having been prompted by the address with which Sir Richard Gregory opened the discussion on "Cultural and Social Values of Science" at the Blackpool meeting of the British Association.

One of the handicaps under which the man of science labours in communicating his thoughts to the outside world is the necessity for using abstract terms that defy precise definition. He may use far too many of them, but he must use some; so to avoid misunderstanding and confusion of thought, it is always desirable to start with a preliminary explanation of the meaning of the chief abstract terms he intends to employ. The word 'science', for example, is used very loosely in everyday life: to some it signifies a kind of magic—sometimes 'black' magic; to the schoolboy it is 'stinks' or 'bugs'; to many educated people it is an esoteric and recondite activity that touches human life but fleetingly and tangentially; the journalist uses it in describing boxing, cricket and other pastimes, and the advertiser in any way that helps to sell his wares.

For most people, probably the best definition of a science is 'a body of accurate knowledge', obtained by observation, often under experimental conditions, and sound reasoning. It would be going too far to elaborate this definition by discussing experimental technique, the nature of theories and hypotheses, and the kinds of reasoning, inductive and deductive, used by the research worker; but in any event effort should be made to disabuse the mind that science is a dull, lifeless thing, and that scientific workers are merely highly organized automata. Success in scientific inquiry, it might be pointed out, implies the possession of some of the higher human qualities, such as courage to look facts squarely in the face and to accept conclusions even when they are unpleasant or subversive of established practice and belief; patience; a disciplined imagination; an open mind and a critical outlook; and, perhaps the greatest of all, the artist's sense of striving for perfection.

Culture resembles science in having its roots in accurate knowledge and in critical thought. It is, however, more than knowledge or learning (a small amount of learning is compatible with a high degree of culture), because in concentrating on "the *best* that has been thought and known in the world", it becomes essentially a study of perfection. Culture has therefore close affinities to science, art and ethics. Matthew Arnold, the nineteenth-century apostle of culture, took the view that the pre-eminent part of culture is not "the scientific passion, the sheer desire, to see things as they are", but such ethical elements as love for one's neighbour, beneficence, the desire to remove human error, confusion and misery, and the noble aspiration to leave the world better and happier than we found it.

The distinguishing feature of science would thus appear to be accurate knowledge, and that of culture to be taste, judgment or discrimination between the true and the false, the good and the bad, the beautiful and the ugly. Were Matthew Arnold living to-day, he would readily acknowledge the benefits that science has conferred on humanity in the directions he indicated. Has it not exposed many causes of human error and dissipated confusion of thought ? Has it not done wonders in preventing, alleviating and curing physical pain ? Has it not provided man with the physical means towards a fuller and richer life ? If science has not made man ethically better, that is not the fault of science, for it may be claimed that the golden rule of conduct—consideration for others—which is the foundation of morality and the non-material basis of happiness in communal life, is a valid scientific deduction from the data of experience. Emotion being a more potent factor in conduct than knowledge (*Pour faire quelque chose de grand il faut être passionné*), the contributions of science to "the good life" may compare unfavourably with those of art and religion, but it will be agreed that no conduct can in effect be good unless it conforms with the dictates of reason.

The influence of science upon the development of man, both as an individual and as a member of society, is apt to be overlooked by the historian. The pioneers of natural science, like Copernicus, Galileo, Bacon, Descartes and Darwin, by overthrowing the geocentric and anthropocentric doctrines of their times, and by establishing belief in the constancy of the order of Nature, freed the human mind from the fetters of dogma and unreasoning faith, and opened up possibilities of knowledge and attainment that we are now only beginning to realize and explore.

The services of these men, and of many others who have contributed to our knowledge of the universe and to the liberation of human thought, should be taught and discussed in our schools, and, generally, our educational curricula should be re-oriented in the direction of greater concentration upon the best that has been thought, known *and done* in the world, irrespective of time and geographical location. Our teachers need to be men and women of higher culture, seeking to emulate the great men of culture, who, as Matthew Arnold said, "have had a passion for diffusing, for making prevail, for carrying from one end of society to the other, the best knowledge, the best ideas of their time ; who have laboured to divest knowledge of all that was harsh, uncouth, difficult, abstract, professional, exclusive : to humanize it, to make it efficient outside the clique of the cultivated and learned, yet still remaining the *best* knowledge and thought of the time, and a true source, therefore, of sweetness and light".

The question arises, therefore, whether bodies like the British Association and the Royal Society cannot, in conformity with their statutes, tread the path of the diffusion of natural knowledge with greater vigour than heretofore. Neither body issues a publication which really hits the educational bull's-eye. The Association, it is true, enjoys what is called 'a good Press', but unfortunately that Press, in pursuit of commercial aims, largely selects matter that is calculated to create a sensation, and which seldom leaves a lasting impression.

We therefore suggest that the Council of the Association be urged to consider the advisability of publishing on its own account a special volume, to be available at a low price, containing those addresses, lectures, papers and discussions, or parts of them, which have a direct bearing upon the life of the community, and including descriptions of discoveries and inventions, new light on old truths, economic and social problems, and contributions to higher thought. Authors could be advised in advance that their contributions were ear-marked for dissemination among the public, and that therefore they should be written so far as possible in non-academic language, with a non-academic approach, and with the express object of arousing interest in and appreciation of the social and cultural implications of scientific research among those who are still largely ignorant of or indifferent to it. The first quinquennial review of the progress of science, prepared for the Association by a number of authors, and shortly to be published, though not entirely of this character, should be of great service in extending interest in scientific knowledge and achievement. Our hope for the future lies in enlightened education of this kind.

Petrology and Movements of Snow Deposits

Snow Structure and Ski Fields: being an Account of Snow and Ice Forms met with in Nature and a study on Avalanches and Snowcraft. By G. Seligman; with an Appendix on Alpine Weather, by C. K. M. Douglas. Pp. xii+555. (London: Macmillan and Co., Ltd., 1936.) 25*s*. net.

OF all superficial deposits, that of snow is in its physical nature the most inhomogeneous and changeable, chiefly because it exists at temperatures so close to its melting point that melting, evaporation and sublimation are ever at work within the porous mass, modifying the characters of layers which were themselves distinctive when laid down. In consequence it is extremely difficult to predict the behaviour of snow on slopes, and losses in life and property due to avalanching are severe. Long experience has supplied a wealth of precepts to be followed by the wise snowcraftsman, but the reasons for them are imperfectly understood. The properties of the snow are determined by those of ice at the temperature involved, by the shape of the individual grains, their degree of interlocking and the cohesive force uniting them, whilst a further important control may be exercised by the presence of water. Mr. Seligman seeks to interpret avalanche lore in the light of our knowledge of the structure of the snow on deposition and its transformations under varying conditions, and he paints a vivid picture of the complexity of the problem.

The insufficiency of the available data is apparent, and it relates to both laboratory and field investigation. It is surprising that we should still be in almost complete ignorance of the properties and stability conditions of the vitreous state of so fundamental a substance as water, and much remains to be learnt regarding the internal structure and temperatures of accumulations of snow and ice. Only recently, Prof. H. U. Sverdrup has obtained evidence for the unexpected conclusion that in Spitsbergen, where the average annual temperature is − 12° C., the glaciers with the exception of a superficial layer subject to seasonal variation are at a temperature of 0° C. throughout, so that only the latent heat of fusion is wanting to remove them. The present work, which deals with the development of snow through all stages to compact ice, makes an opportune appearance in view of the increased attention now being directed to the subject as witnessed by the meeting of the International Commission of Snow in Edinburgh this year. Lavishly provided with beautiful illustrations, it should perform a valuable service in enlisting the interest of snow sportsmen in theory and observation.

Lack of precision in the terminology of the multitudinous forms of ice deposits has been responsible for much confusion in the past, and the author's definitions and analysis of foreign usages should pave the way for more fruitful discussion in the future. The classification and terminology adopted is on the whole satisfactory, although views will differ on details: thus the restriction of the 'glacier proper' to a moving mass of ice the surface of which is bare in summer, although convenient for the snowcraftsman, will not be acceptable to the geologist and physiographer. A somewhat careless employment of the terms 'condensation' and 'sublimation' will puzzle the non-specialist whom the book is cunningly devised to attract—the formation of super-cooled water drops is not a sublimation process—and it would be wise in view of the wide constituency addressed to limit 'condensation' to signify the passage from vapour to liquid only.

Mr. Seligman gives an admirable digest of the huge and undisciplined literature on snow and ice, and the arduous nature of his own field researches may be illustrated by his statement that on one occasion he spent two hours on a cornice in a fifty miles an hour gale attempting to make microscopic observations, all but a few minutes, however, being occupied in restoring circulation! The number of factors governing the form and interrelationship of the granules of a snow deposit is very great, and meteorological conditions exercise an important control over the processes active in the uppermost layers, whilst through the agency of freezing percolating melt waters, surface heat is delivered to the deeper layers and their structure modified. Snow phenomena provide Nature's greatest display of sublimation, and the author convincingly demonstrates the important role it plays in the development of structure, whereas regelation, which was formerly called in to explain many things, is now considered to be of minor application.

The origin of many avalanches is bound up with the stratification of the snow, in which beds laid down and altered under different meteorological conditions, and consequently of varied structure and properties, are insecurely welded to each other, and the elucidation of these matters properly belongs to the province of stratigraphical and metamorphic geology. Mr. Seligman's book provides a stimulating record of the advances which have been made towards the solution of the problem of deducing meteorological history from the petrography of the deposits, and conversely the prediction of structure and mechanical properties from knowledge of past conditions. The perusal of Part 3, which treats of the different kinds of avalanches, the precautions to be taken in the hope of escaping them, and the procedure to be followed in attempting to rescue unfortunate victims, cannot fail to impress the reader with the hazardous nature of the snowcraftsman's exercise. The timid will keep away from the snow mountains, but happily for the growth of knowledge there are others.

L. H.

Poverty, Malnutrition and Disease

Poverty and Public Health
By G. C. M. M'Gonigle and J. Kirby. Pp. 278. (London: Victor Gollancz, Ltd., 1936.) 6*s*. net.

IN producing the book under notice, Dr. G. C. M. M'Gonigle and Mr. J. Kirby have made a practical and notable contribution to the study of community and family nutrition, which should help responsible authorities and individuals to acquire a true perspective and a sound sense of values in regard to the many factors which collectively influence the health of the general public. The authors write with the authority of first-hand experience. For many years their official duties have brought them face to face with the realities of poverty, malnutrition, disease and death in the depressed areas, and in the course of their work for the health and welfare of the local community in Stockton-on-Tees, they have collected data, instituted inquiries and made original investigations into the nutritional state of children and family health and economics.

Such is the background of knowledge and experience behind the publication before us. It has appeared at a time when the national conscience is alive to the significance of diet to health, and the fact that malnutrition is not merely a problem to be solved by satisfying hunger. The health and fitness of the nation are primarily determined by the state of nutrition of the people, and of necessity the food consumed by the individual child or adult must be physiologically adequate in respect of quality, quantity and balance if optimum nutrition is to result.

The book opens with an examination of available information relating to the physical condition of the adult population and the health records of elementary school children. The findings of the Ministry of National Service (1917–19) are reviewed, and the data revealed by the routine medical examination of elementary school children and special investigations are dealt with in detail. It is pointed out that in 1933 no less than 3,094,926 children, or 61 per cent of the average attendance at elementary schools, were subjected to examination by school medical officers, and that of these, 1,140,445 children, or 36·8 per cent of those examined, showed defects requiring treatment or calling for careful observation. The chapter dealing with child welfare records is of particular interest. In it the authors have presented a careful analysis of the data of 741 children who attended the child welfare centres in Stockton-on-Tees. They have correlated the incidence of defects with the evidence collected in regard to satisfactory or unsatisfactory diets. Bone defects, pharyngeal conditions, dental decay and anæmia were markedly more prevalent among the children whose diet was judged unsatisfactory. Attention is directed to the common error of including an excessive amount of carbohydrate food in the diet of children, and it is recorded that in Stockton-on-Tees a reduction in carbohydrate food coupled with an increase in protein, fat and vegetable constituents was followed by a decrease in rickets and other defects attributable to sub-optional nutrition.

A large section of the book is devoted to a critical analysis of the data obtained in Stockton-on-Tees of 152 families subsequent to being rehoused on a new housing estate. The health, mortality records and economic circumstances of these families are compared with those of 289 families which were not transferred to the new housing estate. The dietaries of the families in the two groups are examined, and it is held that the increased cost of rent on the new housing estate accounted for the unsatisfactory diet purchased. The intimate details of family budgetary expenditure are examined with great care and thoroughness. It is pointed out that in addition to rent, many other items in the budget are unavoidable, and their payment of necessity limits the money available for the purchase of food. In particular, the case of the unemployed is dealt with, and the book concludes with the well justified suggestion that the data presented are of sufficient importance to warrant further investigation and inquiry.

Quantum Electrodynamics

The Quantum Theory of Radiation
By W. Heitler. (International Series of Monographs on Physics.) Pp. xi+252. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 17*s.* 6*d.* net.

THE quantum theory of the electromagnetic field is without doubt the 'difficult child' of quantum mechanics, which in spite of many attempts at improving it, has retained all the disquieting and unpleasant characteristics which it showed from its birth. There is a number of physicists who refuse to discuss it because, as they would put it, (*a*) it is unnecessary, since all its correct results can be derived by simple means; (*b*) it is wrong, because its application to problems like the self-energy of the electron leads to contradictions; and (*c*) it is extremely complicated.

In face of this opposition, it requires courage to devote a book to an exposition of this theory and its main applications. However, Dr. Heitler has a strong case against the opposition; for as to objection (*a*), the 'simpler' methods, namely, the quasi-classical introduction of the field in calculating the absorption, which is then related to the emission by means of Einstein's law, is, in fact, completely equivalent to quantum electrodynamics, both in the assumptions and in the procedure. Indeed, Einstein's law is based on Planck's radiation formula and thus on the concept of the light quantum, and therefore contains no more and no less than quantum electrodynamics itself. If we applied the 'simpler' procedure consistently, we should arrive at the same contradictions as in the usual form of quantum electrodynamics. Which of these methods one prefers is a matter of taste, but quantum electrodynamics has the advantage that, instead of requiring a new 'recipe' for each new type of problem, one can develop a general scheme to deal with all kinds of radiative processes and, from this, solve special problems by merely inserting appropriate values into the general formulæ. The importance of such a general scheme is emphasized by Dr. Heitler, and this will make his book very valuable in dealing with practical problems.

As for the argument (*b*) that the theory leads to inconsistencies, this is undoubtedly true. But as Dr. Heitler points out, we can always pick out those terms in the solutions which are significant as opposed to those which are due to the self-energy and do not correspond to reality. Thus in all practical applications we can obtain a definite answer, provided we do not require an accuracy exceeding a limit determined by the ominous number e^2/hc or 1/137. In all cases, except possibly where very high energies are involved, these predictions agree with experiment, and we believe that whatever may be the form of a future theory, it is not likely to alter these predictions except for corrections of higher order in e^2/hc. This fact in itself justifies an account of the theory and its applications.

Nevertheless, we should keep in mind that the theory is, strictly speaking, inconsistent, and if Dr. Heitler calls it "the reasonable quantum theoretical extension of classical electrodynamics in the same way as quantum mechanics is . . . the extension of classical mechanics" (p. 81) he is perhaps too optimistic.

As for the objection of being complicated, this only makes a clear and comprehensive treatment more desirable. Moreover, from a study of this book the reader will find that although one cannot exactly call radiation theory an elementary subject, it is very much simpler than it would appear from most of the original papers, which —with few exceptions—were unnecessarily complicated.

The book starts with a short account of the classical theory of radiation, emphasizing the difficulties connected with the structure of the electron. The second chapter deals with the quantization of the field *in vacuo*, and contains an account of Bohr's work on the uncertainty relations for the field strengths and the limits of accuracy with which these may, in principle, be simultaneously measured. Then the terms describing the interaction with matter are introduced, and general formulæ for the probability of any radiative process are derived. Emission, absorption, photo-electric effect, scattering, dispersion and Raman effect, etc., are then discussed as applications of these formulæ. Complete results are given for those phenomena that are of particular interest in dealing with hard γ-rays and fast particles. Chapter iv deals with the theory of the positrons and their creation and annihilation, while the last chapter deals with the passage of fast electrons and γ-rays through matter. The limitations and difficulties of the theory are then summarized again, together with a short note on Born's attempt to remove them.

The exposition is very clear. The reader is assumed to be familiar with ordinary quantum mechanics and classical field theory.

It is, of course, unavoidable that there should be a few minor points on which author and reviewer disagree (for example, the statement that the field fluctuations have no connexion with the zero-point energy, p. 67), and a few places which leave the reader puzzled (such as, for example, the dotted curve in Fig. 7, or that a formula which has been derived "agrees roughly with what we should expect", p. 170), but their number is small. They do not affect the value of the book, which will be indispensable to anybody interested in either the principles or the applications of radiation theory.

R. P.

Chinese Materia Medica

Chinese Medicinal Plants from the Pen Ts'ao Kang Mu, A.D. 1596

Third edition of a Botanical, Chemical and Pharmacological Reference List. Compiled by Dr. Bernard E. Read. (Published by the Peking Natural History Bulletin, 1936.) Pp. xvi+389. (Peiping: The French Bookstore, 1936.) 6 dollars.

THE fact that this book, which gives the maximum of information in the minimum of space and therefore appeals only to experts, should have reached a third edition, is a striking testimony to the interest now being shown in the chemistry of plants. It is also a tribute to the learned author's success in accomplishing the remarkable literary and scientific feat of transmuting medieval Chinese materia medica into this thoroughly modern treatise on the medicinal plants of China. The data he has accumulated as a result of his labours are set out in tables giving the kind of information usually provided in books on materia medica, namely, botanical family, specific name, habitat, principal constituents, etc., but with the unusual addition of a bibliography of the chemical, medical and pharmacological literature of each drug.

Of the 898 drugs dealt with, many are either identical with, or closely related to, drugs still in use in Europe; others have long been obsolete in medical practice, and there are many which seem to be peculiar to China. None of the recognized cardiatonic drugs seems to have been used in China at the date, A.D. 1596, when this list was compiled. An interesting feature of the list is the inclusion of a considerable number of foodstuffs, especially fruits, nuts and cereals, a point to which Prof. Read directs particular attention as possibly indicating that the early practitioners had a sound, if empirical, belief in the importance of an appropriate dietary in the maintenance of health.

It is well known that Prof. Read's labours have already had the practical outcome of extending enormously the use of the alkaloid ephedrine throughout the world, but he probably has small hope of achieving similar triumphs with other constituents of Chinese drugs. At the present time, the investigation of natural drugs on the basis of local belief in their therapeutical value seems to be almost confined to Soviet Russia, Japan, China and India, and though interesting results have been obtained in all these countries, results of practical value, so far as additions to therapeutical resources are concerned, remain unimportant.

In other countries, work in plant chemistry is being carried on on broader and, in the writer's view, better conceived lines, in the correlation of components in allied species, the determination of the constitution of plant constituents and the investigation of the biological processes by which these substances are produced in plants. By these less direct methods much new knowledge is gained, and they are equally certain to lead in due course to the discovery of any still unknown plant constituents of therapeutic value.

To both the direct and the indirect worker in these fields, Prof. Read's book is a gift, the value of which can best be appreciated by those who have had practical experience in assembling all the relevant chemical, medical and pharmacological data regarding a single drug. To repeat the process with nearly nine hundred drugs, as Prof. Read has done, is to exhibit scientific altruism as rare as it is welcome. The careful and critical compiler rarely receives the credit he deserves for his indispensable work, and it must be some satisfaction to Prof. Read to be able to begin his introduction to the third edition with these words: "The large number of researches upon Chinese Materia Medica undertaken during the last decade necessitates a new edition of this reference list", for he is undoubtedly the cause of most of these researches, and his book may be cordially recommended as a source of information to any new worker who thinks of pegging out a claim in this field.

T. A. H.

British Association for the Advancement of Science

A Scientific Survey of Blackpool and District. Prepared for the Blackpool Meeting, 1936, by various Authors. Edited by Arthur Grime. Pp. 152+3 plates. (London: British Association for the Advancement of Science, 1936.) n.p.

THE well-known British Association handbooks prepared annually for each centre visited have now for some years been issued in a uniform format, and if the appearance of the pamphlets is less impressive than the bound volumes of former days, the contents shows a marked improvement, and leaves little to be desired.

The handbook for the Blackpool meeting begins with an exhaustive survey of all aspects of the Fylde, illustrated by several useful maps. This includes chapters on the historical geography and the place names. A section of Lancashire sea fisheries follows. Then comes an account of the growth of Blackpool itself, from which we learn that there was a Blackpool of a few cottages so far back as the seventeenth century, and that the seaside resort began to be known in the eighteenth century. It was not, however, until the second half of the nineteenth century that the great growth set in. A full account is given of this growth and of the varied municipal activities of the borough. The coast defence works are also fully explained. Lastly come chapters on the geology and natural history of the Lake District, added no doubt in view of the excursions to that part of England. The book maintains the high standard of recent volumes in the series and reflects credit on its numerous contributors.

A Method of Illustration for Zoological Papers

By H. Graham Cannon. Pp. x+36. (London: Association of British Zoologists, 1936.) To Members, 2*s*. 6*d*.; to non-Members, 3*s*.

ALTHOUGH so much illustration of scientific papers is now performed by photographic methods there are still many cases where the process fails, such as complicated anatomical subjects, or those that present difficult problems of lighting or where a semi-diagrammatic treatment is called for. These require a selection and emphasis of parts which can still only be done by hand. The comparative ease and accuracy of the photographic process has done much to kill many of the older forms of art. Lithography, which in the past has produced such magnificent work, is almost as much a thing of the past as the woodcuts of Bewick. But as handwork is not, and never can be, entirely superseded, the student and advanced worker will be glad of any help that will get him over the technical difficulties in making his drawings. Everyone should at least try to produce his own illustrations with his own hand.

Prof. Graham Cannon has written a small booklet, published by the Association of British Zoologists, in which he claims that "any zoologist as long as he can draw a reasonably straight line . . . can turn out drawings that are really convincing". The method advocated appears sound and the illustrations of the method also appear convincing.

Bibliography of Soil Science, Fertilizers and General Agronomy, 1931–1934

Pp. xxxi+473. (Harpenden: Imperial Bureau of Soil Science, 1935.) 25*s*. net.

IN 1929–1930, eight Imperial agricultural bureaux were set up to act as clearing houses of information on different aspects of agricultural research and practice for the use of research and advisory officers in the Colonies and Dominions. One of their functions has been to issue abstracts of all the important papers and reports published in every country that bear on their respective subjects. The book under review is an index of all the papers abstracted by the Imperial Bureau of Soil Science, one of these eight bureaux, during the four years it has been issuing abstracts. It covers all the agricultural aspects of the work done in soil science, and in soil and crop management, but is only concerned with plant breeding, plant diseases or animal husbandry in so far as they depend on the soil or its management.

The book is an index of published papers. It gives the author, the title of the paper in English, the journal and the year in which it was published, but it does not give abstracts of the papers. The entries are grouped according to subject, or to the country to which they refer, and the subjects and countries are printed in the order of the numbers which they are given in the universal decimal classification. There is a detailed subject index running to fifty-five pages to enable one to find the number allotted to every subject, and it appears to be excellent.

There are three indexes, the subject index already noted, an index of all the journals quoted, and an author index. A minor criticism can be levelled at the author index in that it only gives one transliteration of a name from a non-Roman to the Roman alphabet, even though the author himself uses several.

E. W. R.

Principles of Electric and Magnetic Measurements

Part 1: Electricity, by P. Vigoureux; Part 2: Magnetism, by C. E. Webb. (The Student's Physics, Vol. 7.) Pp. xi+392. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1936.) 20*s*. net.

THIS text has the advantage that the authors are at the fountain of standardization in electrical science at the National Physical Laboratory and their modern treatment of their respective subjects is thereby enhanced. They start off by carefully defining their units and one is pleased to note the adoption of the new scheme of units based on the kilogram-metre-second system which is to unify the theoretical electro-magnetic and practical electrical units throughout the world in a few years time.

The present interdependence of physics and electrical technology is illustrated by the space given to thermionic devices, quartz crystals, the precision measurement of frequency, and even the linear time-base is mentioned, although, for some reason, the latter is not included in the index. The text is made suitable for students and research workers, but the field is becoming so vast that one must be sympathetic.

L. E. C. H.

A New Fossil Anthropoid Skull from South Africa

By Dr. R. Broom, F.R.S., Transvaal Museum, Pretoria

IT is nearly twelve years ago since Prof. R. A. Dart startled the world by the announcement of the discovery of a new type of fossil anthropoid found in a limestone cave at Taungs in Bechuanaland, South Africa. The specimen consists of most of the brain cast and the practically perfect face of a very young ape. The functional teeth are all of the milk set, though the first upper and lower molars have cut the gum but do not yet meet. Though the ape was only very young, Dart estimated the cranial capacity at more than 500 c.c., and considered that in an adult it might exceed 700 c.c. He believed that this little fossil ape is not very closely allied to either the chimpanzee or the gorilla, and that it is probably nearer to the ape from which man has been descended and thus to be practically the long sought for missing link.

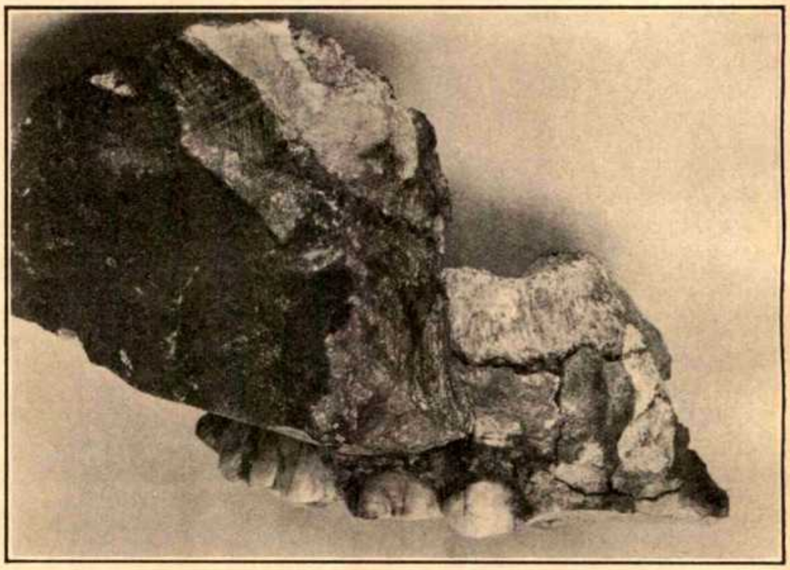

FIG. 2. Side view of right upper maxilla with the 2nd premolar and the 1st and 2nd molars. Parts of the roots of the canine and 1st premolar are shown. Slightly enlarged. Photograph by Mr. Herbert Lang.

Many European and American men of science considered that Dart had made a mistake, and that if he had had a series of young chimpanzee skulls for comparison he would have recognized that the Taungs ape is only a variety of chimpanzee. When after some years the lower jaw was detached from the upper and the crowns of the teeth could be examined fully, it was found that the milk teeth are not in the least like those of either the chimpanzee or gorilla, and that they agree entirely with those of man, though larger. In the gorilla and chimpanzee the first upper milk molars have each two cusps: in man and in *Australopithecus* there are three well-marked cusps in each. In the first lower milk molar of the gorilla there is only one large cusp; in the chimpanzee there is one large cusp and a second rudimentary cusp. In man and in *Australopithecus* there are four well-developed cusps.

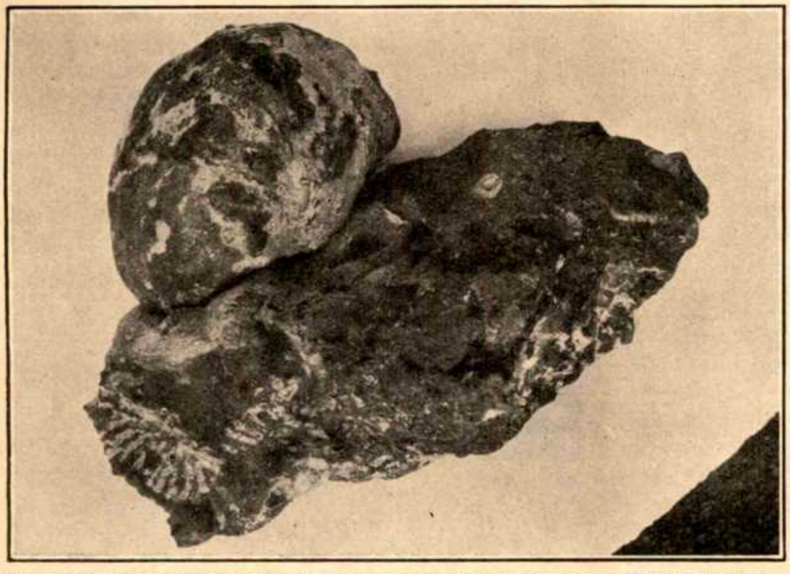

FIG. 1. Half side view of the brain cast resting on the imperfect base. The brow ridges are shown with parts of the frontal sinuses exposed. Part of the left cheek bone is also shown. About ½ natural size. Photograph by Mr. Herbert Lang.

I have constantly maintained since I first examined the skull in 1925 that Dart was essentially right in holding *Australopithecus* is not closely allied to either the gorilla or chimpanzee, and is on or near the line by which man has arisen.

I do not know what is at present the opinion in Europe as to where *Australopithecus* ought to be placed. Gregory of New York regards it as fairly near to the origin of the human line; and Romer of Harvard says it is "clearly not a chimpanzee or a gorilla". But the most important thing to do seemed to be to get an adult skull. For the last three months, I have been busy working on the bone breccia of the limestone caves of the Transvaal largely in the hope of getting either a new 'missing link' or a type of primitive man. I have so far found no trace of man, though I have discovered more than a dozen new species of fossil mammals, a number of which belong to new genera.

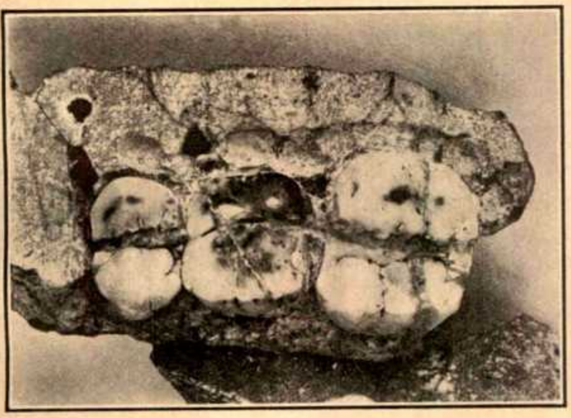

FIG. 3. Crowns of right upper 2nd premolar and 1st and 2nd molars. × about 4/3. Photograph by Mr. Herbert Lang.

Two weeks ago [Dr. Broom's covering letter is dated August 8.—Ed.], when visiting the caves at Sterkfontein near Krugersdorp, Mr. G. W. Barlow, the very understanding manager of the lime works there and on whom I had impressed the importance of keeping his eyes open for a Taungs ape, handed me the brain cast of what appeared to be a large anthropoid (Fig. 1). It had been blasted out of the side of the cave a couple of days before. A search for some hours failed to find any other part of the skull, but we found the cast of the top of the head in the cave wall. A more extensive search on the following day with a large party of workers resulted in the discovery of most of the base of the skull, with the upper part of the face (Fig. 2). In the same matrix was found the detached right maxilla with three teeth, and the third upper molar was also found, though detached. The lower part of the face had been removed before fossilization; and so far no mandible or lower teeth have been found, though parts may yet be discovered in a mass of crushed and broken bones near the side of the head. As the bones are very friable, no attempt has as yet been made to remove them from the much harder matrix.

Much of the cranial vault has been destroyed by the blast, but a large part of each parietal is preserved and a considerable part of the occiput. Unfortunately, the back of the brain cast is missing, and though the base of the skull is complete to the back of the foramen magnum, the contacts of the occipital fragment are lost.

The brain cast is perfect in its anterior two thirds. When complete it probably measured in length about 120 mm. and in breadth about 90 mm.; and the brain capacity was probably about 600 c.c. The skull probably measured from the glabella to the occiput about 145 mm., and the greatest parietal width was probably about 96 mm.

The brow ridges are moderately developed and there are fairly large frontal sinuses. The auditory meatus is 73 mm. behind the brow. It will be possible to make out much of the detailed structure of the base of the skull, but as yet no attempt has been made to clean it out as the bone is very friable and the investigation cannot be done in a hurry.

In the maxilla there are three well preserved teeth, the 2nd premolar and the 1st and 2nd molars (Fig. 3). The canine and 1st premolar are lost but the sockets are preserved. The canine has been relatively small. At its base it probably measured about 10 mm. by 8 mm. The 2nd premolar is somewhat worn. Its crown measured 11 mm. by 9 mm. Its pattern is well seen in Fig. 3.

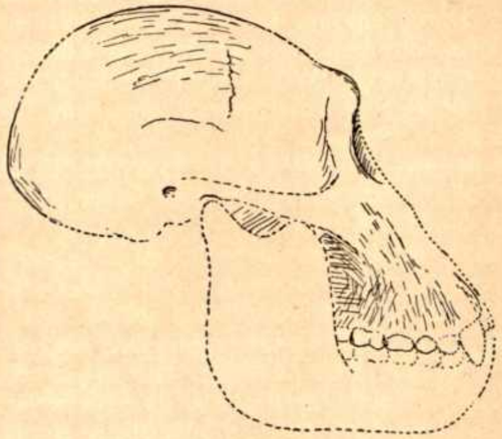

FIG. 4. Attempted restoration of skull of *Australopithecus transvaalensis* Broom. ½ natural size.

Sufficient of the cranium is preserved to show its shape with certainty. Most of the right maxilla is preserved, but it is not in contact with the upper part of the skull, and there is thus a little doubt as to the relations.

The 1st molar is moderately large. Antero-posteriorly it measures 12 mm. and transversely 13 mm. It is of the typical Dryopithecid pattern—four well-developed cusps with a little posterior ridge and a well-marked posterior fovea. The tooth agrees fairly closely with that of the first molar of *Dryopithecus rhenanus*. The 2nd molar is exceptionally large. It measures 14·5 mm. in antero-posterior length and is 16 mm. across. It has four large cusps with a well-marked posterior fovea. The 3rd molar has been detached from the bone but it is preserved in perfect condition and unworn. It has three well-developed cusps, but the hypocone is relatively small owing to the invasion of the large fovea. The tooth measures antero-posteriorly 13·7 mm. and transversely 15·5 mm. The crown in this unworn condition is extremely wrinkled.

The whole premolar and molar series measures 59 mm.

This newly-found primate probably agrees fairly closely with the Taungs ape, but the only parts that we can compare are the brain casts and the 1st upper molars. The brain cast of the new form is considerably wider, especially in the frontal region, and the molar teeth differ in a number of important details. Further, the associated animals found at Taungs are all different from those found at Sterkfontein. I think the Taungs deposit will probably prove to be Lower or Middle Pleistocene, while the Sterkfontein deposit is most probably Upper Pleistocene. I therefore think it advisable to place the new form in a distinct species, though provisionally it may be put in the same genus as the Taungs ape.

This discovery shows that we had in South Africa during Pleistocene times large non-forest living anthropoids—not very closely allied to either the chimpanzee or the gorilla but showing distinct relationships to the Miocene and especially to the Pliocene species of *Dryopithecus*. They also show a number of typical human characters not met with in any of the living anthropoids.

The Control of the Circulation of the Blood*

By Prof. R. J. S. McDowall

VARIATIONS IN THE ACTIVITY OF THE HEART

THE heart is not like an ordinary pump which sucks fluid from one tube and pushes it into another. The veins are so thin that any degree of suction would cause them to close. The heart is filled by the pressure of the blood which reaches it during the time it is relaxed, and adjusts the force of its stroke to the amount of blood in it at the beginning of contraction. The more blood reaching it, the more it pumps out, within limits. This is made possible by the fact that the force with which the heart contracts is increased if the heart muscle is stretched.

The heart can also change its rate. In the past it has been usual to describe the heart as being under two sets of controlling nerves, one the sympathetic, which when stimulated makes the heart go fast, and the other the vagus, which makes the heart go slower. Now we know that this is only part of the story. The evidence is almost complete that the heart is really under the control of two sets of reflexes which have this function. The difference between these statements is that the second involves an afferent pathway to the central nervous system, for the sympathetic and the vagus are constantly carrying down impulses to the heart, and if they are cut off the heart goes slow or fast as the case may be. In the case of the sympathetic, we do not know accurately as yet the exact source of the afferent impulses, but the fact that stimulation of any sensory nerves causes cardiac acceleration suggests that the source is stimulation from the outside world. This is not necessarily conscious, for it has been shown that a sound may accelerate the heart of a person who is asleep, but during waking hours the higher centres undoubtedly play a part in the acceleration. I shall refer to this further in relation to the vasomotor centre. In the case of the inhibitory impulses which slow the heart, the source of the afferent impulses is known. These arise from certain sensitive regions within the circulation itself. These are situated in the left side of the heart, the arch of the aorta and the carotid sinuses, which are small dilatations at the bifurcation of the common carotid artery in the neck.

When exercise is taken, two changes occur: the sympathetic accelerator impulses increase and in particular the vagus impulses are reduced. The evidence for this rests on the effect of exercise and other procedures on the heart rate before and after section of the vagi, and with and without the sympathetic. It has been shown, for example, that if the vagus nerves have been cut the increase of the heart rate is, during the exercise, not nearly so great as it was before they were cut. It is not possible for me to discuss here how the change is brought about, except to say that it is in part due to the action of the higher centres and to a rise of venous pressure. The increased temperature of the blood and adrenaline liberated by the suprarenal gland enhance the effect of the nervous changes.

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* From the presidential address to Section I (Physiology) of the British Association, delivered at Blackpool on September 11.

What I want to emphasize is that the range of acceleration is determined by the degree of activity of the cardio-inhibitory reflexes: indeed, it has been recently shown in Belgium that the capability of dogs to withstand sustained activity is apparently enhanced by removal of the sympathetic. The extent to which the animals have then to rely on the reduction of vagus activity is thereby increased. This, of course, does not mean that the maximum effort for short periods is increased. To show this it is necessary to time the running of the animal over short distances. It has been shown that in athletes during mild exercise the cardiac output is increased with a trivial increase in cardiac rate—that is, the increase is chiefly produced by an increased output per beat. I shall, however, return to this point. Meantime I should like to leave you with the question: The heart increases its output; where does it get its blood ?

Experimentally it can be demonstrated that the vagus restraint of the heart is extremely variable—not only in different animals, but also in the same animal under different conditions, as may be seen if we block the vagi. For example, if we give an animal nitrogen to breathe, the normal vagus restraint can be shown to have disappeared. Or we can increase the restraint by previous sensory stimulation. This last experiment is of special interest, as it may give a clue as to how the normal vagus restraint is built up. We know that animals and human beings which take large amounts of exercise have slow hearts. How exactly this slow heart is produced is not yet clear. All we can say at the moment is that certain procedures such as sensory stimulation or asphyxia increase the heart rate, partly by reducing vagus activity, but that afterwards this reduction is followed by an increase in the activity of the vagus.

VARIATIONS IN THE CALIBRE OF THE BLOOD VESSELS

It may be taken as a general principle that in physical exercise the blood is distributed to the active tissues at the expense of the less active tissues. This local dilatation of vessels, combined with a rise in the general blood pressure which is the result of increased cardiac output and constriction of vessels in less active tissues, results in an enormous increase in blood flow through the active muscles.

The cause of the chemical dilatation has been a matter of considerable debate. It has been demonstrated that blood issuing from tetanized limbs has a vasodilator action. There are first to be considered the products of carbohydrate metabolism—carbon dioxide and lactic acid. Each of these has been observed to cause vasodilatation if applied in suitable concentrations to capillaries under the microscope. I emphasize the concentration, because larger concentrations have the opposite effect. It may be demonstrated also that, if the vessels of the hind limb of a chloralosed animal are perfused with the nerves intact and carbon dioxide is administered, the perfused vessels constrict because of the action of the carbon dioxide on the vasomotor centre, but the blood-pressure does not necessarily rise, presumably because there has been a compensatory dilatation of vessels in the rest of the animal. A number of workers, especially Fleisch, have demonstrated that vessels are sensitive to most minute changes of hydrogen ion concentration, even that which is produced by the addition of the normal amount of carbon dioxide to the blood, and personally I think that normally this is the most important factor concerned.

There is, however, evidence that certain substances of protein origin may be involved. Of these the most important is histamine. It has recently been shown by Anrep that the vasodilator substance which is liberated into the venous blood gives all the known biological reactions for histamine, and it is possible to demonstrate that extensive tetanization of muscles may produce a state which is a very similar one to histamine shock. There is at the same time a constriction of pulmonary vessels such as is produced by histamine. This liberation of histamine—if it be histamine—is of interest, as biochemists have reported that, compared with other tissues, muscles contain relatively little histamine. It is, however, somewhat doubtful if we are justified in considering that what happens during a severe artificial tetanus necessarily occurs in normal exercise.

The nervous dilatation is, judging from the work of Cannon and his associates, probably sympathetic. Here we see a dual function of the sympathetic, for its constrictor action is much better known. It has been known for some time that the sympathetic contained vasodilator fibres. In order to show the vasodilator fibres in the sympathetic, it is necessary to paralyse first the vasoconstrictor fibres with ergotoxine (Dale), or to use slow rates of stimulation. In this connexion it may be remarked that this slow rate of stimulation may be an imitation of what normally occurs, since presumably ordinary muscle contraction may give rise to similar stimuli.

Once the exercise has begun, it seems likely that local vasodilator reflexes, similar to Lovén reflexes, are set up by afferent impulses arising within the muscles themselves, possibly as a result of the mechanical and chemical changes which take place. The evidence is somewhat scanty, but it is impossible to ignore any longer the possibility of the existence of a nutrition reflex as suggested by Hess and supported more recently by Fleisch. By this is meant the fact that oxygen lack in a part sets up afferent impulses which result in reflex dilatation.

Capacity effects.—Now it has been shown by Krogh that when a muscle is active an enormous number of hitherto closed capillaries open up. This opening up of vessels previously closed necessitates the provision of blood, and as there is only a limited amount of blood in the body, it must be provided from other regions, otherwise the blood pressure would fall and the circulation through the tissues be reduced.

It is probable that practically all parts of the body, except possibly the voluntary muscles, the heart muscle and the brain, provide the blood necessary for the active muscles. It has been shown that any exercise, actual or even contemplated, causes vasoconstriction. Constriction of the spleen and of the intestine in animals has been observed. In man it has been shown that the vessels of the skin constrict under any emotional stress or even anticipated activity.

In regard to the sympathetic constriction of the vessels, we are in the same difficulty as we were in relation to the sympathetic acceleration of the heart. We do not know how the actual nerve impulses which originate the constriction arise. For convenience we say that they begin in the higher centres of the brain. It is, however, probably preferable, it seems to me, to consider that it is a sensory stimulation from the outside world, which is the point in time determining the psychical reaction which results in motor movement. Certainly we know that stimulation of a sensory nerve causes generalized vasoconstriction and commonly a rise of blood pressure, and that similar changes but of lesser degree may be recorded in a sleeping man.

It has been usual to ascribe the shutting down of the blood vessels solely to sympathetic activity, just as it was usual to ascribe cardiac acceleration solely to such action. In the case of the heart we have clear evidence that the reduction of the vagus restraint is just as important by increasing the range of cardiac activity and creating a cardiac reserve. It has now become evident that there probably exists an exactly parallel mechanism which increases the range of vascular activity and similarly enhances the reserve.

MAINTENANCE OF THE VASCULAR RESERVE

Just as we have the restraint of the heart by the vagus, which determines the range of cardiac acceleration, so we have in relation to the blood vessels a set of reflexes which determines the magnitude of the vasoconstriction of the blood vessels; that is, they maintain the vessels of the body generally in an actively dilated state. The afferent impulses which are concerned in these reflexes have an exactly similar origin to those responsible for the vagus restraint of the heart. They arise from the cardio-aortic region and the carotid sinuses, and pass up the medulla by the aortic and carotid depressor nerves. Like the cardio-depressor reflexes, the vascular-depressor reflexes are operated by the intravascular pressure in these regions.

It has been generally assumed that the primary function of this control of the vessels is to maintain the arterial pressure at a constant level, and this is quite reasonable, for a constant mean pressure is desirable to maintain a steady flow of fluid at rest from the capillaries to the tissues.

More recently it has become evident that these reflexes may have another and possibly more important function. Several facts led to this suggestion: (1) in physical exercise or mental stress, the blood pressure, like the heart rate, does rise in spite of the reflexes; (2) the response of blood pressure to posture may be normal if the reflexes are destroyed—a fact which shows that the maintenance of mean pressure is not wholly dependent on the reflexes; (3) as in the case of the vagus, different animals, or even the same animals in slightly different circumstances, show great variability in the activity of the reflexes—often it is possible to throw the reflexes out of action without affecting the blood pressure materially; and (4), as might almost be anticipated, the conditions which reduce the activity of the vagus also reduce the activity of the depressor reflexes.

Now since in exercise the venous pressure is increased and, if the stress of the occasion is sufficient, adrenaline is secreted, we may consider what happens to the circulation when the vaso-depressor reflexes are thrown out of action. As I have said, there is a rise of arterial pressure and a generalized constriction of the vessels. It has become usual to consider that this rise of arterial pressure is the result of an increased peripheral resistance to the flow of blood from the arteries. Were this wholly true, we should expect to find that there is a reduced flow of blood to the veins. If the animal, however, is in good condition, the reverse is the case: there is an increased flow to the veins. It is as if there were at the periphery a sponge-like reservoir which, when it is contracted, drives its store of blood into the veins.

When the depressor reflexes are cut off, the reverse, however, does not necessarily occur experimentally. An increased flow into the veins does not necessarily result in a rise of venous pressure, because at the same time the heart is stimulated and the increased pressure is rapidly dealt with. It can, as might be expected, be shown at the same time that there is an increased output of the heart. It is not possible to measure the output of the heart by the cardiometer method without there being some degree of shock or permanent increased capacity of the circulation from the absorption of toxic products. As a result, the increased cardiac activity more than balances any increased flow in the veins, and the venous pressure may actually fall. Commonly it remains unchanged in such experiments. However, if the animal is not subjected to any severe operative procedure, a small rise of venous pressure is the rule. Perhaps I should say that several workers using the Fick method have shown an enormously increased output of the heart when the impulses from the carotid sinus are cut off.

What we can imagine happens in exercise or emotion is, then, that just as the vagus restraint of the heart becomes reduced, so also the depressor restraint of the vessels becomes reduced, more blood is thrown into the circulation and is dealt with by the heart, which at the same time increases both its rate and its output per beat. It is to be anticipated that we shall eventually get evidence that the extent of the activity of the vasodilator reflexes varies in different animals just as the activity of the vagus varies.

The sympathetic and adrenaline.—All the mechanisms which I have described are probably still further enhanced by the vasoconstrictor action of the sympathetic and the action of adrenaline, which is apparently secreted whenever the emotional stress of the occasion is sufficient. Adrenaline in physiological amounts constricts the vessels of the skin and splanchnic region and dilates the vessels of the muscles. Here I should like to emphasize that probably the physiological dose of adrenaline is minute, and may even be insufficient to raise the blood pressure. Certainly the dilatation of muscle vessels is not a result of the rise of blood pressure which may occur, for it can be shown that the dilatation occurs with doses which do not raise the arterial blood pressure. An increased blood flow through the limbs can also be shown to be brought about by doses which do not raise the blood pressure. In such circumstances the constriction just counterbalances the dilatation. Why adrenaline should constrict some blood vessels and dilate others is a major problem in the study of the circulation. Since so far as we know the vessels themselves have the same structure in different parts of the body, we must assume that the difference is due to the different environment. I had hoped by this time to have obtained some definite evidence on this point, but so far the experiments have not been completely successful.

It is interesting to observe the effect of adrenaline on the depressor reflexes. If the hormone is injected, it is found that some minutes afterwards, even after the usual rise of blood pressure has passed off, it is not possible to affect the heart by a degree of stimulation of the vagus which was previously effective, and at the same time the effects of cutting off the impulses from the carotid sinus are markedly reduced or completely abolished. This, of course, is exactly what would be expected if adrenaline were secreted in the same circumstances in which the action of the depressor reflexes and the vagus are reduced, as in exercise.

A further corroboration of this somewhat new view of the function of the vasodilator reflexes comes from a study of the effect of exercise and of emotion on man. It is well known that when a man takes exercise on a stationary bicycle his systolic blood pressure goes up, but falls even below normal the moment the exercise stops. This fall has been explained by Cotton, Slade and Lewis as due to the accumulation of blood in the vessels of the dilated muscles, but from what I have said in relation to the diminution of the peripheral resistance in muscle, it is evident that the fall is in part due to a diminution of this resistance. Now if a careful comparison be made of the psychical effect of intended exercise and that of exercise, it has been found by Gillespie that there is no difference. In other words, the rise of arterial pressure in exercise is the result of psychical changes.

If exercise could be taken without psychical zest being involved, we might expect the blood pressure to fall. This, indeed, has been found to occur in the horse. In man, too, it has been found that if the exercise is slight, although the systolic arterial pressure rises, the diastolic pressure falls. This means that more blood is being pumped out of the heart per beat, but that blood escapes from the arteries more rapidly than normally before the next systole. In other words, from psychical causes alone there is a rise of arterial pressure from an increased cardiac output per beat, which can only be the result of more blood reaching the heart. In emotion, too, it is known that the systolic pressure rather than the diastolic rises. Since we have seen from the experiments of Mosso with the plethysmograph, of Barcroft on the exteriorized spleen and of Florey and Florey on the exteriorized colon, that generalized vasoconstriction is an accompaniment of psychical effort, we must assume that the increased output of the heart is in part, if not wholly, the result of the vasoconstriction which calls into use the reserves of blood, and thus the circulation is maintained in spite of the greatly increased capacity of the active muscles.

Chemistry and the Modern State*

By Prof. J. C. Philip, O.B.E., F.R.S.

IN relation to those essential activities of any society which is intellectually alive—the pursuit of new learning and the cultivation of the spirit of inquiry—chemistry is in the forefront. For the promotion of natural knowledge and the increase of our understanding of the universe, the chemist has laboured with extraordinary success, both in his own fields and in those borderlands where chemistry marches with other sciences. It is perhaps worth while glancing at one or two of the chief avenues in the region of chemical knowledge opened up by such fundamental research.

While our knowledge of atomic structure is to be credited mainly to the work of physicists, the chemist's technique has revealed the molecular architecture of the most complex natural products, and on the basis of this knowledge the same materials can be synthesized in the laboratory. One has only to think of the sugars, the alkaloids, the anthocyanins, to realize the astounding results which have been achieved in this field of investigation, while such elusive substances as the vitamins and the sex hormones are rapidly yielding their secrets to the strategy of the organic chemist.

Take, again, that region in the scale of size which lies between the molecule and the visible particle—the colloid region—the "world of neglected dimensions" as it was once described. In this region, as the physical chemist has shown, the relatively great extent of surface is marked by quite special behaviour, and the labile systems encountered exhibit peculiar characteristics—characteristics which are highly significant for the understanding of physico-chemical changes in the living organism. Our knowledge of this field of surface chemistry is still extending rapidly.

Once more, think of the tracking down of the factors which affect the rate of chemical change, and the elucidation of the mechanism of their operation: a little moisture, a speck of dust, a trace of acid, a roughened surface, a ray of light, a rise of temperature—any of these may have a notable influence on the rate of a reaction. The physical chemist has been remarkably successful in unravelling the role of these various factors and in interpreting their significance. It is in such a field as this—the field of kinetics and catalysis—that the progress of chemical science from the qualitative and descriptive way of treating phenomena to the rational and quantitative has been particularly marked.

These are only one or two of the directions in which the pioneering work of the chemist has opened the way to a fuller knowledge of Nature, especially in the more delicate aspects of her balance and her transformations. In the pursuit of natural knowledge for its own sake, the chemist has indeed travelled far, and his exploration has yielded an abundant harvest of discovery. For the pioneer himself it is an adventure, and original research may provide thrilling experiences. All this, however, is far from the common ways of men, and the investigator in the field of pure chemistry moves in a region mostly inaccessible to ordinary folk, and he speaks an unintelligible language, as indeed is true of specialists in other sciences. The so-called 'jargon' of science, inevitable as it is to some extent, presents a real difficulty in the transmission of knowledge and ideas from the specialist to the average educated man, but it should not be forgotten that other specialists besides scientific workers have a jargon of their own: to wit, lawyers, financiers, and even sportsmen.

It has been maintained that the pursuit of learning for its own sake is a selfish occupation; that knowledge should be a means to life, not an end in itself; that knowledge is of value only in so far as it leads to action, directly or indirectly. With this view I have much sympathy; but it has become abundantly clear, so far at least as knowledge and discovery in the realm of pure chemistry are concerned, that we must take a very long view indeed in assessing their practical value. Again and again in the history of the science observations and discoveries have been made, which at the time were of purely scientific interest but later received important practical applications. The laboratory curiosities of a former generation, such as aluminium and tungsten, have become the industrial commonplaces of the present.

The application of exact methods of measuring density revealed the presence of a new gas in the atmosphere—a discovery of purely scientific interest in the first place—which has led to a whole train of remarkable consequences, from a drastic revision of our ideas about the elements to the widespread development of illuminated signs. Just one hundred years ago, at the Bristol meeting of the British Association in 1836, Edmund Davy announced the discovery of a "new gaseous bicarburet of hydrogen", now familiar as acetylene. Decades passed, however, before the novel gas acquired any practical significance, and indeed it was not until 1892, when a large-scale method for producing calcium carbide was discovered, that acetylene became of industrial importance. Since then its applications have gone ahead rapidly, and its uses in illumination, in welding, in metal-cutting, and in the synthetic production of organic chemicals are widely known. In view of these lessons from the history of chemical science, one hesitates to apply the epithet 'useless' to any specific observation or discovery, however 'academic'. Reflection indeed suggests that the really big changes in the material conditions of human life have generally had their origin in a search for knowledge on its own account.

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* From the presidential address entitled "The Training of the Chemist for the Service of the Community" to Section B (Chemistry) of the British Association, delivered at Blackpool on September 10.

There is, however, much more to be said on this matter of fundamental or academic research. A solution of the most practical of chemical problems on rational and scientific lines is possible only because of our accumulated knowledge of natural phenomena and natural laws. It is only against the background provided by the pure research of yesterday that the technical problems of to-day can be viewed in their proper setting and tackled with a reasonable prospect of success. I would submit, therefore, that work in pure science, remote as it generally is from the practical issues of the moment, is building up a real reserve of knowledge and technique on which future generations of practical workers will be able to draw.

Apart from the chemists who are engaged, mostly in our universities and colleges, but to some extent also in the larger research institutes, in the general task of extending the boundaries of knowledge, there are many more who are carrying on what may be called 'directed' research. Their work aims at the solution of some specific problem, concerned, it may be, with the improvement of an industrial process, the elimination of waste, the safeguarding of health, the utilization of by-products, the synthesis of antidotes. More definitely, and by way of example, the object may be to discover a fast blue dye, to purify a water supply, to find a rustless steel, to produce petrol from coal, to isolate a vitamin, to make a non-inflammable film or a creaseless cotton fabric. The general public, however dubious about pure research, would probably admit that the satisfactory solution of any one of these problems would be of service to the community ; but it must be emphasized once more that the chemist can do these things only by virtue of his inheritance of knowledge and technique. The attack on such problems, to have a reasonable chance of success, must be organized on the basis of what is already known and what has already been achieved ; nay, more, one has abundant ground for belief that the attack, so organized, is bound to succeed, even though it may be 'in the long run'.

In the last twenty years, the amount of directed chemical research in Great Britain has increased enormously. Industries of the most varied description have begun to realize the potential value of the trained chemist in solving their special problems and putting their manufacturing processes on a more rational basis. In this general movement the State, through the Department of Scientific and Industrial Research, has taken a prominent part by fostering research associations. The work of these organizations—such as those dealing with rubber ; with paint, colour and varnish ; with cotton or wool ; with non-ferrous metals ; with sugar confectionery—is in many cases largely chemical or physico-chemical in character. The research associations have not only shown how general problems affecting an industry as a whole can be solved by joint research efforts, but also their existence and activities have induced a notable degree of 'research-mindedness' in the individual associated firms. Financially, the work is based on co-operation between the State and industry, on the principle that the State helps those who help themselves.

The State itself has founded a number of organizations for the study of chemical problems of national importance, and has thus formally recognized the significance of directed research for the community. The work carried out at the Chemical Research Laboratory, Teddington, has included the study of synthetic resins and low-temperature tars and the exploration of chemical reactions occurring under high pressure, as well as research on metal corrosion, chemotherapy and water softeners.

Fuel and food are two notable cases in which State-aided investigation is being carried out, and problems connected on one hand with pulverized and colloidal fuel or the low-temperature carbonization of coal, and on the other with the storage of fruit or the preservation of fish and meat, are being intensively studied at appropriate centres. Reference might be made also to the work of the Building Research Station, where, amongst other matters, the factors determining the weathering qualities of stone are being studied. Other experts than chemists are naturally concerned in the investigation of these problems, but the chemical and physico-chemical aspects are frequently the predominating ones.

Again, the serious question of river pollution has been taken in hand with State help, and some years ago a chemical and biological survey of the River Tees was set on foot, the Tees being chosen for investigation because of the great variety of factory effluents discharged into it both in tidal and non-tidal reaches. Some of the newer industrial developments in Britain are presenting important problems in this direction. It has been estimated, for example, that if the waste waters from all the beet sugar factories in the country were discharged into our streams, they would cause as much pollution as untreated sewage from a population of four or five millions. The effluents from dairies and factories making milk products present a similar problem. Thanks, however, to research activity, largely at the instance of the Water Pollution Research Board, the disposal or purification of these and other trade effluents is being effectively achieved.

The question of river purification demands for satisfactory handling, as already indicated, the collaboration of other scientists with the chemist, and indeed the attack on many such problems, especially those affecting the health of the community, is likely to be successful only by the co-operation of teams of scientific workers from different fields. Smoke and fog, which not only present the scientific worker with interesting phenomena but constitute also a social and industrial problem of vital importance, concern the physicist, the physical chemist, the analyst, the fuel engineer and the meteorologist, and it is only when the knowledge and experience of these workers are pooled that there is any hope of interpreting the phenomena and solving the problem. Again, recent developments in cancer research make it clear that apart from the pathologist, who is mainly concerned, the chemist has a very definite contribution to make to our knowledge of this baffling disease. Some of the most fruitful scientific investigation, indeed, is cooperative in character.

Research, whether fundamental or directed, is by no means the only outlet for the chemist's knowledge and craftsmanship. The works control of chemical processes, the examination of factory products, the safeguarding of the purity of food, and the supervision of water supplies and sanitation, are examples of other activities of a more routine character in which large numbers of chemists are engaged. These are, so to speak, the general practitioners of the chemical profession, and their contribution to the smooth running of industry and to healthy living is far greater than most people suppose. I have myself been surprised, in a recent survey of the present occupations of my former students, by the extraordinary variety of the work in which chemically trained men may be engaged. This survey shows that photographic emulsions, beer, high-speed steel, printing ink, linoleum, dental cream, gramophone records, bank notes, and mineral waters, are a few of the materials with the production of which the chemist is concerned, either in the laboratory or the works. It is true to say that in the industry of the country the chemist is ubiquitous.

I have spoken of the 'chemical profession', and the phrase was used deliberately. A profession is a vocation demanding high educational and technical qualifications, and it connotes also the body of those who by virtue of their qualifications are able to serve the needs and welfare of society in some particular field. On all these counts, chemistry should have a place beside medicine, law and engineering. That the public is so slow in recognizing this claim may be due to the fact that the chemical profession is not yet unified to the same extent as the others mentioned ; but it is due also to a lack of realization of the fundamental and widespread character of the service which the chemist renders to the community.

A just estimate of the chemist's function is almost impossible for those who associate him chiefly with explosives and poison gas, and regard him as a particularly devilish kind of scientist. Such a picture is hopelessly out of relation with the facts. It is, of course, true that chemists have produced dangerous and poisonous substances, but most of these were discovered originally in the general quest for knowledge, and many have legitimate and valuable applications ; their use for destructive purposes is a perversion. Phosgene, for example, one of the so-called poison gases, was discovered more than a hundred years ago, and is an important material at the intermediate stage in the manufacture of certain dyestuffs. Nitrates, which are the basis for the manufacture of most explosives, play a prominent role as fertilizers in agriculture, and explosives themselves are indispensable in mining operations.

The truth is that the employment for other than beneficial ends of the substances discovered by the chemist is due, not to his especial wickedness, but to the weakness and backwardness of the human spirit. Like other scientists, the chemist normally has a constructive point of view, and he cannot but deplore the fact that, as Sir Alfred Ewing once said : "The command of Nature has been put into man's hands before he knows how to command himself". I think I speak for the vast majority of my fellow-chemists in saying that we dislike intensely the present world-wide prostitution of knowledge and skill to destructive ends. The sooner this is eliminated, and the less call there is for lethal and devastating materials, the greater will be our satisfaction.

There are, indeed, welcome signs that scientific workers are increasingly impatient at the extent to which their knowledge is made to serve inhuman ends. The possibilities before humanity have been fairly set out by a recent historian, H. A. L. Fisher: "The developing miracle of science is at our disposal to use or to abuse, to make or to mar. With science we may lay civilization in ruins, or enter into a period of plenty and well-being, the like of which has never been experienced by mankind". To the clearing of this conflicting situation, the scientific worker has not always made the constructive contribution which he might have done: he has been content to adopt an objective and detached attitude, suggesting sometimes complete indifference to the wider human issues at stake, assenting too readily to the misuse of his knowledge and skill. Impelled by patriotic motives, most men of science have put themselves freely at the disposal of the State in time of need, but many are hesitating to admit that patriotism must always override considerations of humanity. Whatever be our individual attitude in this matter, it is time for chemists and scientists in general to throw their weight into the scale against the tendencies which are dragging science and civilization down and debasing our heritage of intellectual and spiritual values.

Obituary

Prof. A. P. Karpinsky

PROF. ALEXANDER PETROVICH KARPINSKY, the greatest of Soviet geologists, president of the Academy of Sciences of the U.S.S.R., of which he had been a member for fifty years, died on July 15 in his ninetieth year. He was a foreign member of many learned bodies; the Geological Society of London elected him a foreign member in 1901 and awarded him the Wollaston Medal in 1916.

An entire epoch in the history of Russian geology, following that of Murchison (the forties of the past century), is connected with Karpinsky's name. Karpinsky compiled a new, much more detailed geological map of the European part of the U.S.S.R. and the Urals. This map was the ground-work of the Russian geological service, of which he was one of the creators, and which was then known as the Geological Committee. Being during many years practically the head and leader of that institution, the staff of which was mainly composed of his pupils, Karpinsky was the creator of the new stratigraphy of Russia. This, however, does not exhaust the significance of Karpinsky's work in the history of geology. He was the last of those geologists who embraced the whole of geological science, working with equal skill in every branch of it.

Karpinsky's personal field-work in stratigraphy concerned all the systems and various regions of the European part of the U.S.S.R., but mainly the Urals; he was the first to solve the enigma of the eastern slope of the latter. His contributions which demonstrated the tectonic structure of the Russian platform were only completed, never reconstructed by later explorers, and were of immense value. He first established the regularity of movements of the earth's crust. Only much later did his ideas receive wider development in the theory of geosynclines.

Karpinsky's palæontological studies are of no less importance. Of his works on invertebrates the most remarkable are those concerning the palæozoic ammonoids. He was one of the first to apply the ontogenetic method, and not to single forms, but to a whole fauna. This led to most important conclusions both zoological and geological (he proved the evolution of the Artinskian fauna *in situ*, whereas it was considered immigrant). A most remarkable study is that on *Helicoprion*, a primitive shark, to the study of which he applied the histological method with brilliant results.

Particular attention may be directed to his monograph on Trochilisks—tiny Devonian algæ. To write this monograph, Karpinsky had to become a botanist. It is curious to note that in a controversy with botanists who did not share Karpinsky's opinion of these fossils, the victory went to Karpinsky. In petrology, besides special studies by which began his scientific activity, it is worth mentioning that he was the first in Russia to introduce the microscope in the study of petrographic slides.

From the very beginning of his scientific activity, Karpinsky was interested in deposits of useful minerals. He forecast the discovery of salt at Bakhmut, he advanced the view that petroleum deposits exist in the Urals; this has been brilliantly confirmed by recent prospecting for petroleum at Ishimbaievo, exactly in the Artinskian deposits established by Karpinsky, as well as by that at Krasnokamsk in the Middle Carboniferous. Karpinsky was particularly interested in the problem of the origin of platinum deposits; he studied some iron deposits and so on. He may be justly called the founder of the practical geology of the Urals.

Karpinsky continued working to his last days, and on his death bed he asked for paper to write down a new idea. In Karpinsky we lose not only the greatest Soviet scientist, but also an excellent man and citizen. Despite his high position, he never ceased to be modest, simple, accessible to everyone, especially to young students, at whose disposal he readily put his knowledge and experience. Injustice and untruth alone aroused his anger, and he frequently expressed his sympathy with the Soviet Government, which he used to call "the most just in the world".

A. BORISSIAK.

Prof. P. H. Stroobant

WE record with regret the death at the age of sixty-eight years, after a painful illness, of Prof. Paul Henri Stroobant, honorary director of the Royal Observatory of Belgium at Uccle. Prof. Stroobant had only recently retired from the directorship of the Observatory which, in May 1935, had celebrated the hundredth anniversary of its foundation. On the occasion of the centenary celebrations, which were honoured by the presence of King Leopold and attended by many foreign delegates, the new equipment of the Observatory was open to inspection. This equipment includes an elaborate Ascania meridian circle of 19 cm. aperture; a Cooke-Zeiss equatorial of 45 cm. aperture and 7 m. focal length, with micrometer; a double Zeiss astrograph, each telescope having quadruplet lenses of 40 cm. aperture and 2 m. focal length, covering a field of 72 square degrees; a Zeiss astrographic triplet of 30 cm. aperture and 1·5 m. focal length, covering a field of 81 square degrees; a 7° objective prism; a Zeiss reflector of 100 cm. aperture, equipped with two spectrographs; and also comparators and measuring machines. The modernization and reorganization of the Observatory was Prof. Stroobant's chief work as director, to which post he was appointed on May 1, 1925. He had previously been, since 1904, professor of astronomy in the University of Brussels.

Prof. Stroobant's astronomical work included the study of the personal equation in the observation of star transits; dynamical investigations on the planets and their satellites and, in particular, on the system of Saturn; researches on the distribution and number of the asteroids; investigations of the motions of the helium stars and of the solar motion. He was the first to establish that the apex of the solar motion and the velocity of the sun, with respect to the near stars, varies in a systematic manner with the spectral type of the stars. A volume entitled "Les Observatoires Astronomiques et les Astronomes", compiled in 1907 by Prof. Stroobant with the assistance of some of the staff of the Uccle Observatory, is a valuable reference work. A revised edition was published in 1931 under the auspices of the International Astronomical Union.

Prof. Stroobant was a *correspondant* of the Paris Academy of Sciences, of the Bureau des Longitudes, and of the Institut de Coïmbra. He was an associate of the Royal Astronomical Society, president of the Belgian National Committee of Astronomy and president of the Commission on Bibliography of the International Astronomical Union.

Dr. Edward Weston

BY the death of Dr. Edward Weston on August 20, the electrical industry loses one of its greatest pioneers. Born in 1850, on the border line between England and Wales, he went to the United States when fifteen years old and devoted his energies to studying the action of existing direct current dynamos and making improvements on them. If not the first, he was one of the first to realize the necessity of laminating the iron in the armature of a dynamo so as to obviate the heavy losses that otherwise occurred owing to the eddy currents induced by the alternating magnetic flux. Edison also worked on this problem, and the efficiency of the dynamo was soon raised from 50 to 90 per cent.

As a working method for the realization of the international volt, the Weston cadmium cell is used. At 20° C. its electromotive force is 1·0183 international volts. The researches made by Sir Frank Smith on this cell, and the modifications in the materials used to which these researches led, have made the Weston cell most trustworthy for the accurate measurement of voltages.

To electrical engineers, Dr. Weston's name is a household word in connexion with moving coil ammeters, voltmeters and wattmeters. The law governing a coil moving in a permanent magnetic field was used by Kelvin on his siphon recorders and by D'Arsonval in his galvanometer. In 1888, Weston, using this principle, developed and produced the first moving coil ammeters and voltmeters. Devices are now used by makers in all parts of the world for measuring amperes, volts and watts which use the essential principles of the original Weston instruments. In the original Weston D.C. ammeter, the coil is pivoted and is controlled by spiral springs which carry the current, but unlike the D'Arsonval galvanometer a pointer is substituted for the mirror. The ammeter can be converted into a voltmeter by using it in conjunction with a high resistance and into an ammeter for measuring large currents by shunting it with a low resistance.

Dr. Weston was the first to employ bakelite, so widely used to-day, on a commercial scale. Amongst his many inventions are a compensated thermocouple instrument for high-frequency A.C. measurements, the rectifier bridge for A.C. measurements and the first commercially practical dry disk photoelectric cell.

Dr. Weston was a past president of the American Institute of Electrical Engineers, and received many honours from learned societies. In 1933 he was awarded the Lamme medal of the Institute for his achievements in the development of electrical apparatus, "especially in connexion with precision measuring instruments". At the time of his death he was a director of the Weston Electric Instrument Corporation and the Weston Electrical Instrument Co. Ltd., at Surbiton. He is survived by his son, Mr. E. F. Weston, the president of the American company.

A. R.

WE regret to announce the following deaths:

Dr. W. H. Harrison, formerly Imperial agricultural research chemist for the Government of India, lately acting agricultural adviser, on August 18, aged fifty-nine years.

Prof. K. K. Mathur, honorary professor of geology in the Benares Hindu University, and principal of the College of Science, Benares, on July 18.

News and Views

British Association Meetings

THE Blackpool meeting of the British Association closed on Wednesday, September 16, with the assembly of the general committee, when research committees were appointed and resolutions were passed gratefully acknowledging the obligations of the Association to the Mayor and Corporation for their hospitality and the ways in which they had contributed to the work and entertainment of the Association at Blackpool. The meeting has been notable in several aspects, and one which is unique of its kind was the opening of the famous autumn illuminations on Saturday, September 12, when Sir Josiah Stamp, president of the Association, switched on from a train the 300,000 coloured electric lights on pylons and archways which illuminated the whole length of the promenade. The day had been spent by a large party which travelled by special train to Furness Abbey, Windermere, Rydal Water and Grasmere; and upon the return journey the train was stopped at Oxenholme so that Sir Josiah could speak from his carriage to the people of Blackpool before he pressed the button which started the illumination of the five miles of the promenade. Sir Oliver Lodge, who was given an enthusiastic welcome at the opening meeting, when he expressed the thanks of the Association to Sir Josiah Stamp for his presidential address, attended a few other meetings before he left on Monday. His presence at Blackpool was much appreciated not only by his scientific friends but also by the people of Blackpool.

NEXT year's meeting is to be held at Nottingham under the presidency of Sir Edward Poulton. The general officers remain as this year; namely, general treasurer, Prof. P. G. H. Boswell, and general secretaries, Mr. F. T. Brooks and Prof. Allan Ferguson. The new members of Council are: Dr. F. W. Aston, Prof. F. Debenham, Prof. T. G. Hill, Mr. W. Campbell Smith, and Mr. J. S. Wilson. The meeting in 1938 will be held at Cambridge, on August 17–24. In January of the same year, it is proposed to send a limited party of the Association to India, when a joint session will be held with the Indian Science Congress, which will then be celebrating its silver jubilee. The 1939 meeting will be held in Dundee. The question of a meeting in Australia is still under consideration; but it will probably not be held there until 1942, as it has been found that 1940, originally suggested, is inappropriate on account of several important international congresses having been fixed for that year.

Sir Edward Poulton, F.R.S.

THE election of Sir Edward B. Poulton to be president of the British Association for 1937 will cause great satisfaction, and is particularly apt in connexion with the renewed interest in Darwinism, and more especially in natural selection. This year's meeting has shown that there is a strong revival of belief in the efficacy of natural selection, and the presidential address to Section D (Zoology), and subsequent papers, demonstrated how much evidence is flowing along different lines to support the theory. The presentation to the world of Mendel's particulate theory of heredity in 1866 resulted in enthusiastic acceptance of the new doctrine and the belief that this process supplied the obvious means of evolution which would finally dispose of the less easily proved theory of natural selection. From this view, Sir Edward vigorously dissociated himself; but so prevailing was it that in the presidential address to the Association in 1913, Sir Oliver Lodge stated that not only was it not true that Nature does not make leaps, but that it was doubtful whether she ever does anything else. Now that the early conception of advance by large sudden changes has been so greatly fined down by the discovery of modifying factors, the two schools will be found to be less antagonistic. No one will rejoice in the reconciliation more than Sir Edward, himself eager to welcome and examine any new ideas on evolution, but always ready to hold the fort against new-comers with blaring trumpets acclaimed as the heralds of a new order.

SIR EDWARD POULTON is widely known for his exposition of the theory of natural selection as accounting for the colours of animals, particularly of insects; he has long been recognized as the chief authority on Darwinism in Great Britain. An Oxford man, having studied under Rolleston, he early distinguished himself as a morphologist; he was a vigorous supporter of Weismann's theory and took a practical part in making his views on the continuity of germ-plasm better known to the English-speaking public. But he became particularly interested in the problem of the colours of animals, and in his classical book, "The Colours of Animals", laid the foundations of his life's work. One general scheme was devised to cover all the manifestations of colour in animals, whether aggressive, protective, or for sexual attraction. The explanations by Bates and Müller of resemblances in colour between insects far removed in taxonomy found their keenest advocate in Poulton, who during forty years in the Hopeian chair of zoology at Oxford has been responsible for the accumulation of a mass of evidence for which no explanation has yet been put forward which covers so many points as does natural selection. Always ready to help in any work that would forward the study of evolution, he has consistently lectured and written as a supporter of Darwin's original views, as evidenced by his presidential addresses to the Linnean and Royal Entomological Societies, and to the zoological section of the British Association, which he has regularly attended since 1881.

Discovery of a New Fossil Anthropoid in South Africa

IN another column of this issue of NATURE (p. 486) there appears a communication from Dr. R. Broom, of the Transvaal Museum, Pretoria, in which he records the circumstances of discovery in July last of the skull of a new type of fossil anthropoid in South Africa, and goes on to give a preliminary report on the more striking and significant anatomical characters of his find, so far as these are patent at this early stage of examination. The specimen, as was almost inevitably the consequence of its discovery in the course of blasting operations, is fragmentary; but fortunately for the student of the palæontology of man and the anthropoids, those parts which have been found, especially the teeth and the forward parts of the brain cast, are among the most significant for determining the relation of the new fossil to previously known forms. Further—and this is a matter of considerable moment—it is at once apparent that not only do these fragments belong to a new type of anthropoid, but also the teeth are those of an adult individual. Hence, as Dr. Broom points out, his find confirms the interpretation which has been placed upon Prof. Dart's Taungs skull, which is infantile, and establishes it by the side of this new and related specimen from the Sterkfontein caves, as "not closely allied to either gorilla or chimpanzee", but "on or near the line by which man has arisen". Dr. Broom, however, considers that he is justified in regarding his new form as differing specifically from *Australopithecus*, while it is probably later, belonging to the Upper Pleistocene. The further implication of his discovery is indicated when, referring to the resemblance in the teeth to those of *Dryopithecus rhenanus*, he emphasizes the fact that a South African Pleistocene form, showing "a number of typical human characters, not met with in any of the living anthropoids", stands in distinct relationship to the Pliocene fossil apes and especially to the Pliocene *Dryopithecus* of Europe, which some palæontologists have regarded as one of the most important links in the chain of relationship between the fossil apes of Europe, Egypt and Northern India and the earliest form of man.

Science and Social Values

TIME and time again in these columns, reference has been made to the fact that men of science as a whole have, in the past, paid little attention to the social consequences of their investigations and discoveries, with the result that science has been widely blamed for the present-day world-wide unrest. While there is still a body of opinion that scientific workers should disclaim all responsibility for the use to which their discoveries are put, there is a growing feeling that men of science should take a more active part in public affairs. Sir Josiah Stamp, in his presidential address on September 9 to the British Association, referred to this topic, and went on to suggest that biological and social investigations should be given more attention than they are at present receiving. On September 10, Prof. J. C. Philip, in his presidential address to Section B (Chemistry) of the Association, part of which is printed in this issue of NATURE (see p. 492), roundly attacked those who find nothing in chemical science but explosives and poison gas, showing clearly the importance of the chemist in the modern State, though he found it necessary to urge upon his fellow chemists and other scientific workers the necessity of "throwing their weight into the scale against the tendencies which are dragging science and civilization down and debasing our heritage of intellectual and spiritual values".

ON the same day, September 10, President Roosevelt addressed a plenary session of the World Power Conference at Washington. According to the Washington correspondent of *The Times*, he said: "Your scientific and engineering genius is destroying one world—the world of relative scarcity—but has it yet undertaken to create the new world of abundance, which is potentially in your command, over natural energies ? . . . Is enough attention being paid to 'human engineering' ? In making a valuation of resources the physical and mental energies of human beings must be included." He added that a higher form of accounting is required which "takes the social values, now left to mere assumption, into its calculations and measures them". This frank statement from the leader of a great modern State, coupled with the movement from within their own ranks, will embolden scientific workers in their approach to the almost unknown fields which lie before them in social research.

Joy in Scientific Discovery

DURING the past few days, a section of the lay press has been at pains to show by word and picture—apparently as a matter for comment—that scientific workers and others at the Blackpool meeting of the British Association have made use of the means of entertainment offered by that well-known resort, even as other folk do. That men of science can also feel and show emotion and pleasure in achieving success in their own special fields of work was the theme of Prof. D. F. Fraser-Harris's public lecture "Joy in Scientific Discovery" delivered at Thornton Cleveleys on September 15 in connexion with the Blackpool meeting. While it is true that scientific men must make an impersonal study of the laws of Nature, there is ample evidence from historical records of the joy they have felt on achieving their goal. Newton, it is said, was so agitated when his work on the law of gravitation approached completion that he had to beg a friend to complete his calculation. Faraday is well known to have greeted the successful conclusion of an experiment with boyish glee, and referred in writing of the life of the man of science to "the delight which the contented mind has in acquiring it [knowledge] for its own sake". Harvey said that "the pains of discovery are amply compensated by the pleasures of discovery". Malpighi was greatly stirred by his observation of the blood streaming through the capillaries. Jenner wrote joyfully to his friend Mr. Gardner of his first successful vaccination. Pasteur had a sleepless night of anxiety when he had completed his first inoculations for rabies on a human being. Lister, a member of the Society of Friends, could write, "I don't think any case ever excited me so much", in referring to his first use of antiseptic ligatures. Graham Bell and Edison were delighted with the telephone and the phonograph respectively. Lord Kelvin, having devised a delicate electrical instrument, would have it brought to his drawing-room mantelpiece, so that he might exult over it at leisure. So the story continues. The joy of the creative intellect, whether in art, literature or science, is one of the most exalted human emotions.

Drops and Splashes

Two public lectures under the auspices of the British Association were given at Preston (September 16) and at Rochdale (September 17) by Prof. Allan Ferguson, who took as his subject "Splashes and What They Teach". The lectures dealt with the phenomena attendant on the formation and separation of a drop of water at the end of a vertical tube, the splash of a drop of liquid falling into a liquid, of a solid sphere falling into a liquid and of a drop of mercury falling on to a horizontal sheet of glass. As is well known, experiments were carried out by Worthington some forty years ago in order to elucidate some of these happenings. Photographic technique was then very primitive, and Worthington's experiments were carried out under difficult conditions. Recently a high-speed camera has been developed, in which the film is drawn continuously through the camera at a speed of about thirty miles an hour. A prism rotating rapidly about a horizontal axis is placed between the lens system of the camera and the film, and throws a picture of the object downwards on the film, so that, for a fraction of a second, the image is stationary relative to the film. In this way it becomes possible to take pictures at the rate of 2,000 a second, and therefore, by running them through a projector at the rate of 20 a second, to alter the time-scale in the ratio of a hundred to one. The films so taken corroborate in a remarkable manner the results obtained by Worthington's method of taking separate photographs of drops, each at a different stage of its fall.

Caucasian Studies

To remedy the neglect of a field in which the Russian literature, with a virtual monopoly created by circumstance, can do less than justice, a society has been founded in England for the promotion of Georgian and Caucasian studies. The promoters include Sir Oliver Wardrop and Mr. W. E. D. Allen, who are among the foremost authorities on Georgia in the West. Sir Denison Ross is the Society's first president. The Society will publish a journal under the title *Georgica*, of which the first part has already appeared. Its contents, for most of which natives of Georgia, recognized as authorities, are responsible, indicate that breadth of interest, combined with sound scholarship, will be the aim of its promoters. *Georgica* will also endeavour to keep its readers abreast of current developments in Caucasian studies not otherwise readily accessible. As preliminary matter, Sir Denison Ross contributes an introductory note explaining the objects and methods of the new society, and Mr. W. E. D. Allen reviews the present state of Caucasian studies. Among the remaining papers are a discussion of Georgian chronology by Prof. Taqaishvili, an examination of the Asianic element in Georgian paganism by Prof. M. Tsereteli (see p. 512 of this issue of NATURE), a census of Georgian manuscripts in England, of which there are three important collections, by the Archimandrite Peradze, and an account of the Holy Lance of Echmiadzin by Mr. F. J. Baddeley, who considers that it is identical with the lance discovered in the siege of Antioch in 1098. Dr. A. Gugushvili adds a valuable, if tentative, system of Georgian phonetics, which, it may be hoped, will lead to further discussion. The honorary secretary of the Georgian Society is Dr. A. Gugushvili, to whom inquiries should be addressed at Commonwood House, Chipperfield, Herts.

Exhibition of Photography

THE eighty-first Annual Exhibition of International Photography by the Royal Photographic Society was opened on September 11. It will remain open daily (Sundays excepted) from 10 a.m. until 9 p.m. (Tuesdays and Fridays excepted—lecture evenings—when it will be closed at 6 p.m.) until Saturday, October 10. Pictorial photography occupies the principal galleries and, as usual, has attracted exhibitors from all over the world. Among the scientific exhibits are two infra-red photographs taken by A. W. Stevens and O. A. Anderson from about 69,780 feet above the ground over Central South Dakota on November 11, 1935. One of these is a vertical photograph, the other lateral. The latter is said to be the first photograph to show the division between the troposphere and the stratosphere. The horizon, 330 miles away from the camera, is clearly arched. The trade sections, though not extensive, are well worth inspection. The emphasis among apparatus is upon the miniature cameras. Instructional exhibits include explanations of the working of the Pola screens and of the Kodachrome process, the effects of varying the filter in making photomicrographs of stained sections and the troubles that may arise through mishandling photographic materials.

Smoke Abatement Exhibition at the Science Museum

AN exhibition on the abatement of smoke will be opened at the Science Museum, South Kensington, by the Minister of Health, the Right Hon. Sir Kingsley Wood, M.P., on October 1, and will remain open until October 31. It has been arranged by the National Smoke Abatement Society (by permission of the director of the Museum, Colonel E. E. B. Mackintosh), with the co-operation of interested Government departments and industrial associations. Models and other exhibits demonstrating the efficient combustion of coal in steam-raising and other industrial operations will be shown, and other sections will be devoted to the uses of other natural fuels, namely, anthracite and anthracitic coals, and oil. Another section will exhibit material relating to the generation, distribution, and uses of electricity. The pre-treatment of coal will be demonstrated by exhibits on high-temperature carbonization (gasworks practice) for the preparation of town's gas and gas coke, and on low-temperature carbonization, in which the product of principal interest is the semi-coke. For the scientific investigation of the smoke problem, methods for the measurement of smoke are required, and an exhibit of the Fuel Research Station will be concerned with current researches on this subject, which are being carried out with the view of developing a domestic fire that will burn coal smokelessly. The Department of Scientific and Industrial Research will show exhibits on the nature and causes of smoke, and on the investigation of atmospheric pollution. A section of the exhibition will be devoted to material demonstrating the effects of smoke. The Annual Conference of the National Smoke Abatement Society will be held at the Museum on October 14–17, and will be opened by Captain Harry Crookshank, M.P., Secretary for Mines. Particulars of this Conference may be obtained from the Secretary of the Society, at 36 King Street, Manchester 2.

The World Power Conference

THE third World Power Conference, which was opened at Washington on September 7, was one of the largest technical conferences ever held. The British party, which travelled by the *Queen Mary*, numbered about a hundred. According to the *Electrical Times* of September 10, the records of the papers and discussions will run to more than three million words. As there was no hall in Washington large enough for a banquet of 3,000 delegates, the official banquets were held in the waiting hall of the railway station, suitably transformed for the purpose. Each country submitted papers to the Conference setting forth its own particular power problems and questions connected with them. Economic, technical and allied subjects were all discussed. The papers from each country having to be read before a mixed international audience, largely American, were naturally mainly reports of the country from which they originated. The British papers therefore were mainly of interest to all dwelling outside Britain. An exception may perhaps be made for the paper read by S. E. Britton, the city electrical engineer of Chester. His paper was entitled "Rural Electrification in Great Britain". When the use of electricity produces a revenue equal to twenty per cent of the outlay on the electrical distribution system, the inhabitants in rural areas can get a supply of electricity for all purposes at economic rates and use it for the same purposes as those residing in urban areas. Information is given of the annual expenditure on heat, light and power by those living in rural areas who use electricity and those who do not. The paper is clearly written and is very complete. It is particularly applicable to the conditions prevailing in the neighbourhood of Chester.

German Chemical Engineering

ALTHOUGH a certain amount of publicity was obtained in the scientific journals, trade papers and the daily Press for the German Chemical Engineering Exhibition held at Cologne in 1934, the organizers felt that these reports were necessarily incomplete, and so they have published the Achema Jahrbuch, 1935–36 (Berlin: Verlag Chemie, G.m.b.H.), to give some indication of the recent progress in chemical engineering illustrated by that exhibition, which was visited by 48,600 representatives of industrial firms and professional men from forty-six countries. Opportunity is also taken of directing attention to Achema VIII, which will be held on July 2–11, 1937, at Frankfort-on-Main, where accommodation amounting to 240,000 square feet of floor space will be available for exhibitors. In this exhibition, one building will be reserved for firms wishing to show scientific instruments and equipment such as are used industrially for making technical measurements or controlling and regulating the flow of fluids, heat and electricity. Another building will house industrial apparatus made of non-metallic materials, whilst the third and fourth buildings are reserved for machines used in the artificial silk and associated industries, and large-size equipment for the chemical and allied industries respectively. It is intended to publish at the beginning of 1937 a catalogue giving detailed information of the exhibition. The "Jahrbuch" also gives a list of the exhibitors at the 1934 exhibition in English, French and German as well as notes in two of these languages on some of the more important sections and the equipment which was shown.

Magnetic Observations in New Zealand and elsewhere

OWING to the world economic crisis and other causes, many magnetic and meteorological observatories, including those of some great nations, have fallen seriously into arrears with their publications. The ideal, approached, if not always attained, by the chief British observatories, is to publish the observations of one calendar year before the end of the next. Now that the great and successful co-operative effort of the Second International Polar Year has been accomplished—so far as the observations go, though the publication and, still more, the discussion of the results is still very incomplete—a desirable goal for new effort on the part of geophysical observatories would be to overtake their arrears of publication within an assigned time, say by the end of 1940. A step in this direction has been taken by New Zealand in publishing three years records of the Christchurch Magnetic Observatory in one volume (Annual Reports for 1931, 1932, 1933. Wellington: Government Printing Office, 1936. Pp. 132. 10*s.* 6*d.*). The volume naturally consists almost entirely of tabular matter, and for economy is reproduced directly from typescript, in a reasonably satisfactory manner. The magnetic data refer (as for 1930) to the Amberley sub-station, about twenty-five miles from Christchurch. Monthly mean daily variations are given for all days (with Fourier analysis) and international quiet days, but (regrettably) not for international disturbed days. The volume includes a brief seismological report for 1931. An account of the instrumental equipment of the Observatory in the introduction would have added to the convenience of users. Though the director's introduction is written in the first person, his name (Mr. H. F. Skey), by a curious oversight, seems to occur nowhere in the volume.

The Rockefeller Foundation

ACCORDING to the annual report for 1935, the Rockefeller Foundation expended 12,725,439 dollars. Of this sum 692,524 dollars was for medical education, including 460,850 dollars to the China Medical Board, 2,217,425 dollars on research programmes at universities and similar institutions, and 669,214 dollars on research programmes at research institutions and organizations. The report gives a brief description of the work of the International Health Division, the budget of which is 2,200,000 dollars; this Division covered yellow fever studies in Brazil, research on yellow fever, malaria and other diseases at the Institute's laboratories, field research on malaria in various countries, surveys to determine the status of hookworm disease in North Carolina, studies on tuberculosis, yaws and mental hygiene, as well as research on typhoid fever, smallpox vaccine and the common cold. Work in China has placed emphasis on organized efforts at rural reconstruction by assisting concrete studies and training personnel, particularly graduates, to participate in such reconstruction work.

IN the field of natural science, the Rockefeller Foundation has devoted its appropriations chiefly to research involving the application of the technique of the exact sciences to biological problems, particularly studies which contribute directly to, or form the necessary basis for, an understanding of behaviour. Grants have also been made for research on plant genetics, vitamins and hormones, physiology of reproduction and respiration, nerve physiology, etc. With regard to the social sciences, the Foundation is using its resources to develop specific areas of activity which promise to assist the solution of pressing social problems. The three areas of study thus far undertaken are social security, international relations and public administration, and the 3,807,500 dollars expended on social sciences in 1935 includes grants for research on problems of the business cycle, study of the relief situation in New York State, the Institute of Pacific Relations, agricultural economics, research on international relations and training projects in public administration.

Science in Poznań

AMONG the contributions to vol. 21 (1936) of *Nauka Polska* is a long account (pp. 70) by Prof. Z. Lizowski of the present position of science at Poznań. This ancient centre of culture in western Poland has become the most intensely Polish of all the university cities in the country, partly because 95 per cent of its inhabitants are Poles and partly because of the impetus given to its development since the liberation of the country in 1918. From the time of the partition of the ancient kingdom of Poland until the end of the Great War, Poznań was nominally a German city, and although the pursuit of scientific investigations was possible it was hampered by cultural restrictions, including the suppression of the Polish language. Since 1919, a definite revival has occurred in all branches of pure and applied natural science and the university has attracted students, lecturers and distinguished visitors from other countries.

THE international character of science has also been promoted by the lectures delivered by Poznań professors in Germany, France, the United States, Czechoslovakia and elsewhere. This issue of *Nauka Polska* also contains particulars of prizes and awards distributed to men of science and to various scientific institutions throughout Poland during the past academic year. No complete figures are given, but it seems that many thousands of pounds have been distributed. Aerodynamics, investigations on the oxides of nitrogen, Grignard's reactions, rubber research and plant physiology are among the many investigations that are being encouraged with financial assistance. In the 'foreign notes' the attention of Polish readers is directed to the Oxford conference on 'academic freedom', whilst several works by British authors are included among the books reviewed.

Rabbits in Britain

ATTENTION has been directed once again, by articles and correspondence in contemporary journals, to the damage caused by the superabundance of wild rabbits in Britain. An introduced animal, the rabbit, encouraged by conditions of soil, climate and food, has bred and spread, so that for the past century its activities have become increasingly harmful to agriculture and forestry. So long as two opposed views regarding its presence are strongly held, one emphasizing its destructiveness and the other its value as food and as an object of sport, it is unlikely that common action against the rabbit will be taken without legal compulsion. But the necessity for control in other countries and the methods employed for control are of general interest, and knowledge of them may become of great importance in Britain also, so that useful service is performed by Guy Dollman's article on "The Rabbit Menace" in the *Natural History Magazine* (5, No. 39, July 1936, p. 297), where a summary of recently developed means of limiting or eradicating the pest is given.

Research in Plant Breeding

SUPPLEMENT 2 of *Plant Breeding Abstracts*, which has been issued by the Imperial Bureau of Plant Genetics, Cambridge (price 5s.), gives a concise account of work carried on during 1932–35 on crop plants in the British Empire. It shows the great variety of plants grown and the large amount of work in progress on such crops as wheat, cotton, rice, sorghum, coco-nut, apples, etc., gleaned from more than four hundred reports in various parts of the Empire. It is so arranged that one can see at a glance, for example, the investigations of coffee that are being made in Mysore, Ceylon, Uganda, Kenya and Tanganyika, or of strawberries in England, Scotland, Canada, New Zealand and New South Wales. Work on cytology and on the genetics of plant parasites is included, and the whole serves as a very useful summary for plant breeders and geneticists. This outline picture also shows that a surprising variety of economic plants is undergoing genetic improvement.

National Research Council of Japan

The report of the National Research Council of Japan covering the period April 1934–March 1935 contains a useful list of papers published in various Japanese scientific journals during the period, together with brief particulars of divisional and committee meetings held during the year. A committee on dyestuffs research has been concerned with the investigation of standards of intermediates and dyestuffs and of the present state of industrial research on dyestuffs and chemical compounds in Japan. A further committee is concerned with radio research, and a committee on industrial research has considered the design of long-range aeroplanes, light-signalling through foggy atmospheres in daytime, the electrolytic oxidation of aluminium and its applications, material-testing by X-ray radiography and chloronaphthalenes as electrical insulators.

Conference on Bee Diseases

A conference to discuss the causes of bee diseases and the practical means of controlling them will be held on Saturday, September 26 at Rothamsted Experimental Station, Harpenden, Herts. Contributions will be presented by Dr. H. L. A. Tarr, of Rothamsted, on "Brood Diseases in England: the Results of a Three Year Investigation"; Dr. Guy D. Morison, advisory entomologist, Marischal College, Aberdeen, on "Bee Paralysis"; Dr. Otto Morgenthaler of the Bee Disease Division, Eidgenossiche milchwirtschaftliche und bakteriologische Anstalt, Liebefeld-Berne, Switzerland, on "Brood and Adult Bee Diseases in Switzerland". A paper on brood diseases in the United States specially prepared for this conference by Dr. J. I. Hambleton, Chief of the Apiculture Division, United States Department of Agriculture, will also be read.

Announcements

Sir Arthur Smith Woodward, Sir Charles Sherrington, M. Ruzicka and M. Bottazzi have been elected to the grade of associate of the Royal Academy of Belgium. Prof. F. Van den Branden, professor of clinical urology in the University of Brussels, and Prof. H. Fredericq, professor of zoology in the University of Liège, have been elected *correspondants* of the Academy.

The following appointments have recently been made in the Colonial Service: E. J. H. Berwick, to be agricultural officer, Malaya; C. E. Johnson, to be agricultural officer, Northern Rhodesia; D. R. N. Brown, J. W. Purseglove, and J. M. Watson, to be agricultural officers, Uganda; J. E. Garfitt, to be assistant conservator of forests, Malaya; N. S. Alexander, to be professor of physics, Raffles College, Singapore; J. R. Clackson, to be European assistant, East African Meteorological Service; O. T. Faulkner, director of agriculture, Nigeria, to be director of agriculture, Malaya; J. E. A. Carver, assistant conservator of forests, Nyasaland, to be conservator of forests, Mauritius; J. S. Dunn, inspector of schools, to be engineering chemist, Public Works Department, Gold Coast; H. Harrison, field assistant, to be field officer, Tsetse Research Department, Tanganyika; J. Y. Moggridge, field officer, to be entomologist, Tsetse Research Department, Tanganyika; V. Rasaretnam, assistant superintendent of surveys, to be superintendent of surveys, Ceylon; C. L. Southall, assistant analyst, Straits Settlements, to be Government analyst, Nigeria.

Prof. Carl Neuberg of Berlin, director of the Kaiser Wilhelm Institute of Biochemistry, has been elected a foreign member of the Swedish Academy of Sciences.

Prof. Friedrich Körber of Dusseldorf, director of the Kaiser Wilhelm Institute for Iron Research, has been elected a corresponding member of the Royal Swedish Academy of Engineering Science.

Applications are invited for the following appointments, on or before the dates mentioned:

A city engineer and surveyor at Lincoln—The Town Clerk, Town Clerk's Office, Corporation Offices, Lincoln (September 19).

Assistants (Grade III) in the Meteorological Office—The Secretary (S.2.E.), Air Ministry, Adastral House, Kingsway, W.C.2 (September 23).

A civilian engineer by the War Department at Christchurch, Hants.—The Under-Secretary of State (C.5), War Office, London, S.W.1 (September 25) (Quote E.B.E.).

Assistants (Grade III) in the Royal Aircraft Establishment, South Farnborough, Hants (aeronautical engineering)—The Chief Superintendent (September 26).

A temporary engineer for work at Ellesmere, Salop, on purification of milk factory effluents—The Secretary, Rothamsted Experimental Station, Harpenden, Herts (September 30).

An assistant (Grade III) in the Air Ministry Scientific Research Pool (physics or engineering)—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (October 2).

An organizer of technical education in the Melton Mowbray district (who in due course will become the principal of the New Technical College)—The Director of Education, County Education Office, Grey Friars, Leicester (October 7).

Assistant quantity surveyors in the Air Ministry—The Secretary (W.B.9), Adastral House, Air Ministry, Kingsway, W.C.2.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 511.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Chemical Composition of the Planetary Nebulæ

THE physical conditions in the planetary nebulæ are such that atoms or ions in metastable states are not disturbed by electron impact or the absorption of radiation during their lifetimes of one minute or more. The intensity of a 'forbidden' emission line (due to transitions from such a metastable state) is then[1] $I=nh\nu$, where n is the number of ions arriving in the metastable state per second, and $h\nu$ is the energy emitted from each transition. It is possible to determine the relative abundance of ions in the nebulæ from the observed[2] intensities of their forbidden lines (listed in cols. 5 and 7 of the Table), if, following Bowen, we assume the excitation to the metastable state to be due solely to inelastic electron collisions, that is, n is proportional to $N(w)p(v,w)\rho(E)$, where $N(w)$ is the number of ions of atomic weight w per c.c., $p(v,w)$ is the probability of electron collision and resultant excitation, and $\rho(E)$ is the number of electrons per c.c. with kinetic energy greater than the excitation potential, E, of the ion.

The 'nebular' lines (that is, lines due to the shortest forbidden transition to the ground state) of five ions are listed in column 3 of the table (the 'transauroral' lines of S+ are included). They are in the range λ6600–λ3800 and therefore have excitation potentials, E (col. 4), between 1·9 and 3·2 electron volts, corresponding to a range of 25 per cent in v, the electron velocity. If we assume that $p(v,w)$ is constant in the small ranges of v and w here involved, the relative numbers of quanta in the forbidden lines, $I/h\nu$, derived from the intensities in cols. 5 and 7, are proportional to the numbers of ions in the nebula. With O++ as standard, these values are lower limits to the relative numbers of ions when the excitation potential is greater than the 2·5 volts of O++, because there are fewer electrons available to excite such ions (that is, $\rho(E)$ is smaller than for O++); otherwise they are upper limits as indicated in cols. 6 and 8.

With a knowledge of the temperature of the ionizing radiation and its dilution, we can use the ionization formula[3] to determine the relative abundances of the elements from the proportions of their ions. The central star temperature is 50,000° K. for the nebula N.G.C. 7027 and the dilution (which is not simply geometrical dilution, but complicated by absorption in the inner layers of the nebula) was calculated from the measured ratio $O+/O++=5\times10^{-3}$. (This was derived by the above method from the intensities of λ5007 and λ4959 relative to λ3726 and λ3729, the nebular lines of O+, given by L. Berman[4]. Berman's published ratio must be corrected by +1·09 mag.) In this manner we arrive at the abundances listed in col. 9, corrected to relative numbers of atoms of the elements (for N.G.C. 7027). The proportions of oxygen, neon, and argon are approximately the same as of their ions, O++, Ne++, and A+++, because their ionization potentials (given in col. 2) are so nearly equal. The N+ and S+ ions, however, form only a small fraction of the total amount of nitrogen and sulphur, which are present mainly as N+++ and S++++, and therefore the determination of nitrogen and sulphur content is of low accuracy.

The most surprising of these first quantitative results is the high abundance of neon and argon in the nebula. If the identification of the forbidden lines and also our assumptions are correct, we must explain a ratio of neon to oxygen 10^6 times as great and a ratio of argon to oxygen 10^3 times as great as on the earth (last col. of the table). There are two

Element At. Wt., w	Ion Ion. pot.	Forbidden lines	Classification[1] E	N.G.C. 7662		N.G.C. 7027			Earth[3], abundance of atoms
				Line Int. I	Abundance of ions, N	Line Int I	Abundance of ions, N	Abundance of atoms	
N 14	N^+ 14·48v.	λ6583 6548	$^3P-^1D$ 1·9v.	... .	..	26[4] ...	<0·21	$<6\ 5\times10^{-2}$	$9{\cdot}3\times10^{-4}$
O 16	O^{++} 34·98v.	λ5007 4959	$^3P-^1D$ 2·5v.	84[2] 32[2]	1·00	118[4] 42[4]	1 00	1·00	1·00
A 40	A^{+++} 40 78v.	λ4740 4711	$^4S-^2D$ 2·6v.	.. 0·98	$>7\times10^{-3}$	0·70	$>5\times10^{-3}$	$>8\times10^{-3}$	$3\ 2\times10^{-6}$
Ne 20	Ne^{++} 40·9v.	λ3968 3869	$^3P-^1D$ 3·2v.	2·6 7·15	$>4\ 9\times10^{-2}$	1·35 5·18	$>3{\cdot}6\times10^{-2}$	$>1\ 6\times10^{-2}$	$6{\cdot}0\times10^{-9}$
S 32	S^+ 10·3v.	λ4076 4068	$^4S-^2P$ 3·0v.	0·00 0 00	>0 00	.. 0·19	$>10^{-3}$	$>3{\cdot}1\times10^{-3}$	$9{\cdot}0\times10^{-4}$

In N.G.C. 6572[4] the abundance of Ne^{++} is 0·054 that of O^{++}.

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[1] L. S. Bowen, *Rev. Mod. Phys.*, 8, 69 (1936).

[2] H. H. Plaskett, *Harvard Coll. Circ.*, 335 (1928).

[3] Clarke and Washington, *Proc. Nat. Acad. Sci.*, 8, 114 (1922) and V. M. Goldschmidt, *Fts. der Min. Krist. u. Pet.*, 17, 114 (1933). The mass of the atmosphere is taken as 0 03 per cent that of the earth.

[4] Derived from line intensities given by L. Berman, *Lick Obs Bull.*, 15, 97 (1930).

possibilities: either (1) the nebulæ are normal in composition and the earth has lost neon, nitrogen, and argon, or (2) the earth is normal, and the nebulæ are low in oxygen and argon content relative to neon.

As regards (1), Russell and Menzel[5] have shown that light gases such as neon and nitrogen would completely disappear from the earth, if and when it were hot enough, long before heavier gases like argon even began to escape. Possibility (2) might be caused by the oxygen and argon at the low black body temperature in the nebula (15° to 20° K.) freezing out on dust particles (the presence of which in the nebulæ has already been suggested on other grounds[4]). The freezing points are: oxygen, 55° K.; argon, 85° K.; nitrogen, 62° K.; neon, 20° K. Unless almost all the oxygen were in combination in the dust particles, however, this still leaves unexplained the high content of argon which, freezing at a higher temperature than oxygen, should be more completely solidified.

We conclude that there is as yet no completely satisfactory explanation of these abundances.

T. L. PAGE.

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Aug. 25.

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[1] I. S. Bowen, *Rev. Mod. Phys.*, 8, 69 (1936).

[2] T. L. Page, *Mon. Not. Roy. Ast. Soc.*, 96, 622 (1936).

[3] cf. Eddington, "Internal Constitution of the Stars", p. 383 (Cambridge, 1926).

[4] *Lick. Obs. Bull.*, 15, 97 (1930).

[5] Russell and Menzel, *Proc. Nat. Acad. Sci.*, 19, 997 (1933).

Radioactive Isotopes of Bromine

FERMI and his collaborators[1] detected two unstable isotopes of bromine characterized by half-periods of eighteen minutes and 4·2 hours. The nuclear transformations are probably expressed by the equations:

$$(1)\quad {}^{79}_{35}\text{Br} + {}^{1}_{0}n \rightarrow {}^{80}_{35}\text{Br} \rightarrow {}^{80}_{36}\text{Kr} + e^{-};$$

$$(2)\quad {}^{81}_{35}\text{Br} + {}^{1}_{0}n \rightarrow {}^{82}_{35}\text{Br} \rightarrow {}^{82}_{36}\text{Kr} + e^{-}.$$

The isotopes 80, 82, of krypton are normal constituents of the element.

We noticed that when pure liquid bromine was exposed to neutrons for a week and then transferred to a thin-walled cylindrical glass cell encompassing a Geiger-Müller counter, the instrument registered twenty impulses per minute after a lapse of thirty hours. Previously we had observed the phenomenon in silver bromide precipitated from an irradiated aqueous solution of ammonium bromide. The time of half-decay is provisionally estimated to be twenty-four hours.

As a result of many experiments we conclude that the following reactions occur very infrequently, if at all:

$$(3)\quad {}^{79,81}_{35}\text{Br} + {}^{1}_{0}n \rightarrow {}^{79,81}_{34}\text{Se} + {}^{1}_{1}\text{H};$$

$$(4)\quad {}^{79,81}_{35}\text{Br} + {}^{1}_{0}n \rightarrow {}^{76,78}_{33}\text{As} + {}^{4}_{2}\text{He}.$$

Selenium, and arsenious sulphide, precipitated from irradiated solutions of ammonium bromide exhibit no long-period activity. This excludes, in particular, ${}^{76}_{33}\text{As}$ ($t_{1/2} = 26$ hours) as a possible source of the 'twenty-four hours' activity. The likelihood that it is due to another radioactive isotope of bromine or to an excited bromine nucleus is strengthened by the fact that we have not succeeded in separating the 'twenty-four hour' period from the other two; that is, all three activities in nearly the same relative proportions (small variations would be anticipated) have been observed irrespective of the form in which bromine is presented to the counter. Up to the present, *bromine*, *ammonium bromide*, *silver bromide*, *lead bromide*, and *ethylene dibromide* have been examined. To an irradiated solution of ammonium bromide, arsenic and selenium compounds were added, and pure samples of the three salts obtained from the mixture. Ethylene dibromide was prepared from radioactive bromine.

When, as in this case, the number of recognizable half-periods exceeds the number of isotopes in the natural element, several hypotheses can be suggested to explain their origin. Moreover, the half-periods are often difficult to determine precisely, and may sometimes be compounded of two or more. If there are, in fact, only three periods characteristic of bromine, the simplest explanation appears to be that a neutron is either absorbed, equations (1) and (2), or causes the expulsion of another neutron, thus:

$$(5)\quad {}^{79}_{35}\text{Br} + {}^{1}_{0}n \rightarrow {}^{78}_{35}\text{Br} + 2\,{}^{1}_{0}n;$$

$$(6)\quad {}^{81}_{35}\text{Br} + {}^{1}_{0}n \rightarrow {}^{80}_{35}\text{Br} + 2\,{}^{1}_{0}n.$$

Fermi[1] discussed this type of collision, but did not observe it. Bromine atoms of mass 80 are produced by reactions (1) and (6), and until a fourth half-period can be shown to exist must be presumed identical. The isotope ${}^{78}_{35}\text{Br}$ may emit a *positron* or an electron, becoming ${}^{78}_{34}\text{Se}$ or ${}^{78}_{36}\text{Kr}$. These are stable.

In our experiments the substances were exposed to fast and slow neutrons (and γ-radiation) produced by a mixture of beryllium dust and radium bromide. Fast neutrons are probably required to bring about reactions (5) and (6). The effect of varying the relative concentrations of slow and fast neutrons will shortly be investigated. The main results are summarized in the accompanying table:

Half-period	Relative initial activity	Relative total activity
18 min.	8	1
4·2 hours	3·5	6
24 hours (?)	1	10

Figures in the third column are proportional to the total number of impulses given to the Geiger-Müller counter during the whole period of decay. They are of interest in connexion with the hypothesis suggested above, wherein isotope 82 is produced by absorption of a neutron, 78 by disintegration, and 80 by both processes, but an attempt to assign half-periods to particular isotopes would be premature at this stage.

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Proc Roy. Soc., A, **146**, 483 (1934); A, **149**, 522 (1935).

Neutron Absorption of Boron and Cadmium at Low Temperatures

IN the same arrangement as used for silver absorption[1], we have measured the influence of temperature on the absorption of neutrons in Fermi's group 'C' by boron and cadmium, using the 2·3 min. silver activity as detector.

Absorption curves were taken with detector, source and absorber kept at room temperature in the centre of a large vessel containing liquid hydrogen (20·4° K.) or water (300° K.). The ratio of thickness giving equal absorption at different temperatures, $\sqrt{(300)}/\sqrt{(20{\cdot}4)}$, was found to be fairly independent of the absorption itself, its value being $1{\cdot}65 \pm 0{\cdot}20$ for boron and $1{\cdot}4 \pm 0{\cdot}25$ for cadmium.

The theoretical value to be expected from a $1/v$ law of absorption, assuming a Maxwell distribution, would be 3·84. Preliminary results on cadmium absorption in paraffin cooled by liquid nitrogen (77° K.) gave, for $\sqrt{(300)}/\sqrt{(77)}$, a value less than 1·1 in agreement with the results of Rasetti, Segrè, Fink, Dunning and Pegram[2] with the mechanical selector, and those of Dunning and others[3], obtained at 85° K. We therefore conclude that the absorption curve of cadmium has a selective character, though comparison with 20·4° K. shows that an increase of cross-section certainly exists at the lowest energies, presumably due to overlapping of a selective band with the usual increase obtained with most elements at very low energies.

The results with boron cannot be explained on the assumption of a $1/v$ law for both boron and silver, but it is not possible to decide whether this is not due to the deviation of the silver detector alone from the $1/v$ law, since experiments have not yet been made with a boron chamber as detector.

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[3] *Phys. Rev.*, 49, 650 (1936).

The State of Ascorbic Acid in Plant Tissues

DURING the last two years, considerable discussion has arisen over the state in which ascorbic acid occurs in natural food materials. It is an experimental fact that some vegetables after being heated in boiling water exhibit an apparent increase in the amount of titratable ascorbic acid, which can then be extracted from the plant tissues.

Three explanations for this anomalous increase have been advanced:

(1) Heating breaks up the cellular tissue and allows a more complete extraction of ascorbic acid[1].

(2) A part of the ascorbic acid exists in a combined or esterified form which is hydrolyzed by heat or acid[2,3].

(3) Heating inactivates the oxidizing enzymes, thus preventing the oxidation of ascorbic acid[4].

The first explanation has been discarded, but the (2) and (3) have provided the basis for the present controversy. As a matter of fact, all the phenomena were noted by Tillmans and his associates[5] several years ago. They state that with certain vegetables the proposed titrametric method agreed with the biological assay method only if the oxidized ascorbic acid were reduced with hydrogen sulphide. The oxidation of ascorbic acid occurred during the extraction and might be prevented by heating before extraction or by extracting with stronger acid.

These facts have been insufficiently realized by later workers. Thus, Ahmad[2] considers that no oxidase was concerned, since raw cabbage extracted with cold 20 per cent trichloracetic acid gave a lower titre than boiled cabbage extracted with the same acid. The assumption that 20 per cent trichloracetic acid completely inhibits the enzyme action in cabbage is erroneous. In a forthcoming communication from this laboratory, it is shown that while the optimum *p*H for the reaction of ascorbic acid oxidase is about 5·5, a considerable activity persists at very much lower *p*H values. Although an oxidizing enzyme has been found in every one of nine vegetables investigated, its activity varies greatly. The oxidase in cabbage is barely inhibited by extraction with 1 *N* sulphuric acid, in which case the *p*H of the extract is 0·8. Furthermore, it should be realized that while the final concentration of an extract may be 20 per cent trichloracetic acid, it is very much less than that in the crushed plant cells during the first few moments of grinding up the vegetable.

Recently, Guha and Pal[6] have reported experiments which are claimed to demonstrate almost conclusively that the increase in ascorbic acid content of certain foodstuffs on boiling cannot be accounted for on the oxidase theory. Alcoholic and ethereal extracts of cabbage are claimed to give an increase in ascorbic acid after heating. It should be pointed out that ascorbic acid oxidase is completely inactivated by both absolute alcohol and ether. Therefore any increase in ascorbic acid on heating these extracts has no bearing whatever on the oxidase theory, but must be explained by other means.

EXPERIMENTAL PROCEDURE

Treatment	Ascorbic acid (mgm. per gm. of vegetable) Before Reduction with H_2S	After Reduction with H_2S
1. 20 gm. cabbage extracted with 100 ml. cold water	0·003	0·50
2. 20 gm. cabbage covered with 40 ml. cold water and heated 4 min. at 100° C. under CO_2. Extracted with 60 ml. additional water	0·47	0·48
3. 20 gm cabbage extracted with 100 ml. cold 1*N* H_2SO_4 containing 2 per cent HPO_3	0·50	0·51
4. 20 gm. cabbage + excess Na_2SO_4 extracted with 100 ml. cold anhydrous ethanol	0·51	0·54
5 20 gm. cabbage + excess Na_2SO_4 extracted with 100 ml cold anhydrous ethyl ether	0·004	0·03
6. Extract (1) heated 4 min. at 100° C. under CO_2	0·04	0·47
7. Extract (1) made 0·2 per cent with resp. to HCl, let stand 1 hour	0·006	0·43
8. Extract (1) made 1 per cent with resp. to HCl, let stand 1 hour	0·008	—
9. Extract (4) heated 4 min. at 100° C. under CO_2	0·50	—
10. Extract (4) heated 10 min. at 36° C. under CO_2	0·47	—
11. Extract (5) air dried, then heated in 50 ml. water 4 min. at 100° C. under CO_2	0·004	—

I have carefully repeated the experiments of Guha and Pal and failed to observe any increase in ascorbic acid content on heating. Instead, the results show that the samples of cabbage examined in this laboratory did not contain appreciable amounts of ascorbic acid in a combined state. If the enzyme is inactivated by heat or alcohol, or inhibited by extracting with *sufficiently strong acid*, the total amount of ascorbic acid is obtained. The fact that practically none of the ascorbic acid is recovered by acidifying or heating an aqueous extract indicates that nearly all the apparent increase on cooking is due to the inactivation of the enzyme. The slight increase on heating the aqueous extract may or may not be due to the liberation of bound ascorbic acid. I do not regard it as evidence of the existence of an ascorbic acid ester in natural foodstuffs.

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Aug. 3.

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[3] McHenry and Graham, *Biochem. J.*, 29, 2013 (1935).

[4] Van Eekelen, NATURE, 136, 144 (1935).

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[6] Guha and Pal, NATURE, 137, 946 (1936).

Phosphagen in Echinoid Muscle and in Electrical Tissue

IT has been shown[1,2] that the electrical organs of *Torpedo* contain phosphagen, thus adding another to the series of resemblances already known to exist between electrical and muscular tissue. The possibility that both tissues may make use of the same or similar chemical mechanisms led us to study the electrical cells of *Torpedo* from the point of view of the interrelationships of certain of the phosphorylated compounds believed to be concerned in muscle chemistry.

It was found that the partition of phosphorus in the tissue is very like that in the muscles of the rat and the frog, and the following observations all serve to confirm the close resemblance already mentioned. (1) Extracts and breis prepared from the electrical organ will synthesize creatine phosphoric acid from creatine and phosphoglyceric or phosphopyruvic acid in the presence of adenylpyrophosphate or adenylic acid under conditions which lead to a similar synthesis in muscle preparations. (2) In dialyzed extracts this synthesis is catalyzed by the magnesium ion. (3) Phosphoglyceric acid is converted into pyruvic acid (demonstrated by the nitroprusside reaction and by the formation of a crystalline 2–4–dinitrophenylhydrazone). (4) Phosphagen can be synthesized from adenylpyrophosphate in high concentration without the addition of phosphoglyceric or phosphopyruvic acid. (5) Adenylpyrophosphate is rapidly dephosphorylated by such tissue preparations.

Hence this electrical tissue, like muscle, contains enzymes capable of catalyzing the following reactions :

(1) Phosphoglyceric acid → phosphopyruvic acid ;
(2) Phosphopyruvic acid + adenylic acid → adenyl pyrophosphate + pyruvic acid ;
(3) Adenylpyrophosphate + creatine → adenylic acid + phosphagen ;
(4) Adenylpyrophosphate → adenylic acid + phosphoric acid.

It therefore seems very probable indeed that the cells of muscle and of the electrical organ of *Torpedo* alike derive the energy for their activity from the same chemical sources through the same chemical mechanisms, a suggestion which harmonizes with the well-known parallel between the physiological and pharmacological behaviour of the tissues in question, and the fact that they are both derived from embryonic pre-muscular rudiments.

Needham, Needham, Baldwin and Yudkin[3] reported the presence in the jaw muscles of *Paracentrotus* of two phosphagens, believed to be the phosphoric acid compounds of creatine and arginine respectively. In view of the phylogenetic interest[4] of these results we have studied the behaviour of certain phosphorylated compounds in the presence of enzyme extracts, prepared from the jaw muscles of *Sphærechinus granularis*, and have been able to demonstrate the synthesis of two phosphagen-like compounds from creatine and arginine respectively. The first of these behaves exactly in the way expected of creatine phosphoric acid, and in view of the results already reported by Needham, Needham, Baldwin and Yudkin, is almost certainly that compound. The second, synthesized by the enzyme preparations from arginine, behaves, so far as we can determine, like arginine phosphoric acid. Its hydrolysis is considerably retarded by molybdate, and the base liberated by the hydrolysis gives the Sakaguchi reaction and, when submitted to the action of arginase prepared from rabbit liver, gives quantitative yields of urea.

All the evidence we have obtained confirms the existence in echinoid jaw muscle of enzymes analogous to, if not identical with, those found in the muscles of other organisms and, as reported above, in the electrical organ of *Torpedo*, and we have found no reason to suppose that the mechanisms involved in the synthesis of the two phosphagens differ essentially from those demonstrated in vertebrate muscle by the Parnas school[5] and Needham and van Heyningen[6], and in arthropod muscle by Lehmann[7].

This confirmation of our earlier results makes us feel justified in laying considerably more emphasis than hitherto upon the phylogenetic significance of these purely biochemical results.

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August 15.

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[2] Baldwin, *J. Exp. Biol.*, 10, 222 (1933).

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[5] Parnas, Vᵉ Congrès de Chimie Biologique, Bruxelles (1935).

[6] Needham and van Heyningen, NATURE, 135, 585 (1935).

[7] Lehmann, *Biochem. Z.*, 281, 271 (1935).

Swarming of the Males of Certain European Anophelines in Captivity

THE study of the biology of the European *Anopheles*, particularly the complex of forms known as *Anopheles maculipennis*, has been greatly hampered by the difficulty of inducing mating under laboratory conditions. Missiroli and I[1] have given a summary of the experiments made with these mosquitoes, of which only the 'race' known as *atroparvus* has mated in captivity. In this form, it appears that there is no sexual dance on the part of the males as a preliminary to mating. Curiously enough, females of all the races will mate with *atroparvus* males, but repeated attempts on the part of many investigators to get them to pair with males of their own kind have failed.

Some years ago, I constructed a large cage of wire netting, 10·5 metres long, 5 metres wide, and 6·2 metres high, in connexion with the malaria laboratory in Albania. The cage was designed for the observation of the behaviour of *maculipennis*, and an attempt was made to make the conditions within the enclosed area as natural as possible. A cement pool, a stable, a small laboratory, and a tree were included within the cage. Fertile *typicus* eggs were found in the pool in 1934, but in small numbers compared with the quantity of mosquitoes released, and no sexual activity was observed in the cage. Between June 19 and July 12, 1936, we released in the cage 4,500 adults of *typicus* bred from the egg, and on July 7 we first observed swarming of the males, although larvæ had been found in the pool some days previously. Since then we have found the males swarming almost every evening, the swarm usually starting between 7.15 and 7.30 p.m., and the principal swarm always forming in the same position: about half a metre beneath the top of the cage, directly under one of the cross beams, and about half a metre from one of the upright poles supporting the side. This orientation, under the cross beam, seems very curious, and we should consider it to be fortuitous were it not repeated so frequently.

The wire cage is, of course, completely open to external stimuli, and we have been carrying on some experiments in the opposite direction: in a room insulated so far as possible from external stimuli, so that all the reactions of the mosquitoes would be to factors within the room. The room used is 2·5 metres long, 2·3 metres wide and 2·6 metres high. It is constructed of mud brick, with an air space between the ceiling and the roof; the windows are kept closed and have been covered on the outside with canvas curtains, so that the maximum light during the day is only about five foot-candles. The climate within the room remains remarkably constant, the temperature showing a diurnal fluctuation of about 5° around a mean of 20°, the humidity varying between 84 and 94 per cent. We released in this room about a thousand *maculipennis* adults bred from *typicus* eggs, but we did not observe any sexual activity, and we only obtained two batches of fertile F_1 eggs. At the same time, about 600 *Anopheles superpictus* were released in the room, and the males of this species were found to swarm under these conditions very readily, and numerous fertile *superpictus* eggs were found in the aquarium in the room. Up to July 27 we had released in the same room about 500 *Anopheles elutus*, raised in the laboratory. The males were first observed swarming on July 28, and afterwards batches of fertile eggs were found in the aquarium.

We are thus able to observe under varying conditions the sexual activities of the three malaria vectors of Europe. A few *bifurcatus* were also released in this room, and one evening four or five males were observed forming a swarm, and fertile eggs of this species were afterwards obtained.

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Seksioni Antimalarik,
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August 1.

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Persistence of the Eel-Grass Disease and Parasite on the American Atlantic Coast

EARLY in the summer, through facilities extended by Mr. John Lynch, of the U.S. Biological Survey, I was able to make a number of investigations of the existing eel-grass beds along the middle Atlantic coast, in the range of Cape Cod, Massachusetts, to Barnegat Bay, New Jersey. Mr. Lynch also supplied me with systematically taken specimens from beds farther north and south, Casco Bay, Maine, to Chesapeake Bay, Maryland, and with repeated observations from a number of points between. These studies were undertaken to discover to what extent the increasing number of optimistic reports concerning new and larger beds might indicate an effective return of the plant. For the greater part such reports describe late spring growths, during the season of rapid vegetative development, and give no clue of the plant's ability to withstand conditions arising in the less favourable warmer months, when the parasitic *Labyrinthula* is most active, or of its value as winter food for migratory birds, a matter of practical concern.

At the time of the first survey, in early June, small scattered beds of eel-grass, varying in vigour, were found all along the coast so far south as the northern end of Barnegat Bay, and extensive beds of small-leafed growths were described in the eastern shore of Chesapeake Bay, where the latter was being used for packing material. Barnegat Bay and the Delaware coast were notably free from the plant, as were the relatively rocky bays of the Connecticut coast.

The shallow bays of Long Island, Rhode Island, and Massachusetts bore patchy beds often several acres in area, and these were underlaid by extensive mats of healthy stem stock. These beds could conceivably be of ecological value, especially those along Rhode Island and Massachusetts, where the leaves averaged a metre in length, and foliation was relatively dense.

In all beds studied some plants were in seed, and, I understand from Mr. Lynch, a large fraction in the beds south of Cape Cod are now seeding. Seeds have been produced early in the summer for the past three years. It is surprising, therefore, to find but few seedlings even among the scattered plants in what appear to be new beds. Most shoots can be traced back to stem stock one or two seasons old, not very vigorous stock as a rule. If the beds continue to propagate mainly from stem stock, progress will be slow, even under favourable conditions of competition with the parasite.

Symptoms of the wasting disease were present everywhere in June, but there seemed to be no correlation between density of growth and infestation. The wasting is now at its height, so that some beds, as in Great Bay, Long Island, have entirely disappeared.

Specimens from all beds visited were examined microscopically for the *Labyrinthula* described in NATURE last year, and with which confirmatory inoculation experiments have since been performed[1,2]. Without exception it was present and active in streaked or mottled leaves, and in many regions it had already caused considerable wasting.

If previous experience may be taken as an indication, the following seasonal sequence may be expected: Very slow winter growth of the *Zostera* with the *Labyrinthula* passive in the leaves (the spindle form of the parasite has been found in winter specimens), rapid vegetative development in the late spring, with slight increase in activity of the *Labyrinthula*, diminution in the vitality of the plant prior to seed formation in the early summer with sudden activation of the parasite, destruction of leaves, development of new leaf shoots and their subsequent destruction (repeated several times in mid-summer), and final exhaustion of a portion of the stem stock and dying back of part of the bed developed earlier. A number of plants will seed prematurely, or will appear to because more retarded members die off before the normal fruiting period is finished. Barring the development of resistent strains of *Zostera* or general attenuation of the parasite, this seems to be the probable cycle within any progressive return of the plant. This, I realize, is not a cheerful interpretation, but it will be recognized that readjustments no less drastic, but easily overlooked, occur constantly.

I should be grateful to readers of NATURE for particular information on local conditions of the eel-grass in England and on the Continent.

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[1] C. E. Renn, NATURE, **135**, 544 (1935).

[2] C. E. Renn, *Biological Bulletin*, **70**, 148 (1936).

A Case of Complete Reversion of a Chromosomal Rearrangement in *Drosophila melanogaster*

THE process of gene mutation is known to be reversible, since back-mutations occur both spontaneously and under X-ray treatment. Yet no authenticated case of a complete reversal of a gene rearrangement has hitherto been observed. Muller and Stone[1] induced a partial re-inversion of the *ClB*-inversion of the *X*-chromosome, but neither of the new breaks corresponded to the original *ClB* breaks. A spontaneous re-inversion of the same inversion observed by Gershenson[2] has not been completely analysed; so it remains doubtful whether in this case old and new breaks coincided precisely.

In 1935, I described[3] a very long inversion of the *X*-chromosome induced by X-rays which was inseparably associated with a 'gene' for very rough eye-surface. In a stock homozygous for this inverted chromosome and carrying several recessive markers, animals with normal eye-surface appeared. Contamination was excluded by the fact that all the other factors were still present. A thorough genetical analysis showed that in these animals not only the rough eye-surface 'gene', but also the inversion had disappeared, and that old and new breaks were identical. This has since been checked up cytologically by my colleague, Mr. C. W. Emmens, in the salivary gland chromosomes.

The rough eye-surface associated with the inversion behaves allelomorphically with the factor roughest[3]. Genetical and cytological methods have hitherto failed to reveal any signs of a chromosomal abnormality associated with that mutant. Nevertheless, it remains still possible that roughest[3] is a position effect too minute to be demonstrable with our present methods.

This seems to be the first case in which a complete reversal of a gene rearrangement has been demonstrated by all available criteria. At the same time, the case furnishes crucial evidence for the existence of a position effect, since phenotypic effect and inversion appeared and disappeared simultaneously.

A detailed analysis of the case will be published in the *Journal of Genetics*.

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Aug. 28.

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[1] H. J. Muller and W. S. Stone, *Anat. Record*, **47** (1930).

[2] S. Gershenson, Drosophila Information Service, No. 1 (1934).

[3] Hans Gruneberg, *J. Genetics*, **31**, 163 (1935).

Different Results in Reciprocal Crosses between Diploid and Triploid *Allium Schœnoprasum* L.

IN the summer of 1934, crosses were made between diploid forms of chive ($2n=16$) and artificial triploids ($2n=24$)[1]. The somatic chromosome numbers in the progeny of these crosses have now been determined for 100 plants and are shown in the accompanying table.

The results exhibit a decided difference, according to whether the diploid or the triploid was used as the mother plant. In the former case, the majority of the progeny obtained were diploids, only 18 out of 71 plants having different chromosome numbers, namely, $2n=22$–24. In this cross the numbers 17–21 were not found at all. If, on the other hand, the triploid was used as the mother plant, all chromosome numbers between 16 and 24, except the number 20, were obtained. The trisome class, $2n=17$, which was not formed in the former case, was now the one most numerously represented. In addition, there also occurred one plant with 28 chromosomes, the result of the functioning of a giant gamete.

Direction of cross	Chromosome number of the progeny										Total of plants
	16	17	18	19	20	21	22	23	24	Med.	
$2x$ ♀ × $3x$ ♂	53	0	0	0	0	0	4	11	3	17·8	71
$3x$ ♀ × $2x$ ♂	8	9	1	2	0	4	1	2	2	18·5	29

It is obvious that the effect of the elimination or non-formation of aneuploid zygotes is greater when the embryo develops on a diploid than on a triploid plant.

These results are in agreement with earlier work on reciprocal crosses between diploids and triploids, for example, in *Oenothera*[2] and *Zea*[3].

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July 23.

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[1] Levan, *Hereditas*, **22**, 1 (1936).

[2] van Overeem, *Beih. Bot. Zbl.*, **38**, 73 (1921).

[3] McClintock, *Genetics*, **14**, 180 (1929).

The Feulgen Reaction of the Bacteriophage Substance

THREE years ago, a method was described which yielded pure preparations of a *Coli* bacteriophage of large particle size (*WLL*) in weighable quantities[1]. The high phosphorus content (3·7 per cent) of these preparations and their high affinity for basic dyes suggested—in connexion with other analytical results—that the chief constituent of the particles was of nucleoproteid nature[2].

It has now been found that they are intensively stained by Feulgen's reagent, generally regarded as a histo-chemical reagent for thymonucleic acid. Bacteria and bacterial debris (even a concentrated preparation of debris of phage-size obtained by lysing the organism with the very small phage *S*13 which afterwards could be removed by washing) treated in the same way remain unstained. So the phage-substance seems to be chemically different from any constituent of the bacterial cell normally present in significant amount.

The concentrated and purified preparations of a *Staphylococcus* phage obtained recently by Dr. Elford show exactly the same staining reactions as the *WLL-Coli*-phage.

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London, N.W.3.
Aug. 8.

M. Schlesinger, *Biochem. Z.*, **264**, 6 (1933).

[2] M Schlesinger, *Biochem. Z.*, **273**, 306 (1934).

Lightning and Atmospherics

IN NATURE of August 15, on p. 278, I notice a paragraph dealing with atmospherics produced by lightning discharges. From my own observations, I would express the opinion that the statements made in that paragraph only represent a part of the complete picture. There are so many different kinds of atmospherics observed both aurally in radio receivers and visually when they are recorded as by means of cathode ray oscillographs, that a complete generalization in such simple terms as are there expressed is scarcely possible.

With certain classes of atmospherics, in some cases quite a prolonged crackling can be observed lasting as much as a second before the lightning flash is observed visually. In such instances the crackling, one can only presume, arises from initial priming discharges somewhat in the nature of long brushing streamers, such as may be observed with high-tension electrical test apparatus, which brushing ultimately culminates in a complete sparkover. In all cases of observed atmospherics of this nature, the crackling sound of more or less prolonged duration finishes with a loud crack coincident with the final sparkover, which is observed as the visible lightning flash.

This type of atmospheric is only observed with certain forms of thunderstorms and is by no means of general occurrence. In many cases the sounds heard are of a simple click nature, which corresponds to straight sparkover without the preliminary brushing discharges giving the prolonged crackling sounds.

So far as my own observations go, the type of atmospheric particularly referred to, which gives the long crackling noise followed by the final crack of the sparkover, is a much rarer form than the simpler types in which it is obvious that the sound accompanies the visual flash. It is possibly for this reason that little notice has been taken of this form of discharge.

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Colloid Substrate in Photosynthesis

IN an earlier note on this subject[1] it was recorded that in the interaction of two salts in an aqueous medium, leading to the formation of periodic structures (mineral arboreal growth), a colloidal condition is created in the medium, this state remaining stable under the original experimental conditions.

Since then, it has been observed that whilst periodic structures find their existence above the transition point of the colloid to the physico-chemical associations approaching double salts, the range of the colloid state is much wider, extending both above and below this transition point. Thus in the interaction of calcium chloride with sodium carbonate, arboreal growth appears above the hydrocalcite to calcite transition point, that is, at 10°–12°[2] with a range of formation of 10°–12°. But the systematic formation of the colloidal phase itself commences with the appearance of the gelatinous membrane at the interface of the two electrolytes at about 4°, and is produced regularly so long as this membrane exists.

Close observation showed that the colloid was not always confined to the aqueous medium. Very often it was also dispersed in the air above it. During the eruptions from the membrane-protuberances, effervescence on the surface of the liquid could be frequently observed, and by means of a narrow parallel beam of light from a Miller projecting lamp, the Brownian movement of finely divided colloidal matter could be seen in the space above the liquid. The evolution of this effect depended on such experimental conditions as osmotic pressure, height of column of liquid above membrane and character of membrane itself.

In the light of researches by Baly, Dhar and others on photosynthesis, these observations when applied to marine and atmospheric surroundings appear to have an important bearing upon natural phenomena. Details of this work are to be published elsewhere.

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Aug. 17.

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[1] NATURE, **132**, 67 (1933).

[2] Copisarow, *J. Chem. Soc.*, **123**, 785 (1923).

Indication of a Decrease in the Polarizability of a Non-Polar Molecule by Pressure

SOME years ago, results were published of measurements on the dielectric constant of carbon dioxide under pressures up to 1000 atm.[1]. Using Amagat's isotherm data, where available, the Clausius Mosotti function $P = \frac{\varepsilon - 1}{\varepsilon - 2} \times \frac{1}{d}$ was calculated; P is proportional to the polarizability of the molecule. It was stated that P showed a tendency to decrease, the decrease at 1000 atm. being about 1 per cent. It was considered not impossible at that time that this decrease was due to an uncertainty in the density d.

Lately more accurate isotherms of carbon dioxide have been published[2]. Using these data, the value of P has been recalculated. As an example of the results, values of P have been plotted in Fig. 1 against density, and in Fig. 2 against pressure. It can be seen that P decreases with pressure and this decrease is obviously more simply related with the change in pressure than with the change in density.

There are two possibilities to account for this effect. The first is, that the Clausius Mosotti expression is not the exact relation between the polarizability of the molecules and the dielectric constant; the second one is, that the polarizability of a molecule is really decreased by pressure. With regard to the first possibility, it must be remembered that a rigorous proof of the Clausius Mosotti expression has not yet been given, and it is possible that the assumptions necessary to arrive at the formula do not hold under the present conditions. From the way in which the formula is deduced, and from a recent discussion by Darwin[3], it can be expected that, if corrections to the simple Clausius Mosotti expression are necessary at higher densities, these will be functions of density, which will not strongly depend on temperature. This view is, however, in contradiction with the experimental data.

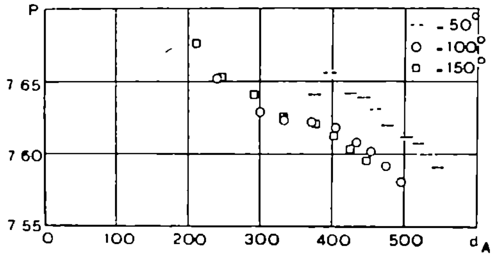

FIG. 1.

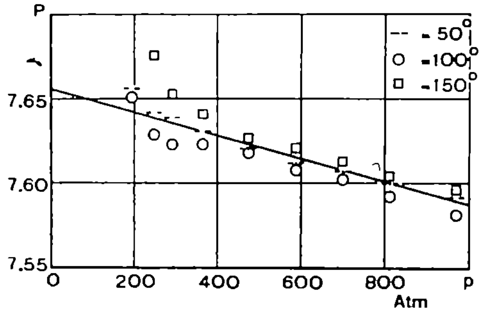

FIG. 2.

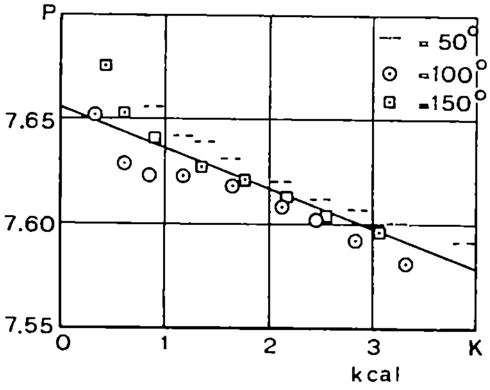

FIG. 3.

In favour of the second possibility, an argument can be given making use of the virial theorem. If the constituent parts of the molecule, that is, nuclei and electrons, are treated as separate particles, all the forces acting between those particles are Coulomb forces. The virial theorem applied to such a system leads to

$$3\Delta pv = \Delta K + \Delta U^4.$$

where pv is the product of pressure and volume, U is the total energy of the system, and K is the sum of the kinetic energies of all particles. For an isothermal compression the kinetic energy of the molecules (for example, translational and rotational) is constant by the equipartition law. Therefore ΔK measures the increase of the kinetic energy of the internal motion of the molecules (for example, kinetic energy of nuclear vibrations and electronic motion) and can be considered as a useful measure of any alteration inside the molecule, caused by compression. It is, therefore, apparent that a relation between ΔK and P must be sought.

In the case of carbon dioxide, ΔK—which can be calculated from isotherm data—amounts to 3·5 kgm. cal./mol. at 1000 atm., or 0·15 e.v. per molecule. It changes almost linearly with p, and is affected only slightly by temperature. The simple relation found between P and pressure therefore points to a similar relation between P and ΔK. In Fig. 3, P is plotted as a function of ΔK, for three sets of measurements at different temperatures, and it can be seen that, within the experimental accuracy, P is a linear function of ΔK. (The uncertainty in P is estimated as ± 0·03 at density 200 A.; ± 0·015 at 400 A.; ± 0·01 at 600 A.)

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[1] Michels and Michels, *Phil. Trans.*, A, **231**, 587 (1933).
[2] Michels and Michels, *Proc. Roy. Soc.*, A, **153**, 201 (1935).
[3] C. G. Darwin, *Proc. Roy. Soc.*, A, **146**, 17 (1934).
[4] W. Schottky, *Phys. Z*, **21**, 232 (1920); J. C. Slater, *J. Chem. Phys*, **1**, 691 (1933).

Excitation of Raman Spectra of Substances with the aid of 'Optical Catalysers'

IN a recent paper[1], we have shown that the infrared frequencies of glass can be calculated by taking the wave-lengths of the maxima of absorption bands of didymium glass as the incident exciting radiations, and those of the maxima of the fluorescent bands of the same glass excited by sunlight, as the Raman lines. The values thus obtained are in excellent agreement with those obtained for glass by the usual method of experimentation using a mercury lamp and many hours of exposure.

Following the same method of experimentation, we have now extended our observations to water, methyl alcohol, ethyl alcohol, acetone, pyridine and nitric acid solution in water. In order to produce absorption bands in these media, a trace of potassium permanganate was added to each of the above substances. The corresponding fluorescent bands obtained with sunlight were photographed. The duration of exposure varied, from two to three hours giving sufficiently strong bands on development of the plate. From the wave-lengths corresponding to the maxima of absorption and fluorescent bands as located by microphotometric records for each material, Raman shifts have been calculated which represent both fundamental and combination frequencies. It is interesting to point out in this connexion that combination frequencies calculated in this way, when not in agreement with the values of previous workers, can still be built up either entirely with their values or jointly with our own.

The importance of this new technique for the study of Raman spectra lies in two directions. First, with the use of sunlight the time of exposure is considerably cut down, so that very faint lines can also be brought out; secondly, small shifts of faint Raman lines, which generally are masked by the strong incident spectrum, can be calculated.

Since the minute traces of potassium permanganate used to produce the absorption bands in the various substances do not seem to affect their modes of vibration concerned in the Raman effect, their action and that of didymium salts in glass may very appropriately be referred to as 'optically catalytic'. Workers on the Raman spectra of glass have also noted previously that small quantities of metallic oxides present in different varieties of glass do not alter their Raman lines.

There are other points connected with the method which throw an interesting light on the nature of the relations observed. For example, the work of Merton[2] and Taylor[3] on the absorption bands of solutions of potassium permanganate in different solvents shows that the differences of wave numbers between successive bands, for any solution, are not really constant, although their mean value is usually taken to represent the frequency of the MnO_4 ion as affected by the particular medium of the solvent. On the view taken in this paper, these discrepancies between the differences of wave numbers of the successive absorption bands are real, and are due to the fact that the actual positions of the absorption bands are conditioned by the appearance of Raman lines representing either fundamental or certain combination frequencies of the solvent medium, at certain definite wave-lengths constituting the fluorescent spectra of the substance under examination.

No results are given here as they would occupy too much space. They will be published with full experimental details elsewhere shortly.

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Aug 11.

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[1] *Z. Phys.*, 98, 324 (1935).

[2] *Trans. Chem. Soc.*, 99, 637 (1911).

[3] "Molecular Spectra and Molecular Structure", Faraday Soc. Disc. No. 790, pp. 860–63 (1929).

Points from Foregoing Letters

THE first quantitative measurements of the abundances of the elements in the planetary nebulæ are derived by Mr. T. L. Page from the intensities of 'forbidden' lines in the spectra of these objects. An explanation is sought for the surprisingly high abundance of neon and argon relative to oxygen, as compared with their proportions in the composition of the earth.

A variety of radioactive bromine has been detected, by Dr. C. H. Johnson and F. T. Hamblin, which possesses a half-period of some twenty-four hours. The authors consider that it is either an activated bromine nucleus or a new isotope.

The absorption of neutrons (belonging to Fermi's group C) by boron and by cadmium at ordinary and at low temperatures has been determined by a group of investigators from the Ukrainian Physico-Technical Institute. They conclude that the absorption curve of cadmium has a selective character. The results for boron do not agree with the 'inverse velocity law', but that may be due to a deviation of the silver detector from the $1/v$ relation.

G. L. Mack writes that he has failed to confirm the increase of ascorbic acid (vitamin C) when cabbage is boiled, as reported by Guha and Pal. The amount, he says, is no greater than that obtained by alcohol extraction or after treatment with hydrogen sulphide. The author concludes that practically all the apparent increase is due to the inactivation of an oxidizing enzyme, and not to the hydrolysis of an ascorbic acid ester.

E. Baldwin and Dr. D. M. Needham find that the electrical tissue of the ray, *Torpedo*, contains enzymes analogous to those found in the muscular tissue of that fish, and also in the jaw-muscle of the sea-urchin, *Sphærechinus granularis*. They deduce that both muscle and electrical organ derive their energy from the same chemical sources and through the same chemical mechanism.

In a stock of fruit-flies with very rough eye surface, accompanied by an inversion in the X-chromosome (originally induced by X-rays), Dr. H. Grüneberg has observed the appearance of animals with normal eye surface and without chromosome inversion. This is claimed to be the first clearly demonstrated case of complete reversal of a gene rearrangement.

A. Levan reports that crosses between two strains of chive (*Allium Schœnoprasum*) containing 16 and 24 chromosomes respectively gave offspring containing mostly 16 chromosomes when the mother plant contained 16, while when the mother plant contained 24, the chromosome number in the offspring varied between 16 and 24 (except 20), the most frequent being 17.

Dr. M. Schlesinger finds that his pure bacteriophage preparations are intensively stained by Feulgen's reagent, whilst bacteria and bacterial debris treated in the same way remain unstained.

Graphs showing the relation between the Clausius Mosotti function, P (proportional to the polarizability of the molecule) and the density, the pressure and the change in kinetic energy of the internal motion of the molecules, ΔK, are given by Prof. A. Michels, C. Michels-Veraart and A. Bijl, from calculations based upon recent data for carbon dioxide. They find a nearly linear relation between the polarizability and the pressure, also between polarizability and ΔK.

Previous work of Prof. K. Prosad and D. K. Bhattacharya on didymium glass, of which the wave-lengths of absorption bands were taken as the incident exciting lines for the study of the Raman spectra of glass with very satisfactory results, has now been extended to a number of organic liquids and to nitric acid solution. Absorption bands in these liquids were produced by adding traces of potassium permanganate.

Research Items

Asianic Deities in the Paganism of Ancient Georgia

A RE-EXAMINATION of the evidence relating to Paganism in early Georgia by Prof. M. Tseretelli (*Georgica*, 1, 1) indicates the need for revision of hitherto accepted views, and the recognition of a considerable Asianic element in the ancient cults of the Caucasian area. The deities enumerated in the sources are Armaz Zaden, Ga or Gaím and the Chaldean goddess It'rujan, or It'rushana. The resemblance of Armaz to Ahura-Mazda, together with the fact that Mazdaism was introduced into Georgia long before Christianity, suggests an obvious identification. There is no doubt that Armaz is a Georgian national deity. The account of the copper idol and the religious festival of Armaz given by St. Nina point to identification with Teshub, the god of the Mitanni and Urartaeans, the pre-Indo-European people of Armenia, who is represented with thunderbolt and axe, and may be related to Zeus Labraunda and Jupiter Maximus Dolichenus, *natus ubi ferrum exoritur*, whose worship was said to have been brought to Kommagene by Khalybean smiths. The god Zaden with Armaz gives rain and fertility to the Georgian soil. He is, in fact, the Asianic god of fertility, Sandar or Marduk, the Babylonian Tamūs. The custom of offering first fruits and the first born of man and beast to Zadin is probably Semitic. Human sacrifice was also offered to Ga and Gatsi. It is argued that Gatsi and Ga are the 'father' and 'mother' of the widespread fertility cult. A deity not mentioned in the texts, the goddess Ašhara, is still worshipped among the Abkhasians. She may be the goddess Išhara, mentioned in the Boghazhoĭ texts, who was also worshipped in Babylon, Assyria and Elam. She is the tutelary goddess of the homestead, and the mountaineers still worship "the angel of the house". Finally, there is the Chaldean goddess It'rujan who is opposed to Armaz. It'ru is rightly identified with Ishtar; 'jan' is probably Samain, the goddess of heaven, who as a Chaldean deity destroyed the idol of Armaz and was resisted by the natives. There is also evidence of a tree and pillar cult.

Antiquities in Shetland

A TOUR of archæological investigation in Shetland made by Mr. Ludovic Man in July last, following up a similar investigation in Orkney last year, has produced some interesting results. An examination of the glacial clays and derived gravels produced a number of rolled stone implements of types similar to those of the palæolithic cultures of England and France. At Bressay an old land surface about three feet below the existing surface yielded more than a hundred tools, mostly of quartz and quartzite and of small dimensions, unrolled with sharp edges, which Mr. Man classifies as mesolithic. On Ward Hill at Sumburgh, a settlement of considerable size has been exposed by wind erosion. Stone foundations of a large number of buildings have been bared. The walls appear to have been three feet thick at the base, and the oval internal chamber some fifteen feet by ten feet in dimensions. No traces of superstructure survive; but stone implements, the half of a large saddle quern, and a massive hammer-stone, weighing thirty pounds, point to a considerable antiquity. Possible evidence of cultivation is found in small cleared plots, thirty feet in diameter, with the stones from the clearing lying without system on the periphery—it may be a prehistoric anticipation of the present method of cultivation in walled enclosures. The most interesting find, however, was at Braewick, where storm water had breached an 'ayr', or storm beach, and drained a small lock, exposing ancient timbers, in which the distinctive character of the nails, and the wooden pegs with hexagonal shafts, point to a Viking origin. If further examination of the material, which is now in Glasgow, confirms Mr. Man's conclusion that this is part of a Norse boat, it is the first find of that kind to be recorded in Scotland.

Fossil Horse Remains from Idaho

NORTH AMERICA has supplied in its remains of fossil horses one of the most complete of evolutionary series. The collection of bones described by C. Lewis Gazin, from the Hagerman lake beds of Idaho, belonging to the Upper Pliocene, contains an abundant assortment of remains of *Plesippus shoshonensis*, an advanced member of its genus bordering on the horse types of the Pleistocene age (*Proc. U.S. Nat. Mus.*, 83, No. 2985, 281, Washington 1936). The material included 130 skulls of the species named above, and a large quantity of other skeletal material, some of which was found still in a position of articulation. The appearances are that the remains accumulated naturally round a water-hole, for amongst the many other vertebrates which are represented in the Hagerman beds there is a noticeably large number of aquatic forms. The paper contains descriptions, measurements, and comparative comments upon the horse remains.

Urethral Sinus in Rodents and Insectivores

THE male of certain rodents and insectivores possesses a sac-like diverticulum of the urethra, the urethral sinus. The development of this structure in the white mouse and its occurrence in other forms have been dealt with by Hall (*J. Anat.*, 70, Pt. 3, 1936). The sinus makes its appearance about the sixteenth or seventeenth day. At this time, the fusion of the genital folds gives rise to the penile or secondary urethra, and the sinus arises as a dorso-lateral bulge at their point of junction, but is derived from the primary urethra. A pair of solid club-shaped structures then arise as buds from the urethral epithelium just at a point where the sinus bulge occurs; these are the rudiments of Cowper's glands, which in the adult open into the base of the urinary sinus. The walls of the sinus are similar in nature to those of the urethra, and contain glands, whereas the epithelium of the penile urethra is non-glandular. The presence of this urino-genital sinus is reported in *Evotomys glareolus*, *Microtus hirtus*, *Apodemus sylvaticus*, *Mus rattus*, *Cricetus auratus* and *Fiber* (that is, *Ondatra*) *zibethicus*. It is apparently not present in *Cavia cobaya*.

Loose Smut of Oats

THE fungus *Ustilago Avenæ*, causing loose smut of oats, is capable of infecting its host through the stigma of the flower, and the disease may also appear from later infection. A paper by Mr. Robert McKay ("Methods of Infection of Oat Grain with Ustilago Avenæ and the Influence of External Factors on the Incidence of the Disease", *Sci. Proc. Roy. Dub. Soc.*, 21, No. 33, July 1936) shows that under the conditions of the crop in Ireland, the fungus produces a resting mycelium within the glumes, and further spores may also lodge there. These remain ungerminated until the following spring. Experiments on washing flower-infected grain in water, and on removing the glumes (de-hulling), both gave a substantial reduction of infection in the subsequent crop. A combination of these two methods of treatment resulted in almost complete control of the disease, and suggests that most of the infection is brought about by the ungerminated spores lodging within the glumes.

Immunity of Apples to Woolly Aphis

IN certain countries the use of immune stocks and stems on which desirable varieties are grafted has met with considerable success as a means of combating attacks of woolly aphis (*Eriosoma Lanigerum*). An attempt to elucidate the underlying causes of resistance and immunity to this pest is described by M. B. Crane *et al.* (*J. Pom. and Hort. Sci.*, 14, 2, 137; 1936). Its life-cycle is outlined, and preliminary experiments on the physiological aspect of immunity described. These suggest that the mechanical structure of the stem and the presence of certain insoluble substances may possibly be related to resistance, though they do not explain complete immunity. A genetical analysis was made by crossing a large number of common apple varieties with a number of well-known susceptible and immune rootstock varieties and testing the resultant seedlings for resistance or immunity. The results of this analysis indicate that "the hereditary behaviour of immunity is determined by and dependent upon a certain balance of genetic factors and is governed by a number of genes, the action of which is in part complementary and in part cumulative". Several immune seedlings raised in this way are being tested for their suitability for general use in respect to vigour, ease of propagation and productivity.

Diorites of the Cascade Range, Oregon

A SERIES of dioritic intrusions penetrate Tertiary volcanic rocks in a narrow belt which extends longitudinally through the Cascade Range of Oregon. An interesting regional study of these rocks and the associated metasomatism and metamorphism has been made by A. F. Buddington and E. Callaghan (*Amer. J. Sci.*, 421–449; 1936). The intrusions are mostly dyke-like, but there are numerous plugs and a few small stocks. The rock-types represented range from augite-diorite to granodiorite and porphyritic dacite. Replacement of plagioclase by orthoclase is a common feature throughout. Similar orthoclasization, described by Gillson, transformed a gabbro into quartz-monzonite (Pioche, Nevada) and was ascribed by him to the action of potash-bearing emanations from below during the magmatic stage and also, locally, after solidification. The Cascade rocks are shown to be closely related chemically to those of the Mesozoic intrusives of the Sierra Nevada. Volcanic rocks surrounding the intrusions have been modified through zones varying in width from a few inches to nearly half a mile. In places the original rocks (basalt-andesite-rhyolite series) have been wholly reconstituted and changed to tourmaline-hornfels.

The Patwar Meteorite, 1935

IT has been estimated that the number of meteorites recovered, after their fall to the earth's surface has been actually seen, averages about four per year since the year 1850. A large proportion of these meteorites are stones or masses of crystalline rock, a much smaller proportion being composed of metallic iron alloyed with nickel and cobalt. An account of the "Patwar Meteoric Shower of 29th July, 1935", by Dr. A. L. Coulson (*Rec. Geol. Surv. India*, 69, 439), illustrates the considerable amount of careful work required to ascertain the circumstances of the fall of a meteorite, the recovery of its various parts, and the subsequent mineralogical and chemical analyses. Reports collected from the Tippera district of Bengal indicate that the Patwar meteorite fell on July 29, 1935, at $14^h\ 20^m$ Indian Standard Time. Its fall was accompanied by the usual phenomena of light and sound. Five portions of the meteorite were recovered over an area of about 4½ square miles. The largest portion, weighing 23 kgm., which came from Patwar, had penetrated the ground, presumably soft owing to monsoon conditions, to a depth of 34 inches. This portion, which is completely illustrated in the report by a number of photographs, has a greatest circumference of 2 ft. 9½ in.; its greatest length is 1 ft.; its breadth 10 in. and its thickness 8½ in. The specific gravity of the meteorite is 4·21. Analysis shows that the meteorite, which is intermediate in composition between a stone and an iron, is composed chiefly of nickel-iron, with olivine, enstatite and bytownite, together with smaller amounts of other compounds including hydrocarbons.

Absorption of Short X-rays

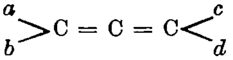
T. R. Cuykendall and M. T. Jones have recently described (*Phys. Rev.*, 50, 105) absorption experiments on X-rays from a 600 k.v. tube. A double crystal spectrometer was used to isolate X-ray beams of wave-length down to 40 X.U. The absorption of very short X-rays by carbon was in excellent agreement with the Klein-Nishina scattering formula. The absorption coefficients for a number of elements, heavy and light, were determined, and the photo-electric part of the absorption fitted to an empirical formula. The photo-electric absorption observed in lead in this frequency region is about 10 per cent higher than that calculated theoretically by Hulme and others.

Mass-spectrographs

IN an article on "Second Order Focusing for Mass Spectrographs" (*Proc. Camb. Phil. Soc.*, 32, pt. 3) Mr. W. W. Sawyer considers the conditions under which focusing may be improved when, instead of the electrostatic deviation being produced by the field between parallel plates, the field between co-axial cylindrical plates with the axis perpendicular to the plane traversed by the charged particles is substituted. The mean path of the particles in this field is nearly a concentric circle, and on emergence they enter a magnetic field the lines of which are parallel to the axis of the cylinders and the section of which is a circle. The advantages of this arrangement were mentioned by Dr. F. W. Aston in a recent note in NATURE (137, 357 ; 1936). Mr. Sawyer gives the dimensions of the spectrograph constructed on these lines as follows : mean radius of cylinders 40 cm. ; angle subtended at the axis ½ radian ; distance from farther edge of electrostatic to near edge of magnetic field 15 cm. ; diameter of magnetic field 15 cm. ; the near edge of the photographic plate is 11·3 cm. beyond the farther edge of the magnetic field and 16·2 cm. from the axis of the beam between the two fields ; and the plate itself is inclined at 24° to this axis.

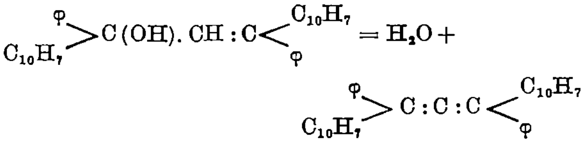
Resolution of an Allene Compound

THE prediction that optical activity could be exhibited by allenes of the general type



$$ {}^{a}_{b}\!>\!C = C = C\!<\!{}^{c}_{d} $$

was made by van't Hoff in 1875 ("La Chimie dans l'Espace", p. 29) and many unsuccessful attempts were made to verify it. The linking of the central carbon atom in the triad differs considerably from those types for which the tetrahedral theory has been shown to hold. The groups a and c and b and d may be identical. P. M. Raitland and W. H. Mills (*J. Chem. Soc.*, 987 ; 1936) have now shown that the compound in which $a = d = C_6H_5 = \varphi$ (phenyl) and $b = c = C_{10}H_7$ (naphthyl), when produced by the catalytic dehydration of the alcohol :



$$ {}^{\varphi}_{C_{10}H_7}\!>\!C(OH).CH:C\!<\!{}^{C_{10}H_7}_{\varphi} = H_2O + {}^{\varphi}_{C_{10}H_7}\!>\!C:C:C\!<\!{}^{C_{10}H_7}_{\varphi} $$

by means of optically active catalysts, can be obtained in two entiomorphous forms. As catalysts, *d*- and *l*-camphor sulphonic acids were used in benzene solution. The specific rotation $[\alpha]_{5461}$ of the active allene has the large value of 437°–438°. The two forms (m.p. 158°–159°) combined in solution in ether to a racemic compound (m.p. 242°–244°). Van't Hoff's prediction of the enantiomorphism of unsymmetrically substituted allenes is thus verified. It depends on the assumptions of the linear arrangement of the three carbon atoms and the disposition of the external valencies of the terminal carbon atoms in planes at right angles to one another.

The Marconi-E.M.I. Television System

ON the occasion of the recent demonstrations of television provided in connexion with the Radio Exhibition at Olympia, the programmes were transmitted on alternate days by the Baird system and by the Marconi-E.M.I. system. Some details of the latter system are given in an illustrated pamphlet just issued by the Marconi-E.M.I. Television Co., Ltd. The system employs one or more 'Emitron' scanning cameras, having no moving parts, by means of which the scenes to be transmitted are directly and continuously transformed into electrical impulses without the intermediary of a film device. These cameras can be used under normal conditions of daylight on exterior locations or in studios. Film scanning cameras are also included in the normal equipment. In either case, the resulting electrical impulses are fed to a specially developed modulator unit, whence the oscillations of the main transmitter are controlled. A suitable synchronizing signal is included in the transmissions by means of which complete steadiness of the received picture is ensured. The pictures are transmitted at a frequency of 25 per second with a scanning detail of 405, 240 or 120 lines, and provision is made in the equipment for either straight or interlaced scanning. The latter system is recommended since flicker of the received picture is entirely eliminated. The radio transmitter consists essentially of a master oscillator, frequency doubler and amplifying and modulating equipment. With the carrier frequency in the region of 40 megacycles per second, it is claimed that the frequency can be maintained constant to an accuracy of ±1 part in 20,000. The modulating stages are designed to have linear response from zero frequency up to 3 megacycles per second. The aerial system comprises a number of aerial and reflector units suspended round the periphery of an octagon ; the whole system is designed to give maximum radiation in the horizontal plane, uniform in all directions. In the arrangement of the aerial system at the B.B.C. station at Alexandra Palace, the aerials for the sound and vision transmissions are erected one above the other on the same tower.

Accuracy of Meteor Observations

WITHIN recent months, three independent articles have appeared in different journals dealing with this subject. Mr. B. S. Whitney has published (*Mon. Not R.A.S.*, 96, 5, March 1936) an interesting paper, "New Methods for Computing Meteor Heights", in which it is admitted that meteor heights deduced from ordinary visual observations are subject to large errors because of the difficulty in observing and plotting the paths accurately. He proceeds to develop a method for adjusting the beginning and ending as seen at different stations, the adjustments being the smallest possible which will refer the recorded directions to a common point. In the case of multiply observed meteors or fireballs a least square solution is developed, and three cases have been already computed by the method by the staff of Flower Observatory of the University of Pennsylvania, where the author is engaged in research. Unfortunately, the numerical results are not given, so it is impossible to judge the extent of the observational errors. In *Popular Astronomy* of May 1936 there is an article by Messrs. F. Watson, jun., and E. M. Cook, entitled "The Accuracy of Observations by Inexperienced Meteor Observers", in which some rather startling conclusions are drawn from the results of observational tests. It appears that in the case of inexperienced observers, the probable error in the direction of a meteor lies between ± 10·8° and ± 18·8°. Experienced observers, however, concentrating on bright meteors, have reported observational errors as low as ± 4°. The Rev. Dr. M. Davidson (*J. Brit. Ast. Assoc.*, 46, 8, June 1936) has given a very comprehensive analysis of the method which he proposes for computing real paths, assuming the *direction* of flight to be accurately recorded, but allowing for the beginning or ending of the apparent path to be missed. In this article, "The Computation of the Real Paths of Meteors", two numerical examples are fully worked out, and it is shown that in both cases a considerable portion of the flight was missed by one or other observer. These papers suggest that the whole subject of meteor observation may require reconsideration in order that more accurate results may be obtained.

Science and Electric Lighting

A POPULAR discourse at the Blackpool meeting of the British Association was given on Friday, September 11, by Mr. C. C. Paterson. He chose as his subject "Science and Electric Lighting", and illustrated his discourse by many striking and spectacular experiments. Through the medium of these experiments, he enabled the audience to picture the present outlook of the scientific worker in the field of electric lighting and how rapidly it is changing. During the last four years, the amount of light that can be obtained from a given quantity of electricity has been increased three times. During this time, it has also been demonstrated that it is possible to make lamps of which the luminous component is at least a hundred times brighter than the brightest filament previously available. These great achievements are rapidly being exploited by industry in Great Britain.

Mr. Paterson began by showing the fundamentally different methods of producing electric light by filament lamps and discharge lamps. In one we obtain light from solids and in the other from vapours. In the latter kind of lamp, the light comes from vapour made brilliantly luminous by passing electricity through it. He showed a lamp with a container for a small quantity of vapour having a volume of about a twentieth of a cubic inch. Success followed research when it was found how to pass a current through this little enclosure. The difficulty was to make the free molecules of the vapour carry electricity, but once the current started it was difficult to control it. The intensity of the light in this lamp is a measure of the vigour with which the molecules of vapour respond to the stimulation. The molecules of different vapours respond in different ways, and they show their peculiarities by the nature of the light they emit. By the spectrograph, this light can be separated into its various components, and from the point of view of the lamp maker these specify the lamp.

In the incandescent filament lamp, the filament, of which is now made of tungsten, and is heated to a very high temperature, the molecules of the solid tungsten do not radiate light in the same way as vapour molecules. This is shown by the fact that the spectrum of this lamp contains all the colours shaded into one another. The spectrum of any incandescent solid or liquid is always of this type. This follows because the molecules cannot move as if they were in free space ; they are constrained by the neighbouring molecules. Their light is very similar to that of the sun, which comes from incandescent gases and vapours under extreme conditions of pressure. The light given by an incandescent filament being a rough imitation of sunlight satisfies our demands for illumination. Why therefore should we want to use something else ? The reason is that the new lamps are able to give us much more light in comparison with the waste heat that is always produced.

With filament lamps the higher their temperature the more light they give, but the tungsten evaporates more rapidly the higher the temperature and thus its life is short. Research has discovered that if we coil the filament so that it occupies less space, the total convection currents will be less and the evaporation will be reduced. From this was developed the tightly coiled gas filament lamp which has been the most popular type of electric lamp for the last twenty years. In addition, by coiling the coil the efficiency can be still further increased. More than half the number of lamps now used in Great Britain for domestic purposes have coiled coil filaments and they give up to twenty per cent more light for the same consumption of electricity.

The metal tungsten out of which the filament is made is one of the toughest and most refractory of metals. It is so hard that it has to be drawn through diamond dies which have to be pierced with round holes no more than the size of a fine human hair. The wire diameter has to be correct to within 0·5 per cent, that is, five millionths of an inch. The craftsmanship of the girls who do this wire drawing is deserving of the highest praise. Mr. Paterson said that one of them described the process to him as like threading a wire you can't see through a hole that isn't there. This minute thread has then to be coiled with the greatest uniformity and equal precision, and finally the coil has to be again coiled. Out of the 3,775 turns in this spiral, not a single one must touch its neighbour, although the space between them is less than the thickness of a cigarette paper.

The enhanced efficiency of a vapour lamp is due to the absence of unwanted kinds of radiant rays. For mercury vapour lamps the effective light radiated is about three times as great for the same consumption of energy. If we had two electric lamps both using a pennyworth of electricity a day, but one giving only blue light and the other only green light, the latter appears to give more light than the former. The reason is that the green light is more useful to see with—in other words, it appears brighter. For this statement to be strictly correct, it has been presupposed that the blue light and the green light demand the same proportion of the electric power to produce them.

Tubular lamps were shown containing vapours of many kinds, and the difficulties of producing light of a satisfactory colour at a cheap rate were considered. The sodium lamp, which is the most economical, gives light of an unpleasing colour, and unfortunately no good way of correcting this colour defect has yet been invented. The neon lamp has been found very useful for floodlighting red brick buildings and for other colour effects. It is almost completely deficient in green and blue rays.

Mr. Paterson mentioned that some new investigations have opened out a new and very promising field of research. It has been discovered that if we coat the inside of a neon tube with a certain luminescent powder, the activity of the gas in the tube excites the characteristic fluorescence of this powder. It therefore gives out light of the colour we want, which, as it mixes with the red light from the neon gas, gives a series of pleasant colours very suitable for interior lighting. Hitherto it has only been found possible to excite fluorescence to an appreciable extent by direct excitation of the powder by the electrons of which the current consists, or else by means of the mercury discharge, which is very rich in ultra-violet lines. The great advance lies in the discovery that neon, which is comparatively poor in ultra-violet light, can by using suitable powders be made to excite luminescence. These luminescent materials will probably be largely used in electric discharge lamp lighting. They will add the missing colours to light given out by vapours and gases, thus making objects illuminated by them appear as they do in daylight.

It was found four years ago that very great yields of light could be obtained from the passage of electricity through mercury vapour, if the pressure of the vapour was increased to about one atmosphere instead of using only one hundredth of an atmosphere as in the older types of lamp. This has led to the improved lighting of hundreds of miles of streets in Britain. There are now about 15,000 street lighting posts fitted with these lamps.

Light is becoming so cheap that it is foolish not to make full use of it. Its liberal use contributes greatly to safety. It enhances the beauty of our homes and increases the efficiency of our workshops. Gardens and highways at night can be made beautiful by its use. Blackpool, perhaps more than any other town, has improved its amenities by using artificial light. Incidentally, this gives a royal welcome to its visitors.

Plant Hunting and Exploration in Tibet

THE second evening discourse at the Blackpool meeting of the British Association was delivered on September 15 by Capt. F. Kingdon-Ward. He said that however much we may regret some of the results of the industrialization of Britain—the destruction of forest, the urbanization of pasture land, slums, and so on—our country is in some respects a vast improvement on the England of four centuries ago. It was then a colourless land, especially during the winter. Thanks to the great interest taken in horticulture and sylviculture to-day, it is that no longer. About twelve thousand species of introduced trees, shrubs and herbs are cultivated in the open—nearly ten times the total number of flowering plants which occur wild. Thus the British climate must be singularly elastic, and the plants themselves highly adaptable. Probably in no other country in the world of equal area can so many alien plants be grown. Some are difficult, but more are easy, and not a few naturalize themselves.

Tibet, the highest plateau in the world, is not as is generally supposed a complete desert. There is a gradual increase in the flora from west to east, and from north to south, corresponding with the change in the physiographical nature of the country; the vegetation slowly changes from tundra to scrub and grassland, and from scrub to forest. Naturally, the most prolific and varied flora is found in the forested south-eastern region. This flora is a mixed one. The climate varies greatly from warm temperate at the bottom of the gorges where Tibet reaches its lowest altitude at 5,000 feet, to subarctic on the high snow-clad ranges the peaks of which attain 25,000 feet. All adjacent regions—China, Indo-Malaya, the Himalaya—have contributed to the flora of Tibet. Not every plant found there is hardy in Britain, but a surprising number are. Nor is it possible to forecast whether a given plant will be hardy or not; experience enables one to make a shrewd guess, but no more. On the whole, the plants which have proved most adaptable to our gardens are those which are not found growing under extreme conditions; that is to say, the plants, not of the tundra, nor of the deep forested river gorges, nor of the highest alpine ranges, but those of the intermediate scrub-clad plateau country, at 10,000–12,000 feet altitude.

Throughout the summer, one is busy collecting plants in flower. In late autumn, one starts harvesting seeds. It is not necessary to mark the plants when in flower, of which seed is required. Most plants are found over extensive areas where the climatic conditions are similar, and constant practise enables one to recognize a given plant by its fruits as readily as by its flowers. Particular plants occur in prodigious numbers; most species are at least common; the difficulty is to discover a rare plant! Capt. Kingdon-Ward said that he could recall very few of which he discovered but *one* specimen—*Leycesteria crocothyrros* is one of them.

Tibet has become famous as the land of the blue poppy (*Meconopsis betonicifolia*) and the scarlet creeping rhododendron (*R. repens*). But it is equally the home of many other beautiful flowers, as gentians, lilies, barberries, primulas and many more.

Science at the International Peace Congress

SCIENTIFIC concern for the preservation of world peace found abundant expression at the International Peace Congress held at Brussels on September 3–6. Special commissions considered the bearing of art, science and letters, medicine, agriculture and education on the problems of peace and war, the report of the Science Sub-Commission, formed by a small but internationally representative body of scientific workers under the chairmanship of Dr. J. D. Bernal of Cambridge, being typical of the constructive attitude of the professional delegates.

This committee clearly recognized the effects of war in disintegrating the humane purpose and international character of science, and declared that scientific workers should do their utmost to strengthen international amity not only by a general determination to oppose war but also by definite practical activity. "We have to consider," it decided, "how we can best assist in preventing an immediate outbreak of war, and in permanently removing its fundamental causes. The International Peace Campaign offers us the great opportunity of working effectively for both these ends." Stressing the importance of the radical approach, it added that scientific workers should co-operate "in the task of removing the causes of war by subjecting them to scientific and historical analyses and by exposing the theories of those who strive to excuse and justify war."

It was unanimously agreed, therefore, that a permanent Science Commission of the International Peace Campaign should be set up "with the general object of uniting all scientists in the struggle for peace". Its proposed activities include (1) the co-ordination of the work of the existing peace organizations of scientific workers and their extension to countries in which they do not exist; (2) the formation of joint commissions on (*a*) science and war and (*b*) the removal of the basic causes of war; (3) propaganda for a peace oath by all scientific workers and the incorporation of such a declaration in the oaths of those taking university degrees and diplomas; (4) concrete support for those scientific workers who are made to suffer for refusing to take part in research or other activities concerned with war.

The joint commission on science and war is to include chemists, physicists, engineers, aeroplane technicians, doctors, bacteriologists, geologists and military experts, who will endeavour (1) to study the technique of modern warfare and its probable effects on the military and civil populations; (2) to co-operate effectively in the international suppression of chemical and biological warfare; (3) to publish the results of its investigations promptly and clearly, without minimizing or exaggerating the dangers of modern war or seeking to claim an unobtainable accuracy; (4) to issue critical bibliographies on the technique of warfare and other special studies on this subject; (5) to impress on scientific workers themselves the part they are playing, directly or indirectly, in preparations for war, and to direct attention to the utilization for military purposes of funds intended for civil research and development; (6) to serve as an information bureau on technical military questions to all peace organizations.

The committee concerned with the fundamental causes of war is to include biologists, psychologists, anthropologists, medical men, sociologists, historians and economists, whose immediate task it will be to produce a concise statement on the causes of war and the ways in which men of science can help to eliminate them. It will also neglect no opportunity to expose pseudo-scientific and pseudo-historical theories used for war propaganda, such as those which postulate the biological necessity of war, the need for colonial expansion because of population pressure, the innate inequality of races, the degenerating effects of miscegenation, and so on. The regular work of this committee will therefore include (1) continuous propaganda in the scientific and popular press; (2) the exposure of subtle and direct war propaganda in schools and colleges; (3) appeals to learned societies and other organizations to defend scientific truth against distortion and unjustified rationalization; (4) the provision of study facilities by the publication of critical bibliographies and such other assistance as a central bureau can provide.

The translation of these objectives into effective practice will require considerable funds, organizational ability and individual support, but the success of the Peace Congress as a whole, combined with other evidence of a widespread appreciation of the duty and purpose of scientific endeavour, suggests that these essentials will not be lacking. They must not be if the lust for war is to be overcome by an organized will for peace. CEDRIC DOVER.

Molluscs of Northern Asia

MR. ALAN MOZLEY, after several studies of the Mollusca of Canada, has recently made expeditions into Siberia and northern Kazakstan during the open seasons of the years 1932 and 1933, when typical areas in several of the great natural regions were examined in some detail, and extensive collections made with the object of obtaining fresh and accurate information regarding the constitution and distribution of the molluscan fauna ("The Freshwater and Terrestrial Mollusca of Northern Asia". *Trans. Roy. Soc. Edin.*, 58, Part 3 (No. 24), 1935–36). The area covered includes the greater part of continental Asia to the north of latitude 50°, not including Outer Mongolia and Manchuria.

The aquatic species inhabit three types of water—ponds, lakes and streams. Of these the ponds and pond-like lakes only have an abundant molluscan fauna, and these are mostly hardy northern European species. Both the large lakes, which are uncommon, and the streams, usually present special conditions unfavourable to the molluscs. There is found to be a small group of circumboreal, a large number of Eurasian species, a few which are common to North America and north-eastern Asia, and several endemic forms. On the basis of these groups, Northern Asia may be divided into four faunal regions, the Great Siberian Region, the Baikal Region, the Far Eastern Region and the Chuckchee-Kamchatka Region.

In the northern part of Kazakstan and Southern Siberia there are numerous drainage basins in which the reservoirs are saline to a varying degree, the main salts being chlorides and sulphates which are detrimental to the molluscs. The presence of old shore lines round many of these indicates their greater extent during previous pluvial periods, fossil molluscs being found in some of these old shore-line deposits, in some cases the number of species decreasing in the descending series of beaches, giving evidence of a progressive decrease in molluscs. The species most tolerant of these conditions are *Planorbis planorbis* L., *Limnæa palustris saiidalensis* Mozley, and *Limnæa palustris Kazakensis* Mozley.

Temporary ponds formed by melting snow in spring are characteristic habitats in the steppe and forest steppe region both in Canada and Siberia, conditions of life being severe; but numbers of invertebrates manage to exist in them, including five species of molluscs in Northern Asia.

Educational Topics and Events

Cambridge.—The Vice-Chancellor gives notice that the professorship of animal pathology will be vacated on September 30 by the resignation of Prof. J. B. Buxton.

The Board of Managers of the Frank Edward Elmore Fund have awarded studentships to A. C. E. Cole of Trinity College, G. D. Hadley of Clare College, L. C. Martin of Gonville and Caius College and B. McArdale. Dr. H. G. Booker of Christ's College has been appointed assistant lecturer in mathematics, and Mrs. J. V. Robinson of Girton College assistant lecturer in economics and politics.

Dr. T. S. Hele has resigned his University lectureship in biochemistry, H. W. Hall of St. John's College, W. A. Fell of Sidney Sussex and R. S. Handley of Gonville and Caius College their demonstratorships in anatomy, Dr. M. Born his lectureship in mathematics and T. C. Nicholas of Trinity College his lectureship in geology.

Courses in administration have hitherto been specialized or restricted to different fields of administration, such as industrial, business, public, military, colonial and agricultural administration and often with more emphasis on the adjective than the noun. In a recently issued prospectus, Mr. W. R. Dunlop gives a syllabus of a course in administration with no particular applicational bias, though permitting of such bias by the appropriate selection of illustrative cases and problems. The course embodies the principles and technique, the underlying subjects and the mental activity and art common to all administration. Special attention is given to the history of administration from early times and with special reference to policy and leadership. Administration in its wider sense of human purpose and method is held to be one of the primary objectives of general education, and Mr. Dunlop would like to see specific education for administration, or at least management, made part of our educational system. The prospectus is supplemented by appendixes describing the research work, connexions and experience on which these views and the course itself are based. Copies may be obtained on application in writing to Mr. W. R. Dunlop, 57 Gordon Square, London, W.C.1.

Dr. Roscoe Pound, dean of the Faculty of Law of Harvard University, spoke recently at a Graduate School Convocation in Brown University on "The Place of Higher Learning in American Life". The general tenor of Dr. Pound's thoughtful and stimulating address (*School and Society*, August 8) may be inferred from his remark that his topic might well have had for its title "Higher Learning as Insurance of American Institutions" coupled with his opinion that what is significant in those institutions is that they tend to safeguard opportunity for all, freedom, and the corollary of freedom, responsibility. One of the points he makes is in connexion with the enormous development in recent times of means of manipulating public opinion. "The methods of advertising, carried to the limits of psychological effectiveness in business, have been taken over into public affairs. . . . Even newspapers are being left behind by broadcasting. A proper functioning of democratic institutions calls for corresponding development of the means of resistance to this pressure, and the best guarantee of intelligent resistance is to be found in a general high level of learning".

Salesmanship has long been recognized as a suitable subject of instruction in institutions of higher education in the United States. Recently the complementary science and art of shopping have received a good deal of attention, partly because the industrial depression has focused attention more urgently on the problem of how to get the most one can for one's dollar. At four regional conferences on home-economics education called by the United States Office of Education in 1934, this matter was a principal topic of discussion, and on the basis of material resulting from these and later conferences a pamphlet was prepared by specialists of that Office and published under the title "Consumer-buying in the Educational Program for Home-making : Suggestions for Teachers of Home-making in Secondary School and Adult Classes". Among the reasons given for education for buying are the enormous increase in the variety of commodities and services offered and the fact that price has become even less a guide to quality than it was formerly. The United States Government has been zealous in publishing masses of statistics bearing on the subject in the interest of consumers. Among them are numerous publications of the Department of Agriculture, including its food and drug administration. Such is the profusion of data that in July 1934 a special index to them was published under the title "Government Publications of Use to Consumers".

Science News a Century Ago

Lyell and Mantell

In a letter to Mantell written on September 19, 1836, Lyell referred to John Fleming (1785–1857), the Presbyterian minister and naturalist, who "after several applications in vain for chairs more consistent with his zoological and botanical acquirements", had accepted the chair of natural philosophy at Aberdeen. This appointment, Lyell said, had given him no doubt "much fag to get up arrears of mathematical knowledge. But unfortunately, something worse than the lectures fell to his hard fate. Several University bills and a Royal Visitation caused tremendous secretarian or clerk's labour to fall on the Junior Professor who is obliged to serve as secretary to the University."

"You will see by this that you, my good friend," Lyell continued, "are not singular in finding it difficult to gratify your liberal thirst for science, without interfering with professional profits. Really, as Milman says, it would be well for the country if, instead of abolishing prebendal stalls, they were given to clerical and lay cultivators of literature and science, who had shown that they would devote energy and superior talents to those departments. When Babbage was taunted one day by a Conservative with 'What do you mean to be when the revolution comes ?' he said, 'Lay Archbishop of Winchester'."

Association of German Naturalists

The annual gathering of the Association of German Naturalists—a society which was a forerunner of the British Association—was held at Jena on September 20–26, 1836. The meeting was attended by many civil and military officials, representatives from Great Britain, Russia, Belgium, Holland, Switzerland, Greece and Mexico, and many of the greatest German men of science, including von Humboldt, von Buch, Ehrenberg, Weber, Hansen, Reichenbach, Fuchs and Döbereiner.

At the first general meeting, Dr. Kieser, after alluding to the philosophers and naturalists Jena had produced, gave a sketch of the history of the Association. Fifteen years previously, he said, it consisted of only thirteen persons, in 1835 it numbered 500 members and attracted friends from all parts of Europe and even from the other side of the Atlantic. In imitation of the Association, others had been established in England, France, the Netherlands and America. At the same meeting Mädler described the structure of the moon and exhibited his map of its surface.

There were three other general meetings, while papers were read to the seven sections: (1) Physico-Chemical Science; (2) Geology, Geography and Mineralogy; (3) Pharmacy; (4) Botany; (5) Anatomy, Physiology and Zoology; (6) Medical, Surgical and Obstetric Science; and (7) Technology and Agriculture. On September 24, the visitors and members were presented to the Grand Duke of Saxe Weimar, and after dining with him and other princes in the Orangery, repaired to the theatre, where Goethe's "Tasso" and Schiller's "Bell" were performed.

Andrew Crosse and his Electrical Experiments

At the British Association meeting in Bristol in 1836, no communication raised more enthusiasm than the account given by Andrew Crosse (1784–1855) of his experiments on electric currents and their effects on minerals. Crosse was a man of means who lived at Broomfield on the Quantock Hills, Somerset, and at Bristol he gave a general invitation for any present at the meeting to visit him. The first to do so was Sir Richard Phillips (1767–1840), who described his visit in a letter to Mantell which was read at a conversazione of the Mantellian Museum at Brighton on September 20. The account was afterwards published in Sturgeon's *Annals*. Sir Richard spoke of the fine house and park and also of the music room in which were seven or eight tables filled with batteries. "They resembled battalions of soldiers in exact rank and file and seemed innumerable. Altogether there were 1,500 voltaic pairs at work in this great room, and in other rooms about 500 more. There were besides, other 500 ready for new experiments". But Crosse's "greatest electrical curiosity was his apparatus for measuring, collecting and operating with atmospheric electricity. He collects it by wires, the 16th of an inch diameter extended from poles to poles, or from trees to trees in his grounds and park".

Walter Hancock's Steam Carriages

In the *Mechanics' Magazine* of September 24, 1836, is an account by Hancock of the work done by his steam carriages *Infant*, *Erin*, *Enterprise* and *Automaton* in London. He said that altogether these carriages had run about 4,200 miles, carried 12,761 passengers, made 525 journeys between the City and Islington, 143 between the City and Paddington and 44 between the City and Stratford. They had used some 55 chaldrons of coke. The same issue of the *Mechanics' Magazine* contained a description of the *Automaton*, the last of the four carriages to be built.

Societies and Academies

Paris

Academy of Sciences, July 27 (*C.R.*, 203, 289–352).

Aymar de La Baume Pluvinel: Obituary of Paul Stroobant.

J. Geronimus: Some orthogonal polynomials.

Georges Giraud: Complement to a result on equations with principal integrals.

Kyrille Popoff: The pendular movement of projectiles.

Emile Merlin: A particular case of trajectories of certain heterogeneous perfect fluids.

Assène Datzeff: A transformation which keeps the form of canonical equations.

Raymond Chevallier and Marcel Laporte: The permanent magnetization of steel in the neighbourhood of a circuit traversed by a rapid aperiodic discharge.

Louis Néel: The theory of constant paramagnetism. The application to manganese.

G. Foex and Ch. Fehrenbach: Variations of the magnetic moment of the cobalt ion in the anhydrous chloride and in the systems of mixed crystals $CoCl_2$–$CdCl_2$ and $CoCl_2$–$MnCl_2$.

Mme. Marie Freymann, René Freymann and Paul Rumpf: The absorption spectra in the near infra-red of aniline derivatives.

Roger Servant: A spectro-polarimeter for the Schumann region.

Léon Capdecomme: The influences of elliptic light and of the orientation of the polarizer in comparisons of reflecting powers with the microscope.

Pierre Brun: The formation of metallic alcoholates.

Henri Muraour and Albert Michel Lévy: The spectrum of ionized calcium obtained by collisions with detonation waves.

André Kling and Maurice Claraz: The rapid determination of oxygen in gaseous atmospheres.

Jean Byé: Study of molybdic chlorhydrin and of the normal molybdate of glycol.

Charles Bedel: The minimum temperature of oxidation of silicon. The lowest temperature at which the oxidation of silicon commences is relatively high: it is lowered by the presence of moisture.

Mlle. Denise Montagnon: Contribution to the study of the double iodides of copper and ammonium.

Charles Dufraisse, Léon Velluz and Mme. Léon Velluz: Dissociable organic oxides. Special study of 9-phenylanthracene and of some of its derivatives.

Roger Perrot: Some nitrosochlorides of the benzene series.

Mlles. Marthe Montagne and Yvonne Isambert: The action of ethylmagnesium bromide on butyric ethylanilide.

Martin Battegay and Pierre Bœhler: α- and β-mononitroanthracene.

André Meyer and Paul Heimann: The nitroso derivative of 4-hydroxycarbostyril.

Georges Lévy: The nitration of β-ethylnaphthalene. The synthesis of 2-ethyl-8-naphthol.

Gonzague Dubar and Mlle. Dorothée Le Maitre: New deposits of Spongiomorphides and of Algæ in the Lias and the Bajocian of Morocco.

Charles Bois: Deep focus earthquakes.

Achille Urbain and R. Cahen: The proportion of derivatives of degradation of nitrogen in the serum of some ungulates.

René Legroux: The treatment of glanders in the Equideæ.

Georges Bourguignon and **Marcel Monnier**: The variations of chronaxy under the influence of coloured light in spasmodic stiff neck.

Baruch Samuel Levin and **Ivo Lominski**: Vaccination against bird plague with virus treated with X-rays.

Melbourne

Royal Society of Victoria, July 9.

L. W. **Stach**: An Upper Oligocene bryozoan faunule. A small faunule at 66–67 feet in the Torquay bore is indicative of shallow water deposition. The range of *Cellaria depressa* is extended to Upper Oligocene, and a study of *Otionella cupola spiralis* Chapman suggests that *Cupuladria* Canu and Bassler is a synonym of *Heliodoma* Calvet. *Cucullipora tetrasticha* belongs to sub-family Hippoporininæ of Schizoporellidæ.

F. **Chapman** and W. J. **Parr**: A suggested classification of the Foraminifera. The classification differs from Cushman's in the grouping of the arenaceous after the hyaline types. The whole order (Foraminifera) is arranged in the super-families, the Allogromoidea (chitinous), the Spirillinoidea (hyaline or perforate types), and the Ammodiscoidea (arenaceous, porcellanous and subarenaceous forms). The family groups of Cushman are re-sorted and reduced from 47 to 33. About 570 genera are admitted up to the year 1934, as against 144 genera in Chapman's "Foraminifera" of 1902.

G. W. **Leeper**, **Ann Nicholls** and S. M. **Wadham**: Soil and pasture studies in the Mount Gellibrand area, Western District of Victoria. A soil survey of 12,000 acres of pastoral country surrounding the volcanic cone of Mount Gellibrand. Nine soil formations are defined with laboratory analyses of each type, and mineralogical studies of the fine sand fractions. The present flora is described, and future development of the area discussed.

B. J. **Grieve**: The application of a staining and maceration method in tracing the distribution of bacteria in wood vessels of herbaceous plants.

Moscow

Academy of Sciences (*C.R.*, 2, No. 4, 1936).

G. **Sirvint**: Asymptotic series of Dirichlet.

L. **Vinokurov** and E. **Levshin**: Study of the extinction of luminescence of phosphorescent substances activated by organic activators.

G. G. **Laemmlein**: Model of polymerized molecule of silicic acid in molten flow.

M. N. **Michailova** and M. B. **Neumann**: The cetene scale and the induction period preceding the spontaneous ignition of Diesel fuels in bombs.

S. J. **Krajevoj**: The influence of ultra-short rays on the chromosomes of plants.

O. **Istomina** and E. **Ostrovskij**: The effect of ultra-sonic vibrations on plant development.

A. N. **Klechetov**: New species of *Colletotrichum* on the rubber-producing plant *Taraxacum kok-saghyz* Rodin.

A. **Sergejev**: The influence of human structures on the distribution of birds in steppes.

Forthcoming Events

Tuesday, September 22

Engineers' Study Group on Economics, at 6.30.—Annual General Meeting to be held at 23 Grosvenor Place, London, S.W.1.

Faraday Society, September 24–26.—General Discussion on "Structure and Molecular Forces in (*a*) Pure Liquids and (*b*) Solutions" to be held in the University of Edinburgh.

Official Publications Received

Great Britain and Ireland

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No 37: The Glaciation of the Bantry Bay District. By A. Farrington. Pp. 345–361. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 2*s*. [228

Department of Scientific and Industrial Research. Final Report of the Steel Structures Research Committee. Pp. xxvii+572+16 plates. (London: H.M. Stationery Office.) 12*s*. 6*d*. net. [228

Home Office. Report on Conferences between Employers, Operatives and Inspectors, concerning Fencing of Machinery and other Safety Precautions, First Aid and Temperature in Woollen and Worsted Factories. Pp. 19. (London: H.M. Stationery Office.) 4*d*. net. [258

Board of Trade. Survey of Industrial Development, 1935: Particulars of Factories opened, extended and closed in 1935, with some Figures for 1934. Pp. iv+36. (London: H.M. Stationery Office.) 9*d*. net. [258

London County Council. Lectures and Classes for Teachers: Handbook for the Session 1936–37. Pp. 86. (London: London County Council.) [258

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1682 (2030): Effect of Weight on Take-off and Landing. By E. Finn and S. P. Osborne. Pp. 13+5 plates. (London: H.M. Stationery Office.) 1*s*. net. [268

University of Manchester: Faculty of Technology. Prospectus of University Courses in the Municipal College of Technology, Manchester, Session 1936–37. Pp. 408. (Manchester: College of Technology.) [268

Forestry Commission. Afforestation in the Lake District. Report by the Joint Informal Committee of the Forestry Commission and the Council for the Preservation of Rural England. Pp. 6+2 plates. (London: H.M. Stationery Office.) 3*d*. net [278

Scottish Society for Research in Plant-Breeding. Report by the Director of Research to the Annual General Meeting, July 30, 1936. Pp. 30. (Edinburgh: Scottish Society for Research in Plant-Breeding.) [278

Forest Bibliography to December 31, 1933. Part 1. Pp. xviii+78. (Oxford: Department of Forestry, University.) [288

Papers from the Geological Department, Glasgow University. Vol. 18 (Quarto Papers of 1934–1936.) (Glasgow University Publications, 39.) Pp. iv+11 papers. (Glasgow: Jackson, Son and Co., Ltd.) [288

Other Countries

Proceedings of the United States National Museum. Vol. 83, No. 2991: Pycnogonids from Puget Sound. By Harriet I. Exline. Pp. 413–422. Vol. 83, No 2994: New Species of Polychaetous Annelids of the Family Nereidae from California. By Olga Hartman. Pp. 467–480. (Washington, D.C.: Government Printing Office.) [278

Smithsonian Institution. Bureau of American Ethnology. Bulletin 112: An Introduction to Pawnee Archaeology. By Waldo Rudolph Wedel. Pp. xi+122+22 plates. (Washington, D.C.: Government Printing Office.) 30 cents. [278

Smithsonian Miscellaneous Collections. Vol. 95, No. 13: A Comparative Study of the Labium of Coleopterous Larvae. By W. H. Anderson. (Publication 3393.) Pp. 29+8 plates. (Washington, D.C.: Smithsonian Institution.) [278

Cornell University Agricultural Experiment Station. Bulletin 642: An Economic Study of Land Utilization in Broome County, New York. By T. E. LaMont. Pp. 51. Bulletin 644. Economic Studies of Dairy Farming in New York. 12: 150 Farms in the Tully-Homer Area, Crop Year 1931. By John R. Raeburn. Pp. 53. Bulletin 645: The Residual Effects of some Leguminous Crops. By T. L. Lyon. Pp. 17. Bulletin 649: Rural Youth: Activities, Interests and Problems. 1: Married Young Men and Women, 15 to 29 Years of Age. By W. A. Anderson. Pp. 53. Bulletin 650: Fertilizing Onions on Muck Soils. By J. E. Knott. Pp. 20. Bulletin 651: Quality of Lettuce as it affects the New York Lettuce Industry. By J. E. Knott. Pp. 17. Memoir 187: Effects of Light on Carotenoid Formation in Tomato Fruits. By Ora Smith. Pp. 26. Memoir 188: Genesis and Composition of Peat Deposits. By B. D. Wilson, A. J. Eames and E. V. Staker. Pp. 13. (Ithaca, N.Y.: Cornell University.) [278

U.S. Department of the Interior: Office of Education. Bulletin 1935, No. 10: Public Education in Hawaii. By Katherine M. Cook. Pp. 56. 10 cents. Bulletin, 1936, No. 18—IV: Youth . . . Vocational Guidance for those out of School. By Prof. Harry D. Kitson. Pp. vii+81. 10 cents. Pamphlet No. 69: Per Capita Costs in City Schools, 1934–35. By Lula Mae Comstock. Pp. 22. 5 cents. (Washington, D.C.: Government Printing Office.) [278

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No. 3491 SATURDAY, SEPTEMBER 26, 1936 Vol. 138

Human Tendencies

IN the annals of the British Association there will be found not one but many landmarks in the history of science. The Blackpool meeting of 1936, it is probable, will stand out as a whole, certainly in popular memory, as the one meeting above all others which from the inception of the Association up to that date has endeavoured to address itself on a united front to a diagnosis of the current ills of human society. The presidential address, no less remarkable for its controlled imagination than for its keen insight into and power of analysis of complex social phenomena, set the keynote of the meeting; and it was a striking testimony to the sense of responsibility to the community which is felt by the men of science of to-day that the lead given by the president of the Association was followed not alone by the sections dealing with the biological and humanistic sciences. Even a branch of study so academic, so apparently remote from the stress of current social problems as palæontology, afforded Prof. H. L. Hawkins in the presidential address to Section C (Geology), part of which appears in this issue of NATURE (p. 534), the material for pungent comment on current tendencies in human development.

It is possible, however, that on reflection there may appear no paradox in the fact that a science such as palæontology, of which the data are far removed from current events, should nevertheless provide a canon of criticism for tendencies of to-day. Although we may feel inclined to qualify Prof. Hawkins's dictum that our knowledge of the ancient Romans is at best equal to our knowledge of the trilobites, yet we may agree that as we can here view the beginnings, the prime, and the decay of long extinct species more clearly and more objectively than we can observe the rise and decline of the powers and empires of the past, so we may perhaps deduce from them more certainly the operation of biological laws which affect the evolutionary process in human affairs, no less than those which govern that process in the development of man himself.

Prof. Hawkins led his audience from stage to stage of evolution in organisms of the past to the emergence of man himself. It might seem a sorry commentary on his text for those who believe in the evolutionary process as a progression in perfectability to turn to the discussions and addresses in other sections, and to see what man has made of himself in the vast interval of time which has elapsed since that first emergence. There they would have found that man of to-day was being brought to the bar of judgment for handling the dangerous instruments of which scientific development has given him control with the mentality of a schoolboy, and as Lord Horder pointed out in the discussion on "The Strain of Modern Civilization", indicted as the subject of neuroses and auto-infection, because he has allowed himself to fall a victim to the organization which he himself has built up (see p. 529).

It is unfortunate that on the anthropocentric view imposed upon us by the condition of our being, the evidence of palæontology as an objective standard of progress should cease to be operative with the coming of man. When once man as such has evolved, palæontology can tell us little further of really fundamental and significant organic change. Unless mere size of brain be the criterion —in which event man may have surmounted the peak of his development with the passing of Neanderthal man, and modern man actually represent the entry on a phase of decline—on the coming of the modern man with his more highly convoluted brain, that page of evolution is closed, in any event for the present, whatever the future may hold. From that point onward, throughout man's strenuous struggle to build up civilization, the evidence of change in man is indirect—and neither palæontology, archæology nor, except to a limited degree, history tells us what functional change may have accompanied his further development. Man as we see *ex post facto*, at the time of his emergence, is differentiated from his contemporaries of the animal world by the spirit, and by its achievement he should be judged. Less well equipped than any other animal approaching him in size with either protective covering or strength of tooth and claw, yet he is less at the mercy of his environment. Armed with the most powerful weapon of defence and destruction that Nature has forged, the human brain, he has conquered his environment so that not only has this otherwise defenceless creature made himself master of every quarter of the globe, irrespective of climatic and other environmental conditions, but also he is exterminating or subjugating all animal life, while exploiting all natural resources as well as conquering the air and drawing treasure from the depths of the sea. Hence man's progress in fact is commonly measured by his control of the material resources of the world.

It is scarcely necessary to stress the point to which this assessment of human progress in materialistic terms has brought us. A century of expansion and, on the whole, uninterrupted advance in every department of civilized life has now received a check. A prolonged period of economic depression and disturbed political conditions, international as well as in some instances internal, has dislocated what had come to be regarded as the normal flow of life, and has induced a wave of pessimism, which questions the values of what has hitherto been regarded as progress. Even the very fact whether man has progressed at all, at least since the early days of his emergence from barbarism, is brought into dispute. More grave, because more fundamental, is the judgment implied in the suggestion that 'progress', like Frankenstein's monster, has outrun the power of man to control it, and that therefore scientific investigation, which by its effect on production and therefore on labour is regarded as chiefly responsible, should be slowed down to enable consumption and employment to make good the lag rapidly forming a vicious circle from which extrication will be difficult or impossible. Although the British Association neither generally nor specifically in the meeting at Blackpool is legitimately to be regarded as the foster parent of pessimism, nor would be prepared to admit the ultimate sanity of any suggested check on scientific research or its application to practical affairs, yet the unanimity shown by the sciences in the recent debates, in diagnosing the underlying causes of the present situation as in some way or other involved in a lack of conscious direction, marks recognition of the gravity of the evil at the same time as it seems to point a way out.

The complaint that the strain of contemporary life is too great for human endurance is probably as old as the association of human beings in anything larger than a family group. Nor is it always the part of the *laudator temporis acti*. It certainly goes back so far as Horace when he longed for the quiet of his Sabine farm; it is familiar in the eighteenth century, as for example in the works of Smollett, and Sir Josiah Stamp quoted an apt example from the "Creevey Papers" in the reference to the "frightful" experience of travelling by rail at the rate of twenty-three miles an hour. These plaints, however, date from before the days of the machine, when individuality still had room for play. The more strenuous nineteenth century, with its doctrine of *laisser-faire*, encouraged the struggle of the individual, while imposing conditions upon labour and production against which it was the sense of the community that the worker should be protected. It is unnecessary to recapitulate the familiar story of the social and industrial development of the nineteenth and early twentieth century; but the principal trends which are germane to the present purpose are the growth of associations of both labour and employers, the application of scientific methods and results to all departments of production, as well as to the well-being of the worker, and the recognition by the community of its responsibility to see fair play as between employer and employed and the consumer and the producer, as well as generally to preserve so far as possible some balance between the rights of the individual and the claims of the group, whether trade organization or public authority.

The application of these principles to a large extent was opportunist, and so far as concerns the application of scientific methods and results to the problems of society and industry, was often more or less a consequence of pressure, frequently considerable, brought to bear on authority from outside. Much has happened since then; and of all the lessons of the Great War, the most enduring and the most far-reaching have been the value of scientific research when applied to the problems and needs of practical life, and the impetus which can be imparted to concerted group effort under direction.

Of these two lessons the latter was already in principle familiar to the anthropologist. It is a form of the struggle for existence whereby man seeks to secure survival through combination in groups which ever increase in size and complexity. As a result of experience in the War, this principle has been transformed into a political dogma. It has produced on pseudo-scientific argument the totalitarian State, whether communist, fascist or quasi-constitutional under a virtual dictator.

The weakness of the totalitarian State is as obvious as its strength. It exalts the whole at the price of individuality, and in so far as it must in self-protection stamp the individuality of the many with the brand of the few, however wise and provident they may be, it will in the long run weaken the whole. For the group to survive must survive through the quality of its individual components. The problem of future research in the biological and humanistic sciences is to solve the equation of group interest and individual well-being. As Sir Josiah Stamp indicated in his presidential address to the British Association, the crisis in world economics and politics has forced it on our attention that there is a vast field in the constitution and character of man, his heredity, his training, his social and economic relations, more especially in relation to changing conditions, which await investigation. However intense and far-reaching may be the efforts of research directed to the improvement of material conditions, the result may be, who can say, perhaps more harm than good unless we understand more clearly than we do at present the whole nature of man and his reactions both as a unit and in the group. In the long run, the race will be to those who solve this problem.

A Text-Book of Unapplied Biology

Why Keep Them Alive?
By Paul de Kruif, in collaboration with Rhea de Kruif. Pp. vii+293. (London: Jonathan Cape, Ltd., 1936.) 10*s.* 6*d.* net.

DR. PAUL DE KRUIF is a writer better known, unfortunately, in his own country than in England. Beginning life as a bacteriologist, he soon abandoned academic science and research, and devoted his talents to the vulgarization (in the French sense) of scientific and medical discoveries—becoming, in his own words, "a sort of human loud-speaker, a barker", telling the world at large about some of the wonders of biology. In "Microbe Hunters" (1926), "Hunger Fighters" (1928), "Men against Death" (1932), he has already related, in colloquial American language, various outstanding 'triumphs' of bacteriology, nutritional physiology, and medicine. All these books are distinguished by the accuracy of their scientific and historical data, though these are often presented in a picturesquely overdrawn manner and from a national point of view not always appealing to a more stolid English audience.

As our author has already employed his scientific knowledge and literary gifts to good purpose, we turn to his latest work in confident expectation that he has again some arresting news to announce. And he has. He has discovered that the scientific and medical marvels which he formerly chronicled so dramatically and so hopefully are not being properly used for the benefit of humanity. Despite all our new knowledge—which he has already been at such pains to broadcast—about microbes, vitamins, and hormones, he finds that American citizens are still dying off like flies from starvation and avoidable afflictions. So he asks with righteous indignation why this is so. If we have not the sense to keep even our innocent little children alive and well in a world of knowledge and plenty—to stop them dying from starvation, and from preventable and curable diseases—why in Heaven's name do we let them live at all?

Both the contents and the temper of this disturbing book can be briefly indicated by the titles of its chapters (I almost said "the texts of its sermons"). (1) Why should they die? (2) Discovery that children are forgotten. (3) Discovery that it's dollars or children. (4) The power of science without money. (5) The people's death-fight. (6) Drouth is a blessing. (7) Who owns our science? (8) Observation of children of the shadows. (9) Should children eat? (10) Children can live! These headings give but a faint idea of the variegated and confusing pattern of the whole: yet the reader who conscientiously follows the author to the last page—undeterred by his seeming inconsequence, verbal exuberance, and eccentric punctuation—will find that the game is worth the candle. He will find that he has incidentally acquired much exact information not only about infant mortality in the United States, the diagnosis and cure of consumption in Detroit, and the horrors of drought in Wisconsin and of the slums in Cincinnati, but also about such apparently irrelevant matters as the discovery of the tannic acid treatment of burns and the birth of the famous Dionne quintuplets in Canada.

From this wealth of detail it is not always easy to disentangle the main argument; but de Kruif appears to be trying to enunciate and solve, for a special case, a general problem of supreme scientific importance. How is it that Man, a supposedly intelligent animal, is still unable to use his painfully earned knowledge properly for the good of his own species? His scientific knowledge is already immense, and adequate for most of his specific needs; yet he has hitherto discovered no way to disseminate it for the benefit of all mankind, nor even to prevent its prostitution for human destruction. (This dilemma is, of course, familiar to readers of NATURE. So recently as July 18, an editorial article noted that "Nothing could be more unscientific than the contemporary armaments race, and the existence of widespread poverty and malnutrition in a period of unparalleled development of the technique of production, and the study of the science of nutrition".) But it makes de Kruif's blood boil when he sees people famishing in one of his United States while 'surplus' food is being destroyed in another: and he is driven almost to frenzy by the sight of children dying of starvation and preventable and curable diseases for lack of the money which his Government could find, if necessary, to kill another nation's children in warfare. He wants to know who is to blame for this sinful situation—and make him suffer for it.

Every man of science must sympathize with de Kruif in his indignation, and must share his passionate desire for reform. Nevertheless, it must be confessed that he himself appears to have found no solution of the fundamental problems which he attempts to formulate; and one may well even doubt whether any solutions are possible by his emotional method of approach. There are passages, it is true, in which he appears to favour some form of communism as a remedy for our present economic, social, and scientific disorders; but he is too great an individualist to pursue that line of argument very far. Moreover, when the question of guilt arises, he has an uncomfortable feeling (haven't we all?) that even he himself may not be entirely blameless—for isn't it *his* duty to do something about it? So he takes refuge in the thought that, after all, he is "only a reporter": it is not his job to put things right. When everything else fails, he seeks eternal truth by fixing his eyes on the horizon of Lake Michigan—just as the monks of Mount Athos formerly did (if we may believe Gibbon) by contemplating their navels.

Such consolations are not for everyone, however, and the question of responsibility for the non-application and misapplication of science has got to be faced more scientifically. In a sense, of course, the blame rests upon all mankind—including men of science themselves: but the excuse that "I am only a reporter" (or "only a man of science", which is equally valid) is surely but an echo of the voice of Cain—"Am I my brother's keeper?" Is it likely to be more acceptable? Yet no man engaged upon research in pure science—a whole-time job—can attend to the proper application of his discoveries (if any) at the same time. Though de Kruif now says in the heat of the moment that "science for science's sake" is "balderdash", he knows full well that science must be made before it can be applied, and that no man can serve two masters.

While reading this just indictment, I have been repeatedly reminded of a more famous work published two centuries ago—"A Modest Proposal for Preventing the Children of Poor People in Ireland from being a Burden to their Parents or Country, and for making them beneficial to the Publick" (Dublin, 1729). In this little tract Jonathan Swift, as everyone knows, answered de Kruif's question. He was equally appalled by the wastage of child-life in his own day, and in this shocking satire endeavoured to stir public opinion by the outrageous advocation of cannibalism. The Dean of St. Patrick's is not noted for the terseness of his style: but in this tract he appears almost a Tacitus in comparison with de Kruif, whose prolixity and varied repetitions and seeming contradictions often obscure rather than stress the points in his argument. His feelings—obviously very noble feelings, inspired by well-authenticated facts—too often overpower his thoughts. Indeed, the very title of his book—commendably short in comparison with the Dean's—typifies this defect. His question is merely rhetorical, and appears to be scientifically unanswerable: at all events, de Kruif is not really concerned with its answer. At the beginning (p. 25), it is true, he postulates that "Children must live"; but clearly this is no satisfactory logical reply to the question why they should be kept alive.

But it is much easier to criticize and compare this challenging diatribe than to answer the numberless questions which it raises. Some of these—though not that asked in the title—are really urgent: they concern all mankind at the present moment. Consequently, I hope that de Kruif's latest utterance will reach the widest possible audience, and will not be dismissed as merely local propaganda: for it is far more than this, and deserves serious consideration by everyone who is not content with modern misuses and non-uses of science and scientific method.

I have referred throughout to Paul de Kruif as "the author" because this book is written in the first person singular, though admittedly the offspring of marital collaboration. (All Paul's earlier books, moreover, were dedicated "To Rhea".) If I now look somewhat askance at their newborn child—still a raw product, whose future development no man can predict—it is surely with no ill-will. Indeed, I sincerely hope that this child may escape the fates of those pitiful other babes about whom its parents write so feelingly, and that it will live to lead a long and useful life in the service of all humanity. CLIFFORD DOBELL.

Atomic Spectra

(1) Introduction to Atomic Spectra

By Prof. H. E. White. (International Series in Physics.) Pp. xii+457. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 30*s*. net.

(2) The Theory of Atomic Spectra

By Prof. E. U. Condon and Dr. G. H. Shortley. Pp. xiv+442. (Cambridge: At the University Press, 1935.) 42*s*. net.

THE experimental study of atomic spectra has a long and distinguished history. Even the descriptive analysis of spectra in terms of series and term values—the systematic botany of spectra—has a history of some sixty years. It is only, however, since Bohr's explanation of the hydrogen spectrum in 1913, and still more since his further work in 1921 explaining the structure of the periodic table of the elements, that any fundamental theory of atomic spectra has been available, or any rapid advance in observation or systematics has been made. Indeed no such advance was previously feasible, even on the experimental side, for the experimenter did not know what to look for. The field of atomic spectra provides in fact a perfect example of the way in which experiment and theory can react fruitfully on each other, yielding advances in our understanding of the field at a rate which could scarcely have been anticipated even by the most optimistic. Since 1921 the advance has been so rapid that it is fair to say, as Condon and Shortley do in their introduction, that the interpretation of atomic spectra is now finished in broad outline. All known features of atomic spectra have been at least semi-quantitatively explained in terms of the nuclear atom, strictly according to the laws of quantum mechanics. The period of fruitful research in atomic spectra is not thereby closed, for there remain many important details to be elucidated further, and the proper relativistic theory of the many-electron system to formulate. None the less an epoch is ended.

The growth of the theory of atomic spectra in its early stages was identical with the growth of the quantum theory. The empirically determined requirements of the hydrogen spectrum, including the Stark and Zeeman effects for that spectrum, with assistance from the spectra of the alkalis and alkaline earths, led by themselves to the formulation of Bohr's correspondence principle. From this principle to quantum mechanics the climb, severe as it proved until led by Heisenberg, is short and inevitable. The study of the tremendous field of more complex spectra played only a comparatively minor role in this development, although the first successful systematizations of these spectra preceded it. Once quantum mechanics had been formulated, it was soon found that the whole body of spectra fell together into one consistent scheme, the unforced immediate interpretation of which remains one of the chief glories of quantum mechanics—an achievement sufficient by itself to convince the most sceptical. It is this complete interpretation which is presented in the two books here under review, in White's from the point of view of the experimenter, in Condon and Shortley's from that of the mathematical physicist.

(1) After an introduction covering the history of investigations on atomic spectra, and the developments made by the old quantum theory, and giving some account of Schrödinger's equation and the Dirac electron, White's book gives a general account of atomic spectra in terms of the vector model. This account is in every way admirable from the point of view of the experimenter, or of the intelligent student who may prefer or be forced to approach the subject with little knowledge of mathematics. All the results of quantum mechanics are stated in the form of rules, for which the vector model provides a reasonable unity of appearance, and are elaborately applied to actual spectra, but the readers of the book are not primarily concerned with the

derivation of these rules from any general theory.

Theirs not to reason why
Theirs but the rules to ply,

and this is certainly a good, possibly the best, attitude in which to begin the study of atomic spectra.

The various rules such as the branching rule, the intensity rules, Lande's g-rules and Γ-rules, the permanence rule for the g- and Γ-sums, can all be presented quite simply and fairly systematically in terms of the vector model, adapted to quantum mechanics by taking the square of any angular momentum vector L to be $L(L+1)$, so long as one is prepared not to worry overmuch about the reason provided by quantum mechanics for the procedure specified by the rule. This is the attitude adopted by White, and it results in a most successful book, which can be heartily recommended to the readers for whom it was written. Some of them may even feel that the presentation could just as well have been even less related to the underlying theory, and that some part of the description of the old quantum theory could perhaps have been omitted.

One of the best features of White's book is the obvious glee with which the author writes of features of the more complex spectra, such as "the great calcium triad". Enthusiasm is infectious, and the reader is conducted willingly through fields which might well have proved arid. His willingness is rendered all the greater by the profusion and excellence of the diagrams and plates. Some of the most beautiful of these are the electron cloud photographs which demonstrate the relationship of the Schrodinger's wave functions to the orbits of Bohr's older theory.

(2) Condon and Shortley have written a book which is as different from White's as two books on atomic spectra could well be. They are concerned almost exclusively with the strict derivation from quantum mechanics of the rules of the vector model and other general features of atomic spectra. The space devoted to comparisons between theory and actual observations has been necessarily reduced to a minimum. Such comparisons can be found elsewhere, notably in White's book.

Many methods of presentation are open to an author setting out to expound the mathematical theory of atomic spectra. The main classes of presentation will be determined by whether one admits or excludes the explicit use of certain branches of pure mathematics, notably group theory and matrix algebra. Condon and Shortley admit matrices and exclude groups. They explain that in their opinion, in which the reviewer concurs, the explicit use of group theory would make too great demands on the mathematical equipment of too large a proportion of those mathematical physicists who might be expected to read such a book on the theory of atomic spectra. Not long ago, the same might have been said about matrices, and even to-day the matrix algebra which dominates large portions of the book may prove a difficulty to some readers, though probably only to the older ones. Even such readers, however, will probably put the book down convinced that matrix algebra has come into the subject to stay, and that to attempt to write the mathematical theory of spectra without this compact and powerful language would be retrograde if not impossible.

It will now perhaps be useful to survey in rather more detail the contents of this book. The introductory matter consists of a résumé of Dirac's exposition of quantum mechanics and his theory of observables, of the matrix algebra of angular momenta and of the classical radiation theory. With this background the argument proceeds to a complete discussion of one-electron spectra, which is then extended to many-electron spectra in great detail. An admirable feature of this part of the discussion (both in Condon and Shortley's and White's books) is that both Russell-Saunders and j-j coupling are considered separately on an equal footing. Both are almost equally important limiting cases, and in Condon and Shortley's book there is an instructive chapter tracing theoretically the transition from one to the other through the various stages of intermediate coupling. Having thus completed the theoretical background used in the systematic description of all ordinary spectra, the authors bring X-ray spectra into the optical scheme in a most satisfactory way by a discussion of the properties of almost closed configurations, of which both X-ray terms and many optical terms in the rare gas spectra are equally examples. The book continues with an excellent account of Hartree's method of the self-consistent field, and of the accurate calculations by the Rayleigh-Ritz method of the normal state of helium-like structures, and another of the interaction between different atomic configurations leading to perturbed series and many-electron jumps. The closing chapters describe the Zeeman, Stark and nuclear effects on atomic lines.

No one but an habitual worker in the field of atomic spectra could hope usefully to criticize in detail an exposition such as the present, and the reviewer can make no such claim. Its power and thoroughness leave the general impression of a work of the first rank, which successfully unifies the existing state of our knowledge, and will prove for many years a starting point for further researches and an inspiration to those who may undertake them.

R. H. F.

Compression Ignition Engines

(1) High Speed Diesel Engines:
with Special Reference to Automobile and Aircraft Types; an Elementary Textbook for Engineers, Students and Operators. By Arthur W. Judge. Second edition, revised and enlarged. Pp. xi + 347 + 41 plates. 15*s.* net.

(2) Maintenance of High Speed Diesel Engines:
a Practical Handbook for Diesel Engine Fleet Owners, Maintenance Engineers, Operators, Drivers and Mechanics. By Arthur W. Judge. Pp. vi + 192 + 32 plates. 10*s.* 6*d.* net.
(London: Chapman and Hall, Ltd., 1935–36.)

(1) THAT a second edition of this book should be called for within two years is a tribute alike to the widespread interest in the subject and to the manner in which Mr. Judge has dealt with it. No doubt most of its readers are interested principally in the application of the compression ignition engine to road vehicles and in a lesser degree to the more difficult field of air transport.

The rate of growth of road usage has been remarkable, as the London streets alone bear witness; but the prospect of there being produced an attractive engine for aircraft operation is still one of 'Jam to-morrow' rather than of anything more immediate. Reliability for road usage has been achieved; but the pursuit of this elusive quality for engines with the lighter scantlings necessary for aircraft has proved arduous. So far, the undoubted merit of freedom from the worse forms of fire risk has been balanced, and rather more than balanced, by the disadvantages of greater weight and less dependability. Indeed, reasonable freedom from forced landings is an essential to any air service which depends on the patronage of the public; whilst for military use the petrol engine gains greatly in any comparison by its lighter weight.

One of the virtues of the compression ignition engine is always held to be the freedom it gives from all the complications attendant on the electric ignition system but, as Mr. Judge's pages bear witness, the alternative complications of fuel pump and fuel piping show that there is little to be gained by this exchange.

In the large-scale use for motor transport, there has been shown to be a large saving in fuel costs, and, in Mr. Judge's view, even the present fuel tax will not cause this to disappear. The general utility of the engine in this field, where high crank-shaft speeds are essential, has been won in no small measure by attention to the production of turbulence in the air close to the fuel inlets. The bearing, on this factor, of ingenuity in cylinder head design is fully brought out by the author.

The book is very practical, and it will find many engineers who will value its possession as a really up-to-date guide on a subject which such a vast number of them have to deal with in their daily work. It is true that it is a compilation of work done by others rather than an exposition by a master, but the latter it does not profess to be.

(2) Mr. Judge's second volume relates solely to care and maintenance, and does not call for special remark. It appears to be a thorough compendium of useful experience and practical hints. It will no doubt find its circle of readers.

Down to Earth:
an Introduction to Geology. By Carey Croneis and William C. Krumbein. Pp. xviii + 501 + 64 plates. (Chicago: University of Chicago Press; London: Cambridge University Press, 1936.) 17*s.* 6*d.* net.

IT is unusual, in Great Britain at all events, to find a book of elementary science enlivened with facetious illustrations. Such, however, is the case in "Down to Earth", a volume of nearly five hundred pages by Croneis and Krumbein, published by the University of Chicago Press. There is a large number of figures of which one may be cited as a sample of many. It is entitled "Earth has not yet answered the question of her origin" and Earth is represented as a girl in a straw hat, short skirt and apron scratching her head, and is being pointed at by three stars in top hats and walking sticks. In addition to the many figures there are sixty-three plates which at first sight look as if they had been taken from some weekly illustrated magazine. Yet the book is a very good one. The plates, each one made up of several good photographs or on occasions diagrams, convey a great deal of sound information on various aspects of geology, palæontology and their applications to modern life. Not all the text figures are humorous; many are the more usual form of diagrammatic illustration, portraits or reproductions of historical medieval text figures. The text is good and conveys a great deal of information. A school boy or girl might perhaps be attracted by the lighter aspects of the volume to absorb the more solid parts, which in fact form the larger part of the work.

Biologie der Tiere Deutschlands

Herausgegeben von Prof. Dr. Paul Schulze. Lief. 37. Teil 26: Orthopteroidea II, Phasmodea, Saltatoria. Von Max Beier. Pp. 233–415. 16.50 gold marks. Lief. 38. Teil 9: Acanthocephala, Kratzer, von Friedrich Bock; Teil 31: Hemiptera III, von Herman Weber. Pp. 9+209–355. 16.50 gold marks. (Berlin: Gebruder Borntraeger, 1934–1935.)

THE first portion contains two chapters, one dealing with the Phasmids (stick insects and their allies) and the second the Saltatoria (locusts, crickets, etc.). While other forms are mentioned in the first chapter, it is largely built round *Carausius morosus*. It includes a good account of the anatomy and histology, particularly of the sense organs, but all dealt with in correlation with function. In addition, the reproductive activities and the reactions of the animal are adequately discussed. The second chapter, which deals with the subject matter in the same manner, actually treats of a number of different species and so has a wider basis.

The second portion deals with two separate groups, the Acanthocephala and certain Hemiptera. The structure and life-histories, including the relationship between parasite and host, are very clearly set forth in some of the better known Acanthocephalids. In the introduction, the classification employed is given, and a few pages farther on is a useful list of fifty-eight worms with their final hosts and, where known, the first and second intermediate hosts also. From this it is clear that in many instances the individual species of parasites show a very wide choice of hosts.

The section on the Hemiptera is subdivided into the Aphids and the Coccids. After a satisfactory review of the morphology of the group illustrated by reference to a series of types, there follows a very useful discussion of the life-cycle of these interesting insects. Much of the information is set forth in the form of diagrams, which facilitate comparisons between the different life-histories. While the part relating to the Coccids is somewhat shorter than that relating to the Aphids, it nevertheless covers the ground adequately.

A good feature of all these contributions is the close correlation between the morphological and functional aspects of the problems. The animals are treated as living units so that the series well merits its title of 'Biology'. All the illustrations are well chosen and well reproduced; the information is up to date and the several chapters are furnished with good bibliographies.

Geometrical Optics

By Dr. H. T. Flint. Pp. ix+266. (London: Methuen and Co., Ltd., 1936.) 7*s*. 6*d*.

DR. FLINT has accomplished a task which leaves teachers of optics very much in his debt. He has produced an elementary treatise which begins at the very beginning of the subject, expounds a rule of signs lucidly and fully, and, after discussing in sufficient detail the topics associated with an intermediate course in optics, goes on to treat of thick lenses, combinations of lenses, aberrations of various kinds, apertures, photometry and optical instruments. Under the last heading are given brief but adequate discussions of the microscope and telescope, the eye and its defects, eyepieces, resolving powers, and various photographic objectives. Those of us who were trained in the optics of a generation ago will recognize the debt that the author owes (and acknowledges) to Drude, whose treatment of the one-to-one correspondence between points in the object- and the image-space is, in general, followed.

That Dr. Flint is the author is sufficient guarantee of the clarity and elegance of the treatment of the subject, and one of the chief virtues of the book is that it leaves the student with nothing to unlearn, whatever may be the direction of his subsequent studies in optics.

Here and there are examples of treatment concerning which divergencies of opinion are permissible. Thus, in discussing focal lines the author very naturally bases his treatment on the properties of lines of curvature—it is the method of approach natural to the mathematician. So far as the average student is concerned, the reviewer finds that method of approach most useful which is based on the properties of the caustic; this, however, is a very minor matter.

If a suggestion may be made, it is that, in a future edition, a few *laboratory* exercises might with advantage be added, and that, in the exposition of the properties of the cardinal points, the Bravais points should not be forgotten.

The book may be unreservedly recommended to students in the final or junior honours grade in the universities.

Physical Chemistry for Colleges:

a Course of Instruction based upon the Fundamental Laws of Chemistry. By Prof. E. B. Millard. (International Chemical Series.) Fourth edition. Pp. ix+524. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 21*s*.

WRITTEN, for the main part, in terms of the classical thermodynamic and statistical theory, the fourth edition of this book, nevertheless, gives adequately the facts of recent discoveries. Chapters involving numerical work are pleasingly free from ambiguity, so that the student should find little difficulty in working through the excellent assortment of problems appended to these chapters, although these exercises would probably be more helpful if the answers were provided.

In his treatment of modern physico-chemical theory, Prof. Millard is sound rather than provocative. Thus, while the existence of activated molecules is deduced as a result of the breakdown of the kinetic theory of reaction, their position in the electro-chemical theory of valency is only briefly mentioned. In the same way, heterogeneous reactions, treated largely as an application of the Phase Rule, might well have been correlated with the modern theories of adsorption and catalytic activation. Minor drawbacks of the book include the lack of formal definition, for example, of heat of reaction, order of reaction, etc., and the ambiguous use of the terms atomic weight, gram-molecular weight, etc.

The Strain of Modern Civilization*

By the Right Hon. Lord Horder, K.C.V.O.

FROM the early days of the primitive curse, life has always imposed its strain upon mankind. It is the penalty we pay for living at all. Philosophers have always assured us that we cannot have life without it. Indeed, they have assured us that some degree of strain is good for us. There is, however, implicit in the title of this discussion the suggestion that the stress of modern life has new elements, and is excessive. In the street, the trained eye detects in the physiognomy of the people the early stages of that concern which, in the consulting room and in the hospital ward, shows itself so frequently as the more established picture of 'anxiety neurosis', unloading itself upon the digestion, the circulation and other bodily functions, which are really more sinned against than sinning. 'Functional' diseases, as against 'organic', have increased, whether in the field of the nervous system proper, the heart and blood vessels or the internal secreting glands. I must not stay to expand, or even to justify, these statements; few, if any, medical men will contest them. In case after case, a tactfully conducted pursuit after fundamental causes removes the screen of headache, insomnia, indigestion and fatigue, and the anxiety factor is revealed.

In the sphere of microbic infections, as I have pointed out elsewhere, we have new diseases for old. Preventive medicine has freed us from many of the severer epidemics, as also from many fulminant sporadic infectious diseases. Tuberculosis has come largely under control. But in place of such plagues as these, there is an increase in the incidence of those more subtle germ diseases which we call "sub-infections", in which the virulence of the microbe is low, whilst the susceptibility of the host is high. In many of these diseases the germ comes from within and not from without: "a man's foes" are "they of his own household". In short, we are becoming the victims of our own saprophytes. And the only reason we can assign for all this is a 'give' on the part of our own resistance to auto-infection—a 'give' which seems to follow a lowering of the control exercised in health by the nervous system. Such control is, in a strict scientific sense, only a postulate; it lacks proof; but is it likely that, with nerve control of so many other functions proved, we shall find that the important function of immunity is an exception?

So much for some of the effects of nerve strain. What of the causes? It is almost platitudinous to speak of the anxiety connected with the competition of living, and now with the equally grave and increasing sense of international insecurity; of the pace at which we live; of the precariousness of life itself in the streets, so that we seem in these days to live by accident rather than to die by it; of the monotony and drabness inherent in many workers' long hours of physical and mental effort; of the lack of air and of exercise and of sleep; of the exciting nature of our amusements, whether the immediate demand for them be normal relaxation or a dope; of noise—needless, stupid, provocative, ill-mannered, selfish noise. . . . Platitudinous, and yet, on reflection, the major premise holds good in respect of all these factors.

There is a notion afoot that, in the last analysis, science is largely responsible for the extent and persistence of much of the strain of modern life. I want to say, at once, that I regard this unloading upon science as mere pusillanimity. I hold the view that it is not too *much* science, but too *little* science, that has helped to get us into this trouble. Or rather should I say, not enough interest *in* science and not enough direction given *to* science. What interest does the average individual really take in science and to what extent is he prepared to encourage it? The answer is, almost nil. Which is odd when we reflect that he recognizes quite fully—as how can he fail to do?—that at the present time both politics and economics—and some would add even religion—regarded as systems existing for human betterment, seem to have failed him, and science alone is not bankrupt. Science has, indeed, loaded man with benefits, but he has shown an indifference to them, or a carelessness and a prodigality in his use of them, which is quite pathetic.

A Spanish writer says in this connexion that, speaking for himself, . . . "the disproportion between the profit which the average man draws from science and the gratitude which he returns—or, rather, does not return to it: this is terrifying. I can only succeed," he continues, "in explaining to myself this absence of adequate recognition by recalling that in Central Africa the negroes also ride in motor cars and dose themselves with aspirin".

Not only ungrateful in thought and attitude, but ungrateful in mishandling the benefits accruing from scientific endeavour. Blame science? We need not drive a car so fast that it kills, or make a loud-speaker so loud that it deafens. Science was made for man, not man for science, and the one thing that matters is control. Are we going to drive the machine, or are we going to let it drive us ? Mr. H. G. Wells, in one of his inimitable word pictures, portrays civilization as a high-powered motor-car gathering momentum on a precipitous hill, a quaking, gibbering monkey at the wheel, impotent to check its increasing speed. Not complimentary, but terribly suggestive.

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* From the introduction to a discussion in Section I (Physiology) of the British Association at Blackpool on September 15.

Who cares about the direction along which science produces her gifts to mankind ? We have an astronomer royal, but we have no biologist royal, still less a psychologist royal. Is this a survival from the days when we thought the stars controlled our destinies ? But if "the fault . . . is not in our stars but in ourselves, that we are underlings", as I believe it is, should we not 'do something' about this ? Hygiene of the body—the idea seems, at long last, to have been grasped ; 'mental hygiene', after a long and painful labour, is, I think, being born. What of spiritual hygiene, the hygiene of temperament ? I believe that the spirit of man is fundamentally as amenable to scientific investigation, if not to control, as is his body and his mind.

Amongst the remedies for the ill effects of the strain of modern life, I place first more science, and especially science directed towards the study and development of the mind and the spirit of man. Then it behoves us to guard and support all those amenities which are actually in existence or which are struggling for recognition : leisure for the artisan, the factory hand, the labourer, the shopman and shop woman, the housewife—and for "all who grunt and sweat under a weary life" ; slum clearance ; playing fields ; national parks ; the National Trust ; physical training ; adult classes ; pictures ; poetry ; music ; museums ; libraries ; architecture ; quiet for the brain worker and others. Whether our outlook be mainly that of the eugenist or that of the environmentalist, we must not "cease from mental fight" until we have, by these and other means, "built Jerusalem in England's green and pleasant land". I risk platitudes once more but again the major premise holds.

The critic may, however, be saying : "that's all very well ; you are only dealing with the individual ; it is the mass for whom you must prescribe, the mass that is arising here, and there, and that will determine the trend of civilization in the near future, and even determine whether it continues to exist or not". But, personally, I see little hope for the people of Great Britain through mass movements. Fascist or Communist, when individual freedom has been sacrificed, I see no chance of achieving that control in the spiritual sphere through which alone, I believe, salvation can come to the human race. What matters the colour of men's shirts if these are soon to be their shrouds ? Or what matters their numbers ? The falling birth-rate in Great Britain is causing some people concern. As a disciple of Francis Galton I am much more interested in the quality than in the quantity of our people. When the clash comes, if come it must, between these two hordes of the new barbarians—civilized barbarians if you like—it may well be that the salvaging of the world, or its doom, may depend upon whether Northern and Western Europe, and America, have been able to preserve an individualized society, or, like the two opposed masses in the dictator countries, have yielded to the tremendous pressure of what may prove to be a bastard civilization and have caught the infection of despair. If our own individualities refuse to be tub-thumped, or intimidated, into a pulp, all may yet be well and the clash may be averted. Meanwhile, "'a plague on both' their blouses !" We had troubles enough of our own with which we were busily, and not altogether unsuccessfully, coping : the loud-speaker next door, the roar of the sports-model car up the street (night-silence for hooters notwithstanding) ; and now comes another fire-eating speech from a dictator on tour, or an account of one of these orgies of human sacrifice by which an executive hopes to maintain its precarious control. No wonder our nerves are kept on edge.

Much of what I have just been saying may sound like a statement of my own views on international affairs rather than the contribution of a doctor towards the treatment of a disease. But I wanted to emphasize my opinion that remedies that depend upon parading or dragooning patients in the mass are spurious remedies, and are, therefore, unlikely to be finally effective in freeing the world from the strain that it is suffering.

Recently we have been witnessing the invasion of medicine by mass methods, by direct action, by force. The results have been very disappointing. Too often we have had to admit that many of these therapeutic efforts did little more than demonstrate the triumph of technique over reason. We had to start all over again, working out the particular case, and following the indications carefully. That is, we did this if the direct action method still left us a patient to treat. We remembered—what we never should have forgotten—that it is only by this segregation and study of the individual, and attention to his particular needs, that we have any good chance of restoring him to health. It is for this reason that I have dealt with mass movements as efforts towards restoring that sense of security which is essential to national and to international well-being. The analogy from medicine is all against treating the crowd, and all in favour of treating the individual.

It may, however, be advanced that what may not succeed in Great Britain may succeed in Russia or in Germany. Of this it behoves us to hold an open mind. But it also behoves us to be vigilant lest we sell the birthright of our national characteristic, which is individual freedom and poise, for one or other of the vaunted panaceas that are offered us from outside. I say all this at the risk of being charged with egregiousness—a common charge against Britons.

There is another characteristic in a British patient: to treat him successfully he must be treated through his intelligence and through his will, not through his emotions. He responds badly to the '*ça passe*' method.

Nor shall we, if we be wise, listen seriously to the various panaceas offered to us from within. There are several of these. In respect of the worrying menace of war, and the perpetual anxiety it creates, there is the doctor who says: "sign a post-card *against* war, say you won't *have* war". Which sounds reminiscent of that old story, attributed to President Coolidge, who laconically summed up the preacher's sermon on sin by the statement, "he was against it". Or as who should say, "I don't hold with cancer". But who does? This sort of thing doesn't help anybody. Whereas the sentiment implicit in the soldier-poet's question, "Who lives if England dies?" *does* help, nor is the man or woman who is braced by such sentiment necessarily a jingo or a blatant patriot. Ideals are essential for us all, and are invaluable tonics, but the British patient does better on a practical and an attainable ideal than on one which is, in this present world, too visionary. "The test of truth in matters of practice is to be found in the facts of life, for it is in them that the supreme authority resides."

Then, just as we get the hypochondriac in matters of the body and of the mind, so there is in some quarters, or so it seems to me, a tendency to spiritual hypochondriasis. There are folk who, to use Carlyle's significant simile, spend much of their time looking at their own navels, and even comparing them with those of their friends: much too subjective an occupation to be healthy. We break up the hypochondriac situation by exhorting the patient to be more objective in his outlook and to leave his body alone. His body troubles him less when once he effects this orientation. If for 'body' we read 'soul', the same result may be safely predicted from the same treatment. Following a medical thought, I regard these panaceas as being of the nature of quack remedies, because I do not think that they really deal with the facts inherent in the situation. We are asked if Soviet Russia can change human nature. Frankly, I doubt if it can, because I think the change must come from within and not from without. And if we are given time, and given freedom from paralysing fear—fear, the arch-enemy—we can reduce these strains of modern life by effecting a better adjustment in ourselves to the rapidly changing conditions of our times, reducing the pace at which we live, and achieving control. Given time to meet, and to know each other better, we can pool our various national traits. In the last analysis, we are mostly good fellows with similar needs and probably with similar destinies.

When Browning makes Paracelsus say, "Make no more giants, God, but elevate the race at once", he seemed to subscribe to the element of charlatanry with which tradition debits that romantic figure. As I have already said, I do not think the cure will come that way. I believe that only "man can elect the universal man". But I have faith that the human heart *is* "made of penetrable stuff". I do *not* think that "damned custom" has "braz'd it so, That it is proof and bulwark against sense", though at this moment a morbid Hamlet, were he looking on, would doubtless take that view.

I think, rather, that there are still enough people, "whose blood and judgment are so well commingled that they are not a pipe for Fortune's finger To sound what stop she please"—enough of these sturdy folk to check the disease and to re-establish health. The treatment is the treatment of the individual by the individual. Any physician who can inspire "Gentleness, Virtue, Wisdom and Endurance" will help to hasten and establish the cure. Any physician who cannot prescribe these remedies obstructs the cure, and should stand aside.

Is it permissible, in an assembly of scientists, to end on a transcendental note? If so, I would remind myself that the spirit of man, though often needing comfort and reassurance, and perhaps never more than now, is still the dominant factor in all the experiences that it meets, be those experiences in the bodily, mental and spiritual health of the individual or of the race.

"The Lords of life,
I saw them pass,
In their own guise,
Portly and grim—
Surface and dream,
Some to see, some to be guessed,
They marched from East to West:
Little man, least of all
Walked about with puzzled look.
Him by the hand dear Nature took,
Dearest Nature, strong and kind,
Whispered, 'Darling, never mind!
To-morrow they will wear another face,
The founder thou; these are thy race!'"

Evolution of the Solar System

SIR JAMES JEANS opened a discussion on the evolution of the solar system on September 10 at the Blackpool meeting of the British Association. Prof. A. Holmes described the geological evidence concerning the age of the system ; Prof. E. A. Milne discussed its dynamical aspects from the point of view of his recent work on the foundations of dynamics and gravitation ; in the absence of Mr. R. A. Lyttleton, his binary star hypothesis of the origin of the system was described by Prof. W. H. McCrea ; Prof. V. Bjerknes spoke on some hydrodynamical aspects ; Dr. Harold Jeffreys stated some problems raised by the chemical composition of the planets, and summed up the discussion. Some of the points raised are summarized here.

No theory of the origin of the solar system has yet gained general acceptance. Indeed, until quite recently, none existed which satisfied all the following simple general tests : it should explain (i) the production of satellite systems as well as the planetary system ; (ii) the regularities in the sequence of the planetary masses, of the ratios of the masses to those of the largest corresponding satellites, and of the numbers of corresponding satellites, when the planets are arranged in order of distance from the sun ; (iii) the birth of the system at an epoch when the physical constitution of the sun was not greatly different from what it is at present ; (iv) the large amount of angular momentum possessed by the outer planets.

Arranging the chief theories in order of the number of bodies involved in the birth of the system, we have first Laplace's nebular hypothesis. The origin is sought in the cooling, and consequent shrinkage and speeding up of the rotation, of a single nebular mass of gas extending initially beyond the orbit of the outermost planet. The planets are supposed to be formed from rings of matter thrown off in the process of shrinkage ; but there is a failure to explain how such rings could condense into planetary form, or how they could possess the observed amount of angular momentum even were the condensation achieved.

Laplace's theory is found, in fact, to involve an insufficient number of adjustable parameters. So various subsequent theories (Buffon, Proctor, Bickerton, Chamberlain and Moulton, Jeans, Jeffreys) have appealed to the intervention of a second body. Some twenty years ago, Jeans proposed his tidal theory, which at the time was the most successful in this category. A second star was supposed to have described a hyperbolic orbit about the sun and it was shown that, if the approach had been sufficiently close, the tides raised in each body by the gravitational pull of the other would have become unstable and grown into a great filament of gas in the space between the two. The gravitational instability of this gas would cause it to condense into planetary masses, some of which would be retained in the gravitational field of each of the two stars. This theory is particularly successful in explaining the regularities noted under (ii), but, as Jeffreys and H. N. Russell have pointed out, and as its author admits, it again encounters difficulties with regard to the peculiar distribution of angular momentum. Some of the difficulties Jeffreys has tried to remove by imagining a still closer encounter of the two stars than Jeans had postulated.

Russell was the first tentatively to suggest that three bodies had been concerned in the production of the solar system, by supposing that the sun was originally a double star, and that the planets were formed by an intruding star encountering, not the sun itself, but its original companion. The actual production of planets by the encounter would be supposed to proceed as on Jeans's theory, but it would now clearly be possible to account for their large angular momentum about the sun, or, what comes to the same thing, their large distance from the sun. Russell himself saw difficulties in explaining how the companion and intruder could both escape from the sun after the encounter, and still leave the planets entangled in the sun's field. R. A. Lyttleton, however, independently put forward the same hypothesis, and at the same time showed that these difficulties are not inherent in it. He has demonstrated that, for ranges of real values of the initial velocities of the bodies involved, it is possible for the encounter of the companion and the intruder to communicate velocities to them which carry them both "to infinity" in different directions, while parts of the tidal filament formed between them, and endowed with velocities intermediate between those of the escaping stars, would have velocities insufficient to get away from the sun's gravitational field. Further, this may happen for initial velocities of the intruder relative to the sun of the same order of magnitude as the observed relative velocities of stars in the same neighbourhood of the heavens.

The theory can be developed to account for the similar sense of revolution of the planets round the sun, for their rotations, and for the existence of satellites. The latter are supposed to be formed by tidal encounters of pairs of planets when, in their revolution round the sun, they both arrive back simultaneously in the same neighbourhood as where they were originally formed. That they should do so before they have had time to condense appears improbable, and this is one of the objections that have been raised against the theory. Nevertheless, so far as Lyttleton's theory has been worked out—it is still in its early stages—it does seem capable of accounting for all the *dynamical* features of the solar system.

Geology cannot say anything about the origin of the earth, but from radioactivity data it can set a well-established lower bound to its age. The generally accepted theory of the formation of rocks has indicated where the oldest exposed examples are to be found, and the lead-ratio method has shown these to be about 2,000 million years old, but their constitution shows them to have been made, by weathering and fusion, out of still older rocks. However, combining this information with that got by Paneth concerning the age of meteorites as given by their helium content, we are led to the figure of about 2,700 million years as the age of the solar system. Geological evidence based on seasonal effects preserved in the structure of the varved clays, and on the recurrence of glaciations, shows further that there have been no large changes in the dynamical and thermodynamical relations between the earth and the sun for something like 2,000 million years.

A study of the chemical composition of the planets leads to many grave difficulties, as Jeffreys has emphasized. For example, in the case of the outer planets, the order of increasing mass is the order of decreasing density, which seemingly admits the explanation that when the masses were gaseous the stronger gravitational fields were better able to prevent the lighter elements from diffusing away into space. But now for the inner planets, Mercury, Venus, Earth, Mars, and also the moon, the order of increasing mass is the order of *increasing* density, which is inconsistent with any such simple explanation. Again, the earth consists of a rocky shell of mean density about 3·3 and a central liquid (probably iron) core of mean density about 12. The mean density of the whole moon, on the other hand, is about 3·3, so that it evidently does not possess a heavy core. This suggests that, if the moon was formed by the breaking up of a planetary mass, then it took place after the heavy elements in the latter had had time to settle down towards the centre, indicating that the formation of the satellite took a considerable time. However, most theories of the formation of satellites require them to have been formed very early in the history of the planets. Also it is difficult to explain how the earth retained any light elements unless its crust solidified very quickly, and it is then difficult to see how the moon could have been formed after solidification. In fact, in the present state of the theory, any explanation of one feature of the chemical composition of the solar system appears to be contradicted by some other feature.

The difficulty about the angular momentum of the system has been mentioned. Lyttleton's theory is the most successful attempt hitherto made to resolve it on the basis of ordinary mechanics. There may still be other ways; for example, E. W. Brown has pointed out that the theory of the perturbation of one planet by another might lead to an exchange of angular momentum between them, if it were carried to a higher degree of approximation than is usually done. But a much more fundamental resolution of the difficulty is now put forward by E. A. Milne on the basis of his recent work on the foundations of dynamics. In this work he starts from observers' immediate consciousness of *time*, and their description of motion based thereon, and is able to derive the forms of the laws of dynamics and gravitation from purely kinematical considerations. He postulates the equivalence of observers in regard to their observation of each other and of the rest of the universe, but he does not need to appeal to experience for any empirical 'laws of motion' or of 'gravitation'. His results are derived first in terms of *kinematical time* t. He then finds that they pass over into the local empirical Newtonian forms on transforming to *dynamical time* τ, where $\tau = t_0 \log (t/t_0) + t_0$, and t_0 is the present value of t obtained from the expansion of the universe. The value of t_0 is about 2×10^9 years, which is also about the age of the solar system given by radioactivity data.

So this would place the origin of the solar system at about the singular epoch $t = 0$ occurring in the kinematical theory. If the correspondence were exact, then, since $\tau \rightarrow -\infty$ when $t \rightarrow 0$, the age of the system, reckoned by dynamical events such as the revolution of a planet round the sun, would be infinite. In other words, in dynamical time the solar system never had a beginning. This suggests a reconciliation between the 'short' and 'long' time scales, which have presented inconsistencies in connexion with many cosmological problems.

Another consequence of the theory is that angular momentum is not a time invariant, but the angular momentum of any local system grows at a rate proportional to itself. Thus small initial differences of angular momentum tend to be magnified as time goes on. This would remove difficulties connected with the rotation, not only of the solar system, but also of spiral nebulæ, in which the amount and distribution of angular momentum has long been a puzzle. It should be added, however, that this theory also has yet been given only in a preliminary form. W. H. McC.

Palæontology and Humanity*

By Prof. H. L. Hawkins

PALÆONTOLOGY gives no direct evidence as to the origin of groups, of whatever taxonomic grade; its scope is limited to records of the later stages in the careers of groups already in existence. This is not to deny that the presumptive evidence for the birth of new types is overwhelmingly strong; but actual tangible proof of their parentage and generation is lacking. A palæontologist is more of an undertaker than a midwife.

Again, fossil evidence cannot give convincing demonstration of the origin of structures in organisms; its scope is restricted to observation of the fate of those structures after they have appeared. There must always be a theoretical quality in attempted explanations of the development of new characters; there are facts recording what happens to them in course of time.

The only language which adequately expresses the nature of morphogeny is that used in description of individual life. Structures, once originated, pass through stages of development, modification and amplification that are closely analogous to the phases of personal history, both physical and psychological. There is a continuous duplicity, in that intrinsic characters are involved with external requirements; environment is educative but not creative. There is a limit to the response to environment possible for any structure; if that limit is exceeded, disaster results. Every character of an organism, like every complete creature, is more responsive to environmental influence in its early history than later. Directions of development induced or encouraged by environment become gradually ingrained; just as practices oft repeated become ineradicable habits. In contrast with modern municipal tendencies, trolley-buses are transmuted to trams.

The several characters of an organism are at once independent and inseparable; each can follow its own line of development, but unless a balance is kept within the whole series, collapse is certain. Just as different groups of organisms show very different evolutionary speeds, so the various structures in a single organism become modified at varying rates. The attainment of mature perfection from a stage of immaturity can never be more than a transient phase on the way to a fresh disproportion comparable with senility.

Structures, and with them the organisms to which they belong, grow old, exhausted or hypertrophied by their own intrinsic expenditure of evolutional 'effort' amid an ever-fluctuating embarrassment of circumstance.

We come to the conclusion that the oracular recommendation to know ourselves is a guide to the secret of evolution. Physically and (in the human case) psychologically, we live our lives as compromises between hereditary tendencies and environmental requirements. As we grow older our accumulated load of compromise becomes an obsession, reducing our capacity for further efforts of the kind; and our environment never tires in its changefulness.

If we consider these principles in the light of the struggle for existence, we find that those types which can attain the most perfect harmony with their environment will flourish proportionately. But their success brings Nemesis in its train; for speedy evolution towards dominance implies continuous speed; the perfection point is passed by the same momentum that reached it. Undoubtedly the victor in the struggle for existence wins the prize; but the prize is death.

When we attempt to apply to human affairs the principles of evolution as shown in palæontology, many difficulties appear. Not the least of these is the impossibility of a dispassionate outlook; we are proverbially unable to see ourselves as others see us. Another serious difficulty arises from the shortness of the time during which our species has existed, and the paucity of trustworthy evidence that it has left of its history.

At the outset we must admit that the basis of our analysis of mankind will be on a different plane from that which we employ in the case of other organisms. Morphological and physiological characters change so slowly that we cannot expect to find much alteration during our brief career; and in any event there is practically no evidence of that sort available. But if the conclusions already reached as to the universality of the law of evolution are accepted, it matters not a whit which particular attribute of an organism we select for study. Behaviour is but an expression of the reaction between the qualities of an organism and its environment, and civilization is a kind of behaviour. This argument is not so specious as it may appear, for the evidence available to check its validity is ample.

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* From the presidential address to Section C (Geology) of the British Association, delivered at Blackpool on September 14.

Before following that line further, it will be well to attempt an estimate of the qualities of the human species as they appear to a palæontologist. This is a dangerous task ; for I am bound to omit, for the time being, reference to many human attributes. I must appeal for patience ; I am fully aware of the incompleteness of the analysis I am about to make ; later, in a desperate attempt to arrive at a happy ending, I propose to give consideration to those qualities in man that truly differentiate him from other animals.

If it be asked how a student of 'lower' orders of organisms (and those defunct) can presume to include the human race in his purview, a plea of justification can be made on two grounds. Mr. Tony Weller gave it as his opinion that "the man as can form a ackerate judgment of a animal can form a ackerate judgment of anything". This generalization, like all others, may be debatable ; but the course of human history, in so far as it is known, shows features typical of the course of evolution revealed by palæontology.

The outstanding physical peculiarity of the human species is its upright posture, a feature to which many of its bodily structures are far from completely adapted. In spite of its relatively large size, the human body cannot be claimed as exceptionally capable. A man stripped of the instruments of his devising, left to compete on equal terms with the other occupants of his restricted environment, would stand no better chance than they. It is true that he could perform most of the actions expected of land animals, but none of them superlatively well. Were he compelled to rely on his bodily characters alone, there would be little more reason to single him out for special consideration than there would be the capacity to do so.

The mental powers of man are those that place him in a category apart from other creatures. By the exercise of his wits he can find compensation for structural shortcomings, and challenge, defeat and control all other living things. With the help of the machines that he invents, he can project himself successfully beyond the normal range of terrestrial animals, transporting his body and his habits over the sea and through the air. He can, within fairly wide limits, overcome the influence of environment.

With no intent to belittle the mechanical achievements that have brought man to his commanding position, we must admit that few of them can be claimed as original. They are copies, often improved editions, of devices that already existed in the animal creation, coupled with applications of natural forces that are as old as the world. Man's capacity for generalization has enabled him to foresee the effects of his inventions, and so to reduce the time that would otherwise have been spent on the costly method of trial and error. He can transmit his experiences to his own and following generations, so preventing (for those who listen) a wasteful repetition of mistakes. The speed with which he has beaten all other creatures at their several games is commensurate with the degree of his success. Paradoxically he has become supremely generalized by the exercise of a highly specialized faculty.

It is difficult to find any type of animal behaviour in which man cannot excel. Whether in the strictly mechanical processes, such as locomotion or building, or in the more subtle qualities of affection and aspiration, he stands revealed as an exaggerated animal. There are no activities, constructive or destructive, and no habits, pleasing or loathsome, in which he cannot outdo the most accomplished animal.

This analysis leads to a somewhat equivocal result. On one hand, the high cerebral specialization that makes possible all these developments, and the extraordinary rate at which success has been attained, both point to the conclusion that this is a species destined to a spectacular rise and an equally spectacular fall, more complete and rapid than the world has yet seen. On the other hand, the wide range of directions into which the specialization extends, and the measure of control over environment that it entails, seem to suggest a peculiar kind of plasticity that might pass for generalization, with the consequent hope of a long time-range. In this uncertainty we must look for such facts as are available, facts of history which are at least comparable with the record of palæontology. But first we must estimate the relative value of the evidence afforded by human history.

Fossils and historical documents alike give but a fraction of an account of the matters of which they treat. In both cases the story of the early stages of racial progress is imperfect and often mythological ; the episodes of decline and fall are more fully documented. But, in contrast to palæontological evidence, human accounts are always suspect. Written records of events represent an impression made on one, or at best a few, minds ; they may—indeed they must—be tainted with prejudice and ignorance even when they are not deliberately falsified. The impious rebellion of one writer is the glorious revolution of another. Whatever may be the criticisms levelled at the transcribers of natural history, no doubts can be cast on the essential truth of the record they try to interpret. As an academic proposition, it may be debated as to whether a misread fact is preferable to a misread falsehood ; but there is at least a chance of finding the truth in the former case.

Again, the bulk of human history is the record of the performance of a few actors on a specially selected stage; palæontology, with all its imperfections, gives a picture of events in fairer proportion. The parts of human history usually recorded represent the activities of man the intensified animal, rather than of man the half-fledged angel. The behaviour of the animal is the more rational, and so easier to remember and describe. But from very early times another factor has entered into human affairs—a factor illogical and wayward, but every bit as real to a man as his animal qualities. This factor, which we may call 'altruistic', makes human actions often unintelligible in the present, and still more so in the past. For example, it is easier to find a rational explanation of the presence and characters of a *Micraster* in the Chalk than to form a plausible hypothesis as to the meaning of the Stonehenge that men erected over it. Man can safely claim to be unique, for he is the only irrational creature in the world. A palæontologist may be excused for looking askance at a record of creatures like that written by one of themselves.

Nevertheless, man leaves other traces of his activities besides written screeds, and many of these records are as revealing, and as unintentional, as the shell of a mollusc. By piecing together archæological materials, and fitting documentary accounts into the plan of this mosaic, a conception of human history can be gained that comes within measurable distance of scientific evidence. We have more established knowledge of the Belemnites than of the Incas, but perhaps we know almost as much about the Romans as about the Trilobites.

It would be wearisome to reiterate the various features wherein the history of human affairs corresponds with the course of evolution in other groups. Whether we consider individual lives, dynasties or empires, the same depressing story applies. Some races, once dominant in their particular sphere, have disappeared entirely; others, fallen from high estate, linger in inglorious decay. But all those brave civilizations and empires of which we have records seem to have shown a succession of similar histories. They have risen from obscurity through possession of successful attributes, and have reached the peak of their power only to pass it. Some have rotted away quietly, others have fallen before the onset of less rotten stocks or perhaps of extra-human disaster. Many of the early empires were on so small a scale that their rise and fall had merely local effect; others have been more comprehensive, and their dissolution has spread havoc over wide areas of the world.

Until comparatively recently, there has been a persistent proportion of 'backward' types, unaffected by the civilizing influence of the progressive powers. These have remained as a quiet background to the transient pyrotechnics of the others. They remained to provide a new upstart when the current one had crashed. To-day there are few races of this kind left; almost all mankind has encountered civilization and either perished or been transmuted. The fatal complexity of civilization grips the whole species, crushing it into unity.

The specific causes of the collapse of once dominant races are doubtless varied; but there is general agreement that one universal factor in disintegration is complexity, an aspect of over-specialization. The units of an empire, be they individuals or factions, tend to work together in harmony during the period of upward struggle; but when a position of dominance is won, they continue to struggle. When there are no new worlds to conquer, they begin to fight among themselves. Selfish aims replace patriotic ones, and the community becomes discordant.

The correspondence between this state of affairs and the morphogenetic trends in other races of animals is so close that it needs no elaboration. Those who deny that human institutions are subject to the laws of organic evolution know either no history or no palæontology. Many proverbs give epigrammatic statements of the principles of evolution in imaginative terms.

"Ill fares the land, to hastening ills a prey,
Where wealth accumulates and men decay."

The history of extinct empires, which should be studied as a cautionary tale, is commonly regarded as providing an example to be followed. Human nature has the curious trait of gambling against the laws of cause and effect. We always hope that the fate that befel our predecessors will pass us by. Babylon, Egypt, Rome, Spain all traversed the same track; and to-day we follow in their footsteps hoping to reach some different goal.

If this were all, man's outlook would indeed be dark. According to temperament we might as well sit with folded hands in a darkened room awaiting the inevitable end, or meet the crash with ribaldry and riot. Our peculiar quality of superior mentality seems but a suicidal acquisition, hastening and intensifying the imminent doom. But the human mind is more than a fabricator of evanescent institutions. It can transcend utilitarianism (wherein it but exaggerates animal qualities) and can form idealistic conceptions.

Ideas of chivalry, honour and self-sacrifice have no place in the struggle for existence; but they are inherent in all but hypersophisticated minds. Among ordinary folk, conceptions such as these are stronger incentives to action than animal impulses, as even the most rascally demagogue knows. Learning, philosophy and art are realities to which men will devote their lives, creating rather than copying, with no ulterior or mercenary aim. The arts and virtues bring a new and incalculable feature into the story of evolution. Some, at least, of their achievements outlive kingdoms and empires, seeming immortal.

Men are, for the most part, enthusiastic admirers of virtue, even to the extent of devising laws to ensure its maintenance. Very many of them are actual exponents of virtue in their personal relations; but in public affairs and in the mass they are often content to behave as animals rather than as men. "Manners makyth man" is perhaps the most concise specific diagnosis ever published. But there is only one law of evolution, common to individuals and races alike. If mankind as a whole neglects its "manners", it abandons any claim it may have to qualitative difference from other animals. There is no doubt of man's ability to become the most successful type of animal that has ever existed; but the reward of success in that direction is death.

The love of truth, greatest of all virtues, is especially an attribute of men of science. In this we are idealists, for the truth is unattainable, however worth the seeking. We know that all the progress that our species has made, in material as well as in mental affairs, is the result of the search for truth. We find ourselves strangers in a world riddled with more or less blatant deceit; but we still follow our ideal, confident that all other paths are blind. We recognize in the conception of truth something eternal, not subject to the laws of change and decay.

We know that idealism is the goal and incentive in all actions that can truly be described as human. To the idealist, environment is something to be overcome or adapted into service; the story of human progress is one of triumph over circumstances. The self-styled 'realist', who advocates acceptance of, and submission to, his temporary environment, is less than a man; he follows in the tradition of the beasts that perish.

To idealists palæontology has no message, save to welcome them as something new in Nature. To realists, who seek material success in the struggle for existence, palæontology, with millions of years of history as its authority, declares emphatically, "You have been warned."

Obituary

Mr. C. Fitzhugh Talman

WITH the death on July 24, at the age of sixty-one years, of Mr. C. F. Talman, the U.S. Weather Bureau loses one of its best known members.

Talman was born at Detroit on August 31, 1874, and joined the Weather Bureau in October 1896. From 1898 until 1899 he was in charge of the meteorological stations maintained by the United States in South America and the West Indies; afterwards he was attached to the Weather Bureau Library, where he found his true vocation. He received the official title of librarian in 1908, and though he became junior professor in 1912, professor in 1914 and meteorologist in 1922, he remained in charge of the library throughout. He was intensely interested in bibliographical work, and his knowledge of meteorological literature became almost unique. In addition to the annotated lists of new books and papers which he compiled regularly for the *Monthly Weather Review*, he delved deeply into the history of meteorological terminology, publishing his results in semi-popular articles on "The Language of Meteorology", "The Meteorological Isograms" and "The Vocabulary of Weather". The last, which was reprinted in the *Quarterly Journal of the Royal Meteorological Society* for 1925, ends with the words: "I have been gathering wind-names from the literature of all countries, ancient and modern, for many years, and endeavouring to elucidate them from both the etymological and scientific standpoints. . . . It is a fascinating occupation and I only regret that I have, apparently, the whole field to myself".

Another outcome of Talman's hobby was his selection as meteorological adviser for the "Standard Dictionary" in 1910–11. He had a pleasant literary style, which also found expression in two popular books "Meteorology, the Science of the Atmosphere" (reprinted in 1925 as "Our Weather") and "The Realm of the Air" (1931) and in numerous newspaper articles, but his interest was the collector's rather than the author's, and he published only a small part of his material. It is greatly to be hoped that means will be found for editing and publishing his notes.

WE regret to announce the following deaths:

Dr. J. B. E. A. Charcot, the well-known French explorer of the Antarctic, on September 16, aged sixty-nine years.

Mr. J. W. Gordon, K.C., honorary secretary of the Optical Convention in 1912, and author of "Generalized Linear Perspective, with Special Reference to Photographic Land Surveying", on September 21, aged eighty-two years.

Mr. Ernest Payne, a pioneer in X-ray research work, on September 20, aged seventy-six years.

News and Views

Problems of Present-day Astronomy

In connexion with the recent meetings of the British Association, Sir James Jeans delivered a public lecture at Southport on Friday, September 11, on "Some Problems of Present-day Astronomy". He confined his attention to theoretical astronomy, and dealt almost exclusively with large-scale problems concerned with the character of the universe. After a brief survey of the general structure of the stellar universe, Sir James described the various kinds of nebulæ, directing attention in passing to Kuiper's recent discovery, in a planetary nebula, of "what may well prove to be the smallest of all known stars"—a body with a radius about half that of the earth, a surface temperature of about 2,800° C., and an average density about 36 million times that of water. The theory that the extra-galactic nebulæ were formed by condensation out of an originally unstable continuous mass of gas filling all space next claimed attention, and Sir James remarked that mathematical investigation shows that condensations in such a medium would be "on something like the scale of the observed nebulæ, and would be at something like the same distance apart".

Sir James then turned to problems concerning the character of space. Relativity taught us that the total volume of space was finite—a statement apparently at variance with a later suggestion that the curvature of space might be negative and with Einstein and de Sitter's demonstration that it might be zero—but the latest observations disclosed no thinning out of distant nebulæ to indicate that we have yet explored an appreciable fraction of its extent. The systematic separation of the nebulæ from one another was described from two points of view—first as a movement of bodies in a structureless space and secondly as a system of drifting 'straws' revealing the motion of 'currents' in a space whose character the motions served to indicate. For knowledge of the original and present size of space we are dependent on theoretical arguments, and Sir James gave in this connexion a brief description of the theory of Sir Arthur Eddington relating the expansion of the universe with the mass of the electron. According to this theory, the radius of the universe was originally about four times the distance of the farthest nebulæ now known, and has since expanded about tenfold. This consideration would seem to call for further elucidation of the earlier remark that the theoretical separation of the condensations in the primeval universe is about the same as that of the observed nebulæ. The lecture was liberally illustrated by lantern slides.

Preservation of English Scenery

Several important aspects of the preservation of English scenery were mentioned by Dr. Vaughan Cornish in an address to Section E of the British Association at Blackpool on September 14. In the first place, insisting that a scene from which Nature has been expelled is no fit dwelling place for man, he urged the brightening of towns by rebuilding schemes which give higher buildings, and that in a smaller area accommodate the same number of people, and so leave land free for gardens and boulevards. Dr. Cornish went on to insist that the mere preservation of monuments of antiquity is not enough. It is necessary to preserve a contemporary background as in the case of Stonehenge, the Roman Wall, and the ancient earthworks of the Downs. In these respects, however, the danger to natural amenities is less great than in the threat to the cliff-lands of England and Wales. A considerable extent of our five hundred miles of cliff-land is in danger from bungalows, hotels and other buildings. Before it is too late, the last of these cliffs should be acquired and preserved as national parks. This would necessitate the acquisition of a strip little more than 100 yards in width. Several stretches of Cornish cliff-land are specially suited for national reservations, but it will have to be accomplished soon or the builder will have damaged them beyond redemption. The concluding part of Dr. Cornish's address was devoted to a plea for the recognition as national parks of the New Forest, the Forest of Dean, the Pennine Moors and the Lake District. Cliff-lands, woodlands and mountains would then be represented, these being the three types of English scenery of special importance.

Angiolo Filippi (1836-1905)

October 23 marked the centenary of the birth of a leading Italian medical jurist, Angiolo Filippi, the son of a distinguished medical practitioner of Florence. He studied medicine at Pisa, and directly after qualifying gained some useful knowledge for his subsequent career first as a prison doctor and afterwards in the campaign with Garibaldi, where he acquired considerable experience of gunshot wounds. In 1865 he distinguished himself by his devotion to the sufferers from the cholera epidemic at Ancona, San Severo and Apricene. In 1875 he became assistant to Prof. Bellini, who occupied the chair of legal medicine at Florence, and succeeded him in 1884. His "Manual of Forensic Medicine", of which the first edition appeared in 1889 and the fifth in 1919, was the first of its kind to be published by an Italian expert, and proved an indispensable work of reference to the medical and legal profession in Italy. His other works were "A Manual of Thanatology and Traumatology" (1877) and "Medico-legal Exegesis of the Method of Giving Evidence" (1882). He founded a laboratory for medico-legal research in Florence, and his methods of investigation were followed in other Italian schools of medical jurisprudence. He died on December 30, 1905.

British Commonwealth Scientific Conference

A CONFERENCE was opened by the Right Hon. Walter Elliot, M.P., Minister for Agriculture, and attended by representatives of the Governments of all portions of the British Commonwealth, on the morning of Monday, September 21, in London. Its chief function is to examine the work and future of a number of scientific organizations established on a co-operative basis to perform a common service in various branches of agricultural scientific research. As a result of the Imperial Agricultural Research Conference of 1927, the several Governments of the Empire agreed to establish bureaux or centres of information in eight branches of agricultural science, financed by contributions from all parts and controlled by a council representative of all parts of the Empire. To these, the supervision of two older institutes was added in 1933 on the recommendation of the Imperial Committee on Imperial Economic Consultation and Co-operation. In addition, the Conference is considering the future of certain research schemes to which several parts of the Empire now contribute, and also further methods of the interchange of information and closer collaboration in scientific work.

AFTER the opening meeting on Monday, the Conference inspected the bureaux and centres of information which deal with mycology, soil science, animal health, animal nutrition and genetics, plant genetics (non-herbage and herbage), fruit production, and agricultural parasitology. The Conference re-assembles in London on October 2. The Executive Council of the Imperial Agricultural Bureaux, of which Sir Charles Howell Thomas is the chairman, is responsible to all Governments of the Empire equally for the administration of these common services, and in conformity with the resolution of the Imperial Conference of 1926 is constituted on a basis of equality of representation. It was decided by the Governments in 1933 that where such common organizations are formed, their activities should be subject to detailed examination at periodical conferences. This Conference serves that purpose.

Species in Foraminifera

THE veteran palæontologist, Frederick Chapman, who has retired from the National Museum at Melbourne and is now consulting palæontologist to the Commonwealth of Australia, has contributed to the *Melbourne Age* (under the initials F.C. and under date February 8, 1936) a column headed "The Species Nightmare: an Absorbing Scientific Problem". One of the oldest living authorities on the Foraminifera, trained under H. B. Brady, W. Kitchen Parker and W. Rupert Jones, whose assistant he was until his appointment to Melbourne, he deals with this difficult question, quoting Mr. Heron-Allen's communications to NATURE of July 14, 1934 and November 16, 1935. Frederick Chapman deals with it in connexion with other branches of palæontology, and deplores what Heron-Allen termed "the commercialisation of Protozoology", and his article, which is worth the serious attention of all systematists, but is too long to quote adequately, should receive careful attention. Mr. Heron-Allen is consulted by many of the rising school of petroleum geologists at the Natural History Museum, and, regard being had to the deplorable fact that their lists of species are now regarded as a 'trade secret' not to be divulged for the information of rival petroleum merchants, his advice to these young men is to adhere to the genera established by the great nineteenth century school, both in England and on the Continent of Europe, and to distinguish their species, for their own reference and guidance, only by numbers, or by letters of the alphabet, ignoring the thousands of names given to minor varieties by the American School. By this means they can save themselves an immense amount of labour and brain-fag, and their tabulated results are quite as useful as they would be if they were overloaded by a vast nomenclature which it is impossible —and unnecessary—for the human brain to retain.

Invention and the Modern State

THE externals of modern civilization are the products of invention, and a scientific analysis of invention, what it is, what causes it and whither it is leading us, is long overdue in England. In such an analysis the statistical method must predominate and the easy generalization will have no place. It may require research of a difficult and unusual kind, but unless we know, for example, accurately and in detail, the origins, the training and the methods of successful present-day inventors, we do not know the sources of the real progress-making inventions of to-day, and while we are ignorant of that vital fact the recital of a short list of so-called working-man inventors of the eighteenth century is not merely valueless but also misleading. Mr. C. W. Marshall has just concluded in the *Inventor* a series of articles on "The Science of Invention". In them he attempts to interest and guide inventors of various degrees of proficiency, but, although the trend of recent patent applications can be learned from them, the articles are entirely devoid of statistics. As a consequence of this and of the very diverse standards of the inventors to whom the articles are addressed, their total effect is confusion. At one place advice is being given as to the "psychological factor"; for example, "a camera idea, may be submitted to manufacturers in the autumn so as to be ready for the spring sales". Shortly after this we learn—or do we ?—that the "price of inventions used to vary from £1,000 for 'gadgets' to half a million for inventions such as refrigeration and automatic photo machines". Again, "There is a ready market for inventions which cheapen production of exclusive products. By introducing mass-production machines and an entirely re-designed, simplified product the early Fords were able to tap the potentially great motor-buying public".

No one, it would appear, would care to challenge Mr. Marshall's contention that "so keen is the competition, so deep the technical advance now, that the principle of hit or miss, except perhaps in the gadget class of invention, is not applicable, and the complete inventor is a development of the scientific researcher". But to such a man, the suggestion that he would find it worth while studying Max Planck, Einstein and Eddington would come rather late, while that suggestion, even if accepted, would have no utility to the 'gadget' producer. The high hopes raised by the receipt of a treatise with the title "The Science of Invention" remain unfulfilled by Mr. Marshall's series. An authoritative examination of the position of invention in the modern State is still needed. In such an examination the commercial aspect may well prove to be insignificant, although research by one man or one set of workers may have to be restricted to the material inventions, leaving such things as modern systems of government, the most striking development of man's inventive faculty, to the historian or the alienist. From a calm investigation of the uses of material advances it may be found that they follow social changes and are called forth by them: but research is necessary to discover the vital facts of modern invention and, in Great Britain at any rate, there is little evidence that such research is being carried out. Is it fantastic to believe that if it is ever adequately made, we shall have general consent to the idea of complete control by the State of the inventive faculties of its members ?

Viability of Plant Structures

THE question of the length of the period of viability in seeds and other plant organisms is constantly cropping up, and, although a great deal has been written about it, there is still much to be discovered with regard to the actual length of time seeds and spores can remain viable. Reference was made to this problem in NATURE of May 2, 1931, p. 675, and an article on the subject was published in the *Kew Bulletin* of 1933, p. 257. In that article, all the cases of longevity that have been definitely authenticated were brought together. Possibly the oldest case is that of *Nelumbo* (the Japanese lotus) recorded by Ohga in the *Botanical Magazine* of Tokyo, 1923. Seeds of *Nelumbo nucifera* were found in a peat bed buried under 2 ft. of loess in Southern Manchuria. The seeds all germinated and it is estimated that they were at least 120 years old and may have been as much as 400 years. It is well known, of course, that poppy seeds and charlock can retain their viability for very long periods, but for how long one cannot say definitely. According to an announcement in *The Times* of August 19, M. P. N. Kaptereff has succeeded in reviving plant organisms which have lain in the earth for thousands of years. It appears from this account that it is only spores which have shown signs of life, and it seems quite possible that spores of some of the lowly algæ could have survived in a frozen condition for a very long time. From the account it appears that blue-green algæ may be some of the plants which have developed —possibly some of the unicellular green algæ also. As to the grass-like plants which are mentioned, they might well have retained their general appearance in a frozen condition for a very long time, as the ice would preserve the form perfectly well. One would not expect them to have any life in them and this does not appear to have been the case.

Native View of Baganda Institutions

AN account by an African of his own institutions must normally, though not invariably, have an exceptional value for the ethnographer. Being as a rule a spontaneous production, it avoids the great danger of the usual method of inquiry, in which there is the risk of biasing the sources of information. Sir Apolo Kagwa, the *Katikiro* of Uganda, who produced in 1918 an account of Baganda history and institutions in his native language, was exceptionally well qualified for this undertaking. A man of considerable intellectual power, he had been associated with the royal household from his early youth, and when in 1897 the young Daudi Chwa, an infant, one year and six months old, was appointed king on the abdication and flight to German East Africa of his father, Mwanga, Apolo was made regent and prime minister. He thus had a personal and intimate knowledge of the critical times which led up to the intervention of the British forces in Uganda and the institution of a protectorate. His authority on State affairs and ritual is beyond question. One of the most valuable records he has preserved is that of the officers and queens of each ruler from the beginning of the line with the semi-legendary founder Kintu. The Rev. J. Roscoe, when collecting information for his book "The Baganda", derived a great deal of his material from the *Katikiro*; and, in fact, Sir Apolo's book, which is an invaluable, and indeed a necessary, supplement to Roscoe, was written to expand and correct what he considered to be open to criticism in the work of the latter. The fact that Sir Apolo wrote in Luganda has proved a drawback; but this has now been remedied in a translation by Ernest B. Kalibala, edited by May Mandelbaum (Edel) (*Columbia University Contributions to Anthropology*, 22, 199. 4 dollars). For the convenience of students the mere repetitions of Roscoe's information are omitted, but references to "The Baganda" are given here as well as where Roscoe is supplemented or corrected.

Safety in Mines Research

As in past years, the Fourteenth Annual Report of the Safety in Mines Research Board includes a report of the Health Advisory Committee, which forms in fact Part 4 of the Report, the previous parts being Part 1, General; Part 2, Instruction; and Part 3, Progress of Safety Researches. The Report, of course, begins with an expression of regret on the death of Dr. J. S. Haldane, who "had been a member of the Board since 1923"; there is not a miner who will not re-echo the last sentence of the first paragraph in reference to Dr. Haldane—"His death is a severe loss to the whole mining community"; whilst it also refers to the retirement of Prof. S. M. Dixon, who, as is well known, has rendered much valuable service in connexion with wire ropes used in mining. There is further a number of appendixes to the Report, one of which deals with protective equipment, and it is interesting to note that, generally speaking, protective equipment has been largely adopted by the miners themselves. It is worth knowing that Great Britain is not the only country adopting protective equipment, the article by Leprince-Ringuet on miners' hats appearing in the *Annales des Mines* of Paris proving this point. The various representatives of the local committees are doing good work in popularizing the use of protective equipment, and the subject of falls of ground is making fair progress, considering the inherent difficulties of the subject.

Radio Relay Services

RADIO relay is much more common abroad, where it is regarded as a public service, than in Great Britain. In a pamphlet written by G. S. Lucas and E. S. Hall of the Research Department of the British Thomson-Houston Co., Ltd., a description is given of the radio relay equipment built and designed for the Midland Relay Services, Ltd. It is suitable for 300 subscribers but could easily be adapted to suit 1,000 or more subscribers. It has four radio receivers with their aerial equipment, and a short-wave receiver. The aerial equipment depends upon the locality and conditions of reception. For the installation carried out at Rugby, two vertical aerials about 25 feet in length are used for local reception. For long-distance work a horizontal aerial 100 feet long and 50 feet high is used. For use on short-wave reception a special *V* doublet aerial has been installed. Two of the receivers are suitable for B.B.C. transmission and two for long-distance Continental programmes. The advantages offered to the public by this service are the replacement of aerials by simple overhead wires. The installation of only a simple speaker unit in the house is required; no power supply or battery is necessary. The main control station is under constant supervision and the receivers are adjusted for the best working conditions. The radio relay station is capable of relaying two or three independent programmes to all subscribers. All the vital points of the system are duplicated and the organization can deal quickly and effectively with faults and complaints as they arise.

Telephone Development in Birmingham

A LARGE and imposing building called Telephone House has been built in Birmingham to accommodate the telephone equipment for the city and also the Post Office and engineering and administrative staffs. A description of the telephone equipment required for the trunk, toll and central exchanges which were installed by Siemens Brothers and Co., Ltd., of Woolwich, to the order of the Post Office, is given in the September supplement of the *Siemens Magazine*. The introduction of the maximum fee of one shilling for three minutes on all inland trunk calls made after 7 o'clock in the evening has made the trunk service very popular, and the more recent introduction of a half-crown maximum for a three minute trunk call between any two places on the mainland of Great Britain will still further increase the amount of trunk traffic. Outside London, Birmingham is the most important telephone centre in Great Britain. It is connected by direct trunk lines with all other zone centres and, in addition, forms an important link in the alternative trunk routes between London and other zone centres such as Liverpool, Manchester, Leeds, Sheffield, Nottingham and Leicester. The new trunk and toll equipment has been planned to meet the long distance (trunk) and the short distance (toll) traffic anticipated in the Birmingham district during the next few years. Since 1930 the development of the trunk traffic has exceeded all expectations. There have been installed in the building 367 switchboards, and in addition a centralized manual board for the whole of the Birmingham area. In the same building also a 5,700 line full automatic equipment for the central exchange is being installed. Two motor generator sets driven from the 400 volt 3 phase 50 cycle public supply mains, with an output of 1,600 amperes at 57 volts, are being used.

Research in Mental Diseases

THE Annual Report, 1935–36, of the Joint Board of Research for Mental Disease of the City and University of Birmingham contains an account of much painstaking and laborious work (Birmingham: The University, 1936). The occurrence and distribution of 80 named varieties of micro-organisms are tabulated; 6,565 specimens were examined. Somewhat optimistically the report claims to have solved the problem of the cause of mental disease, since "it appears that mental disorder cannot be classed as an infectious disease, nor as a metabolic disorder, but that it is a *clinical resultant* of infectious and metabolic disorders acting during any period of the ante- and post-natal life of the individual, thus determining the character and onset of the mental symptoms". Also, "The functional disturbances of the central nervous system responsible for the symptoms of mental disorder, can be clinically and pathologically associated with local disturbances of the vascular supply to certain vital centres of the brain". It is true that the pathology of some brain diseases that cause mental disorder is well established, for example, encephalitis, syphilis, tumours; but there still remains a host of disorders, ranging through hysteria and the anxiety and obsessional states to schizophrenic personalities, and cyclothymia or manic-depressive conditions and paranoia, that have so far defied the laboratory expert.

False Killer Whales in South Africa

DR. LEONARD GILL, in the Report of the South African Museum for the year 1935 (1936, p. 10), recounts another of those mass strandings of *Pseudorca crassidens* which have become so frequent since the reappearance of the species in the Dornoch Firth. The school came ashore at Mamre, about fifty miles north of Cape Town, and the occurrence was peculiar because of the large number of whales stranded, about three hundred, and because they came ashore not on sand but on jagged rocks. But a common feature of the strandings has been, as here, that the whales appear to have been trapped by a falling tide in channels cut off from the open sea by sand-banks. The Mamre stranding took place towards the close of 1935, and seven years before, about the same time of the year, the first record of the species in African waters was made when about a hundred came ashore at Kommetjie, some sixteen miles south of Cape Town.

Canadian Reindeer Herd

THE introduction of a herd of reindeer to Canada as an addition to the food resources of the far north has met with success. Notwithstanding the severity of the winter, the herd on its winter range east of the delta of Mackenzie River in the Northwest Territories is reported by the Office of the High Commissioner to be in good condition, and to number about 3,000. Surplus males to the number of 200 were slaughtered during the autumn and the carcasses used for food, while the hides were used for moccasins, mittens and other items of wearing apparel. The herd, accompanied by its herders, undertakes a regular north and south migration, moving northward along the arctic coast early in April and southward again in late autumn, grazing by the way over the hills and valleys of its reserve of 6,600 square miles.

American Research Grants

PART 3 of volume 76 of the *Proceedings of the American Philosophical Society* contains the report for the first three years of its operation of the Committee on Research established by the Society. The Committee set apart 20,000 dollars in 1933, 45,000 dollars in 1934, 60,000 dollars in 1935, and 50,000 dollars in 1936. Ninety-eight grants have been made of the average value of 1,500 dollars: sixteen in zoology, fourteen each in physics and botany, ten in astronomy, nine each in geology and physiology, six in chemistry, five in archæology and smaller numbers in other subjects. These grants are more generous than those made by the National Research Council but are less than those made by some of the great foundations. The Committee proposes to hold each year an autumn meeting at which the reports of grantees as to the progress of their researches will be read. The Committee would welcome suggestions for improving its methods of aiding research.

Research Grant Board, South Africa

THE recently issued report of the Research Grant Board, Union of South Africa, covers the period 1918–35. The Board was established in October 1918 as a result of a recommendation of the Advisory Board of Industry and Science, which had been formed earlier that year from an amalgamation of the Industries Advisory Board and "a Scientific and Technical Committee". It was at first proposed that the Research Grant Board should be attached to the Department of Agriculture, but after forming a sub-committee of the Advisory Board until the dissolution of the latter in 1923, it was attached to the Department of Mines and Industries until 1933, when it was transferred to the newly-formed Department of Commerce and Industries. While attached to one Department, the Board is regarded as serving all branches of Government, recognition being given to this relationship by the presence on the Board of assessor members from other Departments. Initially, the Board's activities were confined to the encouragement of research in universities and museums, but its scope was speedily extended to embrace every branch of knowledge and to include the whole country irrespective of institutions.

ONE of the most important functions of the Board is the administration of Government grants in aid of research as well as research scholarships. It has also undertaken similar duties on behalf of the Carnegie Corporation of New York, which has allocated generous funds for research in South Africa. As at first constituted, the Board consisted of representatives of science and industry, together with the assessor members from Government Departments. When its scope was enlarged, members were added to represent other than scientific subjects. While ordinary members of the Board have been chosen with an eye to representation of all the interests concerned, they are regarded as serving wholly in their individual capacity and responsible only to the Minister. The success and efficiency of the Board are attributed largely to this arrangement and to the spirit of unity it engenders, and also to the excellence of its personnel and the unstinted manner in which they have given of their best to the work.

Carnegie Institution of Washington

THE report of the president of the Carnegie Institution of Washington for the year ending October 31, 1935, refers to developments in methods and organization of research in the Institution, particularly in the support of larger projects and the co-operation of fair-sized groups of individuals, as in the Geophysical Laboratory, Mount Wilson Observatory and the Department of Genetics. Its present organization is adapted not only to the advance of knowledge in new interlocking or overlapping areas of research, but also to bring back to each of the groups engaged upon special problems a wide range of materials otherwise not readily secured. Reference is made in the report to the progress of seismological research and of the investigations on terrestrial magnetism. Astronomical work has included study of the nova in Hercules, of stellar atmospheres, extra-galactic nebulæ, measurement of the velocity of light and observations of sunspot activity. Assistance has been given to research on cosmic rays and on the hydrodynamics of the atmosphere and major climatic variations. Numerous investigations have been carried out by the Department of Plant Biology, including the study of the influence of climatic environment on the life and development of living organisms, and by the Division of Animal Biology which includes the Department of Embryology, the Nutrition Laboratory and the Department of Genetics. Of outstanding interest are the activities of the Division of Historical Research, established in 1929, which has provided the opportunity to study history as science, art, culture, sociology and government in all phases with the application of scientific principles to the collection of materials and to the interpretation of the data acquired. The rapprochement of scientific and cultural or human interests in this way is an outstanding achievement of the Institution.

Conference on College Hygiene

THE second National Conference on College Hygiene of the United States will be held in Washington, D.C., on December 28–31 under the joint sponsorship of the American Student Association, the National Health Council and the President's Committee of Fifteen on College Hygiene. There will be no formal programme, but the work will be divided into five sections devoted respectively to health service, health teaching, organization and correlation, special problems and relationship of college hygiene to training and secondary education. Dr. Livingston Farrand, president of Cornell University, from whom further information can be obtained, is chairman of the Conference.

Indian Science Abstracts

THE National Institute of Sciences of India has recently issued the first number of *Indian Science Abstracts*, an annotated bibliography of science in India, including abstracts of all papers published in India or abroad on work done in India or based on Indian material. The first part includes abstracts arranged tentatively under nine headings. To ensure continuity under each heading and to facilitate reference, the abstracts dealing with each science have been given a separate pagination with the serial number of the heading preceding it. The abstracts in each section are arranged alphabetically and numbered serially. The general editor is Dr. Baini Prashad, who is assisted by nine associate editors for different subjects.

Announcements

DR. HANS VON EULER-CHELPIN, professor of organic chemistry at Stockholm, has been elected an honorary member of the Association of German Chemists; the Justus Liebig Medal of the Association has been awarded to Dr. Gustav Hüttig, professor of inorganic and analytical chemistry at the German Technical University at Prague; and the Carl Duisberg Memorial Prize to Dr. Rudolf Tschesche, of Göttingen.

A PRIZE of 1,000 dollars is offered by the Williams and Wilkins Publishing Company for the best work on a science subject presented before July 1, 1937. The work must be in English and the desired length is 100,000 words. Further information can be obtained from the Company, Mt. Royal and Guilford Avenue, Baltimore, Maryland.

DURING the forthcoming winter, Mr. H. V. Garner, the guide demonstrator of the Rothamsted Experimental Station, Harpenden, Herts, and other members of the staff, are prepared to give a few lectures to chambers of agriculture and horticulture, farmers' clubs, farm workers' associations, agricultural societies, etc., on the Rothamsted experiments. Among the subjects offered are: manures, fertilizers, soil micro-organisms (Bacteria, Protozoa, etc.), agricultural botany, agricultural chemistry, soil physics, entomology, and plant pathology. Further information can be obtained from the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

MR. W. J. HALL, of Walsall, who was formerly with the Wool Industries Research Association at Leeds, and later with British Celanese Ltd., has been appointed technical editor of the *Journal of the Textile Institute*.

MESSRS. ADLARD AND SON, LTD., presented to members of the British Association at Blackpool a handy pocket diary, the main part of which consists of a calendar (September 1936–July 1937) of the meetings of scientific societies. Copies of the little book can be obtained from Messrs. Adlard at 21 Hart Street, London, W.C.1, price 6*d*.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A principal of Llanelly New Mining and Technical Institute—The Clerk of the Education Committee, County Education Offices, Carmarthen (September 28).

An assistant lecturer in mathematics in the Huddersfield Technical College—The Director of Education, Education Offices, Peel Street, Huddersfield (September 30).

An assistant lecturer in metallurgy in University College, Swansea—The Registrar (September 30).

An assistant (Grade III) in the Air Ministry Scientific Pool, for service at the Royal Aircraft Establishment, South Farnborough—Chief Superintendent, Royal Aircraft Establishment, quoting Ref. A.248 (October 2).

An assistant keeper on the higher technical staff of the Science Divisions of the Science Museum—The Director, Science Museum, South Kensington, London, S.W.7 (October 12).

An assistant county dairy instructor for Hampshire—County Agricultural Organizer, The Castle, Winchester (October 12).

A chemist in the Aeronautical Inspection Directorate Test House, Kidbrooke (non-metallic materials section, oils and petrols sub-section)—Secretary, Air Ministry (S.2.d.), Adastral House, Kingsway, W.C.2 (October 24).

A director of the Kanematsu Memorial Institute of Pathology, Sydney Hospital, N.S.W.—Secretary, Universities' Bureau, 88a Gower Street, London, W.C.1 (January 31).

Assistants to civil and mechanical engineers in the Ordnance Factories, E.D.(F.), Royal Arsenal, Woolwich, S.E.18—The Chief Superintendent.

A male junior assistant chemist at the Royal Gunpowder Factory, Waltham Abbey, Enfield Lock, Middlesex—Principal Clerk.

Temporary assistant civil engineers in the Air Ministry—Secretary (W.B.9), Room 712, Adastral House, Air Ministry, Kingsway, W.C.2, by post-card for form of application.

A male laboratory assistant (Grade II) at the Experimental Station, Porton, near Salisbury, of the War Department—Commandant of the Station.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 552.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Oxygen Content of the Stratosphere

AIR from different heights of the stratosphere was brought down by registering balloons by means of a new device for air sampling. As the apparatus was protected against the low air temperature in the stratosphere by a "Cellophane" case, it was possible to employ ordinary stop-cocks. At the desired heights the latter were operated by an electrical arrangement actuated by aneroids. The glass vessels for air sampling were constructed so that the oxygen content could be determined in them by means of heating metallic copper without it being necessary to change the vessel. Before and after heating the copper the volume was brought to the same level, so that the diminution of pressure divided by the initial pressure immediately gives the oxygen content.

The following table gives the values obtained for the oxygen contents :

Date	Height (km.)	Oxygen content (per cent by vol.)
24. 8.36	0	20·92 ± 0·02
19.12.35	14·5	20·89 ± 0·05
5.12.35	18·5	20·84 ± 0·02
18. 8.36	19	20·87 ± 0·02
5.12.35	22·2	20·57 ± 0·05
12. 2.36	24	20·74 ± 0·02
6. 5.36	28–29	20·39 ± 0·05

In approaching the height of 20 km. the oxygen content is diminished noticeably in comparison with the value at the earth's surface (20·90–20·95 per cent); above 20 km. the diminution begins to be more pronounced; at the greatest height there is a deficit of 2–3 per cent of the oxygen content. The values agree with the determination of the helium content of the stratosphere by F. Paneth[1], who at a height of 21 km. finds a helium surplus of 8 per cent.

It is remarkable that at heights greater than 20 km. the values differ rather considerably. This is probably due to the weather conditions. In air masses of polar origin it seems that the diffusive separation begins at lower heights than in equatorial regions where the top of the troposphere is remarkably higher. The insolation in equatorial regions is very much stronger, and the turbulence of the atmosphere reaches to greater heights. Lepape and Colange[2] also find that the content of helium plus neon in the stratosphere is slightly increased, and more variable than on the earth's surface. If my assumption is true, then the height of the ozone layer in the stratosphere should also be lower in polar regions than in equatorial regions, first, because the oxygen content in polar regions decreases with heights more rapidly than in equatorial regions, and secondly—which is perhaps of even greater effect—because the greater stability of the atmosphere in the polar regions tends to increase the diffusion of the heavy ozone downwards.

A more detailed report will be published shortly in *Luftfahrtforschung*.

E. REGENER.

Physikalisches Institut der
Technischen Hochschule,
Stuttgart.
Sept. 6.

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[1] F. A. Paneth and E. Glückauf, NATURE, 136, 717 (1935).

[2] A. Lepape and G. Colange, NATURE, 137, 459 (1936).

Absence of Cosmic Rays from Nova Lacertæ

THE appearance of Nova Lacertæ gave us a second opportunity of investigating whether the conclusion at which we arrived when investigating the relation of Nova Herculis to cosmic rays[1], namely, that no cosmic rays emitted from novæ are observable, was correct or not. For this purpose we have turned the centre line of the field of our apparatus (field of the apparatus: 40° in east-west, 10° in north-south direction; 36 cm. lead between the counters) as soon as the outburst of the nova was signalled, into such a position that the centre line showed only an angle of 2° 09′ north of the nova at culmination. In such a position a set of measurements was performed from June 19 until July 17, 1936.

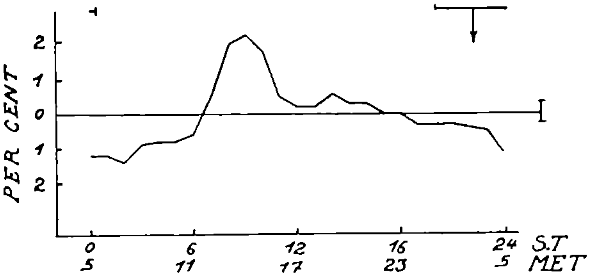

FIG. 1. Variation of cosmic ray intensity (average values) with sidereal time (S.T.) and Central European time (M.E.T.). The horizontal straight line above the diagram indicates the time during which Nova Lacertæ passed through the field of our apparatus, and the arrow the time of its culmination.

Fig. 1 shows the average variation of the intensity for the different hours of the day, as a percentage of the mean value. As can be easily seen, the curve indicates only the well-known diurnal variation, and no increase at the time of culmination of the nova. The assumption that no effect of the nova was detectable, because its cosmic radiation was of much shorter period than the duration of the measurement, cannot be maintained, for even the ratio of the intensity during the culmination of the nova for a single day to the mean value of the daily intensity in no case exceeded twice the error of measurement.

This confirms our previous experience with Nova Herculis, as in neither case could an influence of undeflected cosmic rays originating in the nova be detected.

J. BARNÓTHY.
M. FORRÓ.

Institute of Experimental Physics,
University,
Budapest.
Aug. 13.

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[1] J. Barnóthy and M. Forró, NATURE, 135, 618 (1935). *Z. Phys.*, 94, 778 (1935). NATURE, 136, 680 (1935).

Resonance Levels for Absorption of Neutrons

WHEN a very thin layer of boron is irradiated with slow neutrons, the number of α-particles emitted can be represented by an expression proportional to $\Sigma n^i\alpha^i + P$, where the terms $n^i\alpha^i$ correspond to the nearly homogeneous groups of neutrons absorbed selectively in certain elements; n^i is the number of neutrons having kinetic energy E^i, and α^i is their coefficient of absorption in boron. The most important term represents the group of 'thermal' neutrons, called by Amaldi and Fermi[1] the group C. If we absorb this group in a thin sheet of cadmium, the number of α-particles emitted by boron diminishes by an amount proportional to $a^C n^C \alpha^C$, where a^C is the fraction of the group C absorbed by cadmium. Similarly, let us suppose that we absorb another group, J, in a suitable element; the corresponding decrease of the number of α-particles will be proportional to $a^J n^J \alpha^J$. If, therefore, the relative numbers of groups C and J and the fractions a are known, we can determine the ratio α^C/α^J, which is equal to $\sqrt{E^J/E^C}$. In this way the energy corresponding to the resonance level of the element J can be calculated.

I have used a boron-coated ionization chamber connected to a Hoffmann electrometer. The chamber was surrounded with paraffin wax and irradiated with slow neutrons from a source of polonium and beryllium equivalent in strength to 10 mgm. of radium. The ionization currents were measured (1) with unfiltered radiation; (2) with neutrons filtered through 0·5 mm. of cadmium; and (3) 0·5 mm. of cadmium and 0·1 mm. of silver. The results are as follows:

Filter	none	0.5mm.Cd	0·5mm.Cd+0·1mm.Ag
Ionization	4·0465	0·3285	0·3145

Owing to the smallness of the effect due to absorption of neutrons in silver, a very great number of measurements has been made so that the statistical errors were about ten times smaller than the differences to be measured. We have

$$\frac{a^A n^A \alpha^A}{a^C n^C \alpha^C} = \frac{0{\cdot}014}{3{\cdot}718} = 0{\cdot}00376.$$

The relative numbers of groups A and C and their coefficients of absorption in cadmium and in silver have been determined by Fermi and Amaldi. As it was, however, to be expected that the numbers may depend on the geometrical arrangement, thickness of paraffin, etc., special experiments have been made in order to compare directly $a^A n^A$ and $a^C n^C$. The boron layer has been removed, and a silver foil of 0·05 thickness exposed in its place, all other conditions remaining unchanged. The activity of the foil, due to the isotope of 22 sec. period, was measured by means of a Geiger counter. If a is the activity obtained with unfiltered radiation, b that with neutrons filtered through 0·5 mm. of cadmium, and c that with neutrons filtered through 0·5 mm. of cadmium and 0·1 mm. of silver, then

$$a = 1490, \qquad b = 1134, \qquad c = 344.$$

If r^A and r^C are the fractions of the total number of neutrons absorbed in the silver foil, we have

$$\frac{a^A n^A r^A}{a^C n^C r^C} = \frac{1134 - 344}{1490 - 1134} = \frac{790}{356} = 2{\cdot}2.$$

The fraction r^A/r^C can be calculated using the known values of absorption coefficients of silver for the groups A and C. I find

$$r^A/r^C = 53{\cdot}6, \text{ and hence } a^A n^A/a^C n^C = 0{\cdot}041.$$

According to Amaldi and Fermi, $n^A/n^C = 0{\cdot}016$. Considering that $a^A/a^C < 1$, we see that under the conditions of my experiment, group A appears to be very prominent. This may be due to the special arrangement used, or to the fact that the brass walls of the ionization chamber absorbed a considerable fraction of thermal neutrons. For the ratio of the coefficients of absorption in boron, I find finally

$$\alpha^C/\alpha^A = 0{\cdot}041/0{\cdot}00376 = 10{\cdot}9\ ;$$

and for the energy ratio

$$E^A/E^C = 117\ ;\ E \cong 3 \text{ e.v.},$$

in good agreement with determinations of Preiswerk and Halban[2].

Similar experiments performed with gold have given $E^{\mathrm{Au}} \cong 4{\cdot}5$ e.v. In the case of iodine, using as absorber a sheet of potassium iodide of 1 gm./cm.^{2}, I could not find any diminution of the ionization current. This shows, in agreement with the determinations of other workers, that the resonance level of iodine is essentially higher than that of silver and gold. It should be noticed that Collie[3] has applied a similar method, but obtained definite results only in the case of indium.

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Free University of Poland,
Warsaw.
August 10.

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[1] Amaldi and Fermi, *Ric Scient.*, 2, 544 (1935).
[2] H. v. Halban, jun. and P. Preiswerk, NATURE, 137, 905 (1936).
[3] C. H. Collie, NATURE, 137, 614 (1936).

Destruction of Supraconductivity by Electric Current and Magnetic Field

BY any change of the magnetic flux through a supraconducting ring a permanent current T is induced, the strength of which can be calculated from the field intensity in the centre of the ring, taking into account the field deformation caused by the magnetic properties of the supraconducting ring.

In Fig. 1, T is plotted against the external field intensity H_t for a ring of tin. This curve, which limits the region of supraconductivity ($\rho = 0$), is given by the condition that the sum of the tangential component of the external field and the field caused by the current is equal to the critical magnetic field, either on the inside or on the outside periphery of the ring, while the field is certainly smaller on the rest of the ring surface. Thus our experiments show that it is a necessary condition of supraconductivity, that the magnetic field is zero in the whole of the volume and its effective tangential component does not exceed the critical value at any point of the surface of the supraconductor.

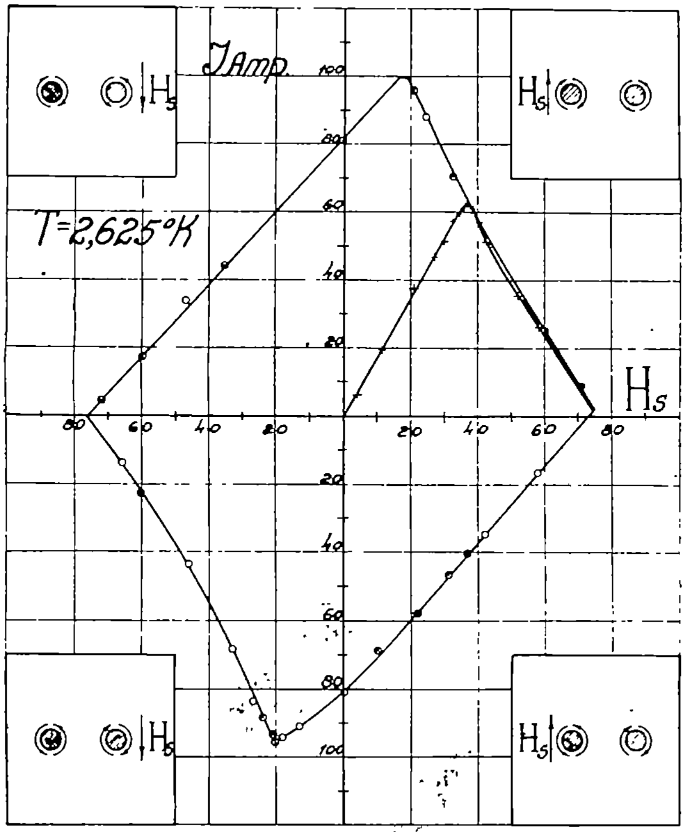

FIG. 1.

In a paper just published by D. Shoenberg[1], the results of measurements on a supraconducting ring of lead are given which are entirely in agreement with our results obtained with tin. But Shoenberg's conclusions are wrong, since he assumes that the decrease in current could be explained by a decrease in the supraconducting cross-section which leads to an unstable condition of current distribution. A more detailed paper on this matter is being published shortly[2].

L. SHUBNIKOV.

Ukrainian Physico-Technical Institute,
Kharkov.
July 15.

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[1] D. Shoenberg, *Proc. Roy. Soc.*, A, **155**, 724 (1936).

[2] *Sow. Phys.*, in print.

Influence of Nitric Oxide on the Thermal Decomposition of Dimethyl Ether. Gaseous Catalysis

IN the course of an investigation on the thermal decomposition of dimethyl ether, alone, and in the presence of other gases, the reaction with nitric oxide was studied. We found that very small quantities of the oxide reduced the rate of reaction, represented by the equation,

$$(CH_3)_2O = CH_4 + CH_2O,$$

and measured by the rate of formation of methane, to a very small fraction of the rate observed in the pure gas. This is in accord with the results of Staveley and Hinshelwood[1] in the case of diethyl ether.

As the concentration of the nitric oxide in the reaction mixture is increased, the rate of reaction, which had become very small, increases rapidly. Staveley and Hinshelwood, writing of the reaction in the case of diethyl ether, refer to this process as one of catalysis. In the case of dimethyl ether, however, investigation by the method of detailed analyses shows that catalysis is not involved.

The CH_4–t graphs, representing the rate of primary decomposition of dimethyl ether, bend less sharply towards the t-axis than they should do if the decomposition process followed a normal course in accordance with the classical theory. The graphs show well-marked breaks, and the rate of reaction is diminished by increasing the surface of the reaction vessel. It appears to be an important fact that the process can only follow a single course, and there are no alternatives such as have been indicated in the case of other processes[2].

If a series of experiments is carried out, within the range at which the presence of nitric oxide increases the rate of reaction, such that the initial concentrations of the dimethyl ether and nitric oxide, and the temperature, are constant, and the time is varied, it is found that the whole process has no relation to the process involved in the primary decomposition of dimethyl ether alone. The products are methane, carbon monoxide and dioxide, with very little hydrogen, and, at high concentrations of nitric oxide, carbon monoxide is the dominant product. The form of the $x - t$ graphs is quite different from those recorded in the case of the primary decomposition of dimethyl ether alone. They are convex towards the t-axis, as in the case of the thermal decomposition of acetaldehyde. The processes involved are strongly accelerated.

The processes are obviously oxidation processes, and the observations now recorded support the suggestions put forward in the two letters to NATURE referred to above. It seems that the reaction of nitric oxide with dimethyl ether gives rise to processes, each of which results in the formation of a short-lived intermediate, which can decompose in two different ways. The oxidation processes can be represented by a series of equations, such as,

$$(1)\quad CH_3.O\,CH_3 + O \rightarrow CH_3.O.CH_2OH \begin{cases} CH_4 + CO_2 + H_2 \\ CH_4 + CO + H_2O \end{cases}$$

$$(2)\quad CH_3.O.CH_2OH + O \rightarrow CH_3.O.CH(OH)_2 \begin{cases} CH_4 + CO_2 + H_2O \\ CH_3OH + CO + H_2O. \end{cases}$$

In a series of experiments in which a quantity of dimethyl ether was heated with increasing quantities of nitric oxide for 15 minutes, the proportion $(CO_2 + CO) = 2CH_4$ was reached.

Since the characteristics of these oxidation processes are almost identical with those of the thermal decomposition of acetaldehyde, it is not surprising that nitric oxide does not influence the rate of thermal decomposition of acetaldehyde in the manner observed in the case of dimethyl ether. The so-called catalysis of the thermal decomposition of acetaldehyde by nitric oxide is also probably initiated by oxidation processes. The inhibition of the thermal decomposition of dimethyl ether by nitric oxide is, however, a very important addition to those facts which we have enumerated, which serve to distinguish this process from the thermal decomposition of acetaldehyde. Taking all these facts together, it does not seem possible to distinguish either process as being the only one which is influenced by chain mechanism.

P. F. GAY.
MORRIS W. TRAVERS.
Chemistry Department,
University of Bristol.
August 31.

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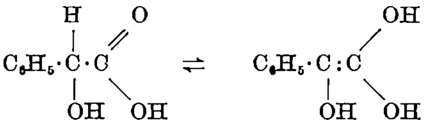
[1] *Proc. Roy. Soc.*, A, **154**, 335, and *J. Chem. Soc.*, 812 (1936).
[2] NATURE, **137**, 906 (1936); **138**, 26 (1936).

Use of Deuterium as an Indicator in Stereochemical Investigations

1. IT is known that optically active compounds under different influences undergo racemization. Various theories have been put forward to explain the mechanism of these changes.

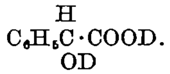
A. Werner[1] took the view that the extreme oscillation of the molecules led apparently to an unravelling of the tetrahedral configuration. Other authors assume that the racemization is brought about through the formation of an enol[2]. Taking as an example mandelic acid, it is assumed that the following equilibrium goes over from the keto-form to the enol-form; that is, there is a change from an asymmetrical to a symmetrical molecule:



The use of heavy water (D_2O) enabled us to decide experimentally between the various opinions, for we know from other examples[3] that the OH group of the enol-forms is exchanged with D_2O. If the racemization in heavy water takes place through the enol-form, then the racemized mandelic acid will show a corresponding high content of the D-atom.

In the control experiment, mandelic acid was recrystallized out of heavy water by heating to 60° C., an operation in which the optical activity is fully retained. The resulting mandelic acid contained, according to isotope analysis[4], $x = 1\cdot7$ D-atom (corresponding to $t = 1\cdot9$)[5], which corresponds to an exchange of two hydrogen atoms.

This result was confirmed by many experiments and is explained by the formation of the acid



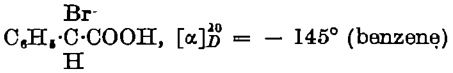
$$C_6H_5\overset{H}{\underset{OD}{C}}\cdot COOD.$$

In the racemization experiment, mandelic acid, dissolved in heavy water, was warmed to a temperature of 140° C. over a period of 51 hours. The acid isolated was optically completely inactive. The isotope analysis of the racemized mandelic acid, carefully purified, freed from all traces of benzoic acid, gave, however, $x = 1\cdot7$, $t = 1\cdot9$ also, corresponding to two interchangeable hydrogen atoms, although if we assume enolization, at least $t = 2\cdot7$ was to be expected. This result, accordingly, is in favour of the Werner-Hund conception of the mechanism of racemization.

A racemization experiment with a mandelic acid in a solution of NaOD also resulted after 16 hours heating at a temperature of 100° C. in a fully racemized acid. Purified and recrystallized from D_2O, the isotope analysis of this acid gives $x = 2\cdot06$, $t = 2\cdot34$.

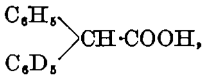
Since the value of t here is again less than $2\cdot7$, it cannot be supposed that racemization and enol formation is the same reaction.

2. There exist the results of a series of experiments concerning the preparation of compounds of the type C.R'R"HD. These communications are partly of negative[7] content and partly positive[8]. In this paper we only want to report on two such experiments. We allowed benzene to react with the optically active compound



$$C_6H_5\cdot\overset{Br}{\underset{H}{C}}\cdot COOH,\ [\alpha]^{20}_D = -145^\circ \text{ (benzene)}$$

in the presence of zinc; the resulting acid,



was optically inactive.

Experiments in which an attempt was made to split up the acid with the aid of alkaloids have also not succeeded in obtaining one isomer from the separated alkaloid salt and its antipodes from the mother liquor. All observed rotation of the plane of polarized light could be traced to impurities. Further experiments are still in process.

However, we have shown with *l*-mandelic acid that the substitution of H by D in an optically active molecule can have an influence on the optical rotation. When *l*-mandelic acid, which is not subject to racemization at 60° C.[9], was allowed to react with heavy water at that temperature, it showed 1·7 D-atoms by the isotope analysis. The measurement of the optical activity of this acid (D) and of the original, untreated *l*-mandelic acid (H), both in dry acetophenone, gave the following results:

	H	D
$[\alpha]^{20}_D$	– 179·10° ± 0 13	– 173 27° ± 0·13
$[\alpha]^{20}_{Hg}$	– 216·34° ± 0·13	– 211·43° ± 0·13

The complete communication will appear in the *Helv. chim. Acta*.

H. ERLENMEYER.
H. SCHENKEL.
A. EPPRECHT.
University,
Basel.
July 21.

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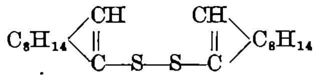
[1] A. Werner, "Stereochemie", 49 (1904); see also F. Hund, *Z. Phys.*, **43**, 805 (1927).
[2] A. McKenzie and H. Wren, *J. Chem. Soc.*, **117**, 680 (1920); T. A. Smith, *Ber.*, **64**, 430 (1931); Th. Wagner-Jauregg, "Stereochemie" (Freudenberg), 858 (1933).
[3] See A. Farkas, "Orthohydrogen, Parahydrogen and Heavy Hydrogen", 200 (1935); H. Erlenmeyer, A. Epprecht, H. Lobeck and H. Gartner, *Helv. chim. Acta*, **19**, 354, 543 (1936).
[4] H. Erlenmeyer and H. Gartner, *Helv. chim. Acta*, **19**, 129 (1936).
[5] The difference from the value 2 is caused by the rates of dissociation; see *Helv. chim. Acta*, **19**, 354 (1936).
[6] W. F. K. Wynne-Jones, *Chem. Rev.*, **17**, 122 (1935).
[7] H. Erlenmeyer and H. Gärtner, *Helv. chim. Acta*, **19**, 145, 331 (1936); J. B. M. Coppock and S. M. Partridge, NATURE, **137**, 907 (1936).
[8] E. Billmann, K. A. Jensen und E. Knuth, *Ber.*, **69**, 1031 (1936); J. R. Clemo and S. McQuillen, *J. Chem. Soc*, 808 (1936); *Chem. and Indust.*, **55**, 441 (1936).
[9] Rothe, *Ber.*, **47**, 843 (1914).

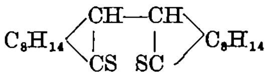
Synthesis of Two Isomeric *bis*-Thiocamphors

In continuation of his researches on thiocamphor[1] reported in this journal, and also published in the *Journal of the Indian Chemical Society*, Mr. D. C. Sen, working in my laboratory, has recently made some interesting observations which, with his views concerning the constitution of the compounds isolated, are reported below.

Bis-thiocamphor has been synthesized by the action of iodine on the sodio derivative of thiocamphor. It may be represented by either (A) or (B).



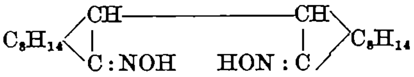
(A)



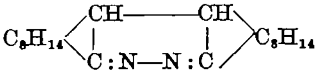
(B)

It has not been possible to synthesize this compound by Oddo's method[2] of synthesis of *bis*-camphor, namely, by the action of sodium or magnesium on β-bromocamphor, as β-bromothiocamphor could not be isolated in the pure state. Incidentally, the synthesis of *bis*-camphor by this method was also tried, but it resulted in the formation of β-iodocamphor instead of *bis*-camphor. *Bis*-thiocamphor has been prepared by the above method in two stereoisomeric forms (*l*- and *dl*-) from *l*-thiocamphor and *dl*-thiocamphor respectively.

dl-*Bis*-thiocamphor, m.p. 164°, forms a dioxine, m.p. 199° (*d*) and an azine, m.p. 176°, whereas *l*-*bis*-thiocamphor, m.p. 180°, also forms an azine, m.p. 200°, under similar conditions. These facts, along with the analytical and molecular weight data of the two *bis*-thiocamphors and their derivatives, lead to the conclusion that they contain two C:S groups, and that they are 1:4-dithioketones, and have the formula (B). The dioxines and the azines should therefore be represented by the structures (C) and (D) respectively.



(C)



(D)

On reduction with aluminium amalgam in moist ethereal solution, *dl*-*bis*-thiocamphor forms *dl*-*bis*-thioborneol, m.p. 148°, which decolorizes iodine and forms a yellow lead salt.

l-*Bis*-thiocamphor has a very high molecular rotation $[M]_D^{20^\circ} = -1109\cdot 5$ in benzene solution, whereas the molecular rotation of *l*-thiocamphor is $[M]_D^{20^\circ} = -41\cdot 3$ in the same solvent, and under similar conditions. This high exaltation in optical activity may be attributed to the presence of a potential conjugated system in *bis*-thiocamphor, which may be effective both in the thio- and thiol- phases.

Studies in absorption spectra in the visible region of *bis*-thiocamphor at different dilutions and the comparison of these with those of thiofenchone and thiocamphor have given interesting results. It has been noticed that a 5·4 per cent solution of bis-thiocamphor in benzene manifests a characteristic absorption band between 5270 A. and 4530 A., and that with dilution this band becomes shorter, and at 2·7 per cent concentration it gives a very short band, having the centre at 4950 A. Similar bands have also been observed in the case of *l*-thiocamphor and *d*-thiofenchone. This selective absorption band is therefore a characteristic property of the C:S group in cyclic thioketones, which is definitely chromophoric.

Further work in this line, which is in progress, will be published in due course in the *Journal of the Indian Chemical Society*.

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Calcutta.

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[1] NATURE, 134, 1010 (1934); *J. Indian Chem. Soc.*, 12, 647, 751 (1935).

[2] *Gazetta*, 1, 27, 149 (1897); *ibid.*, i, 41, 126 (1911); *Ber.*, 37, 1569 (1904).

Non-Existence of Multiplanar Cyclohexane Rings

The work done by us, so far, has shown that it is possible to isolate only two forms of 4-methyl-, 3-methyl- and 2-methylcyclohexane-1-carboxy-1-acetic acids[1] and one form of 3:3-dimethylcyclohexane-1-carboxy-1-acetic acid[2]. In order to get more evidence on the point of the configuration of the cyclohexane ring, we have now synthesized 4:4-dimethylcyclohexane-1-carboxy-1-acetic acid and 4:4-dimethylcyclohexane-1:1-diacetic acid from 4:4-dimethylcyclohexanone. Each one of them is found to exist in one form only, thus supporting the uniplanar structure of the cyclohexane ring. The work is not yet complete, but this notice has been necessary in view of the recent publication of Miller and Roger Adams on the same subject[3]. The full details of the work will be published in due course.

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R. F. Hunter.

Department of Chemistry,
Muslim University,
Aligarh, India.
August 23.

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[1] *J. Chem. Soc*, 416 (1936).

[2] NATURE, 136, 608 (1935).

[3] *J. Amer. Chem. Soc*, 58, 787 (1936).

Normal Erosion as a Factor in Soil Profile Development

In Nature of June 6, Prof. G. W. Robinson directs attention to the effects of lateral transport of surface soil material, moved in the course of ordinary slow denudation, on certain soils in Wales. Erosive processes of this kind not only modify the development of particular soil profiles, but also may be found governing the zonation of soil types over wide areas. I offer an example from tropical semi-arid country.

The diagram (Fig. 1) represents, with the horizontal scale much compressed, a residual granite hillock and the soils around it, in the plateau region south of Lake Victoria. Primary soil substance is made among the rocks from the products of mechanical and chemical disintegration of the granite surfaces, together with plant debris, baboon and hyrax droppings, and the like residues. A shallow skeletal dark grey loam (1) is so formed. This works downhill by creep and slow erosion, to serve at the hill foot as the parent material on which a deeper soil (2) of the red earth group develops. At the base of the red earth profile, where there is temporary accumulation of seepage in the wet season, a clinker-like horizon (3), coarse granitic grit in a black and rusty ferruginous cement, begins to form and may in time attain a thickness of a metre or more. In the meantime, occasional storm-water running over the surface is gradually paring off the top soil, and the spoil travels differentially according to particle size, so that by cumulative effect a zone of washed sand (4) covers the footslope below, silty or clayey sand (5, 6) lies beyond it, and a level clay floor fills the bottom-land—the *mbuga* (7). These deposits may, if we will, be looked upon merely as so much parent material, put there geologically by the denudation process; but at all stages, the erosion having been slow and non-catastrophic, they have borne their appropriate vegetation and have been developing towards maturity as soils. At a late stage, as erosion works down towards base level, the abrasion of the red earth profile ends in the emergence of the clinker-like horizon at the lowered ground surface, where (commonly under the misleading name of 'surface laterite') it resists further erosion like the sill of a waterfall in the profile of a stream.

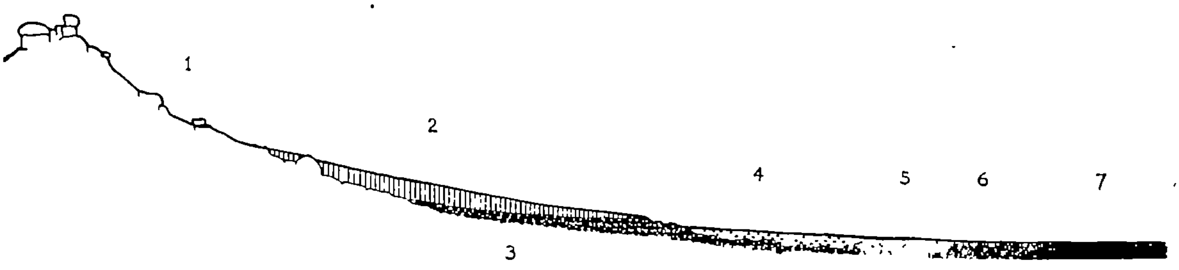

FIG. 1.

A zoned distribution of soil types in relation to the high points in a generally low relief, somewhat as in this example, is found over a great part of the central plateau or elevated peneplain region of Tanganyika. According to the maturity of the topography, or because a new cycle of erosion has been initiated tectonically, or for lithological reasons, the character and proportionate extent of the different soils vary locally, but some six or seven of the main types are of sufficiently general occurrence in their characteristic positions on the contours to have given rise to a well-developed soil nomenclature in the Sakuma language. The complete sequence can be found under seemingly 'virgin' deciduous forest and bush, though there can be little doubt that man has at some time or other usually been in occupation and, as a soil-tilling animal, has expedited the erosive process. The case is not thereby removed from the scope of Prof. Robinson's subject of 'normal' erosion, for primitive man should not be excluded from his due place amongst the natural factors in soil formation.

Does not this example, incidentally, point to an anomaly in the use to which the word *profile* has been put by soil students? To the geomorphologist, geologist or engineer, the profile of the ground would be the outline of my diagram. To the pedologist the profile is what he finds in depth at a selected point. The language of soil description lacks a suitable term having a cross-country dimension, and the want of it is felt as soon as soils are discussed in relation to the lie of the land, as in this matter of erosion. To help in such discussions the word *catena* has been adopted (Provisional Soil Map of East Africa, 1936), to describe a topographic complex of soils such as is represented in my example.

G. MILNE.

East African Agricultural Research Station,
Amani.
July 16.

Centrifuging in Rotating Hollow Cylinders

THE method described in this note provides a quick and efficient means for the fractionation of highly disperse systems—including the larger proteins—using relatively moderate centrifugal forces. Furthermore, all necessary information about the sedimentation rate and the sedimentation equilibria of these systems can be obtained, samples for examination being taken before and after spinning. Many important biological agents (viruses, bacteriophages, antibodies, etc.) remained outside the scope of the admirable methods developed by Svedberg because they are not susceptible to direct continuous optical observation, but they are within the range of the new procedure.

The principal points upon which the new method is based are (1) to have the system spread as a thin film on the inner surface of a hollow cylinder rotating with its axis vertical; and (2) to have this film subdivided in two concentric layers, the inner one being liquid, the outer one a gel of a structure sufficiently coarse to permit free motion of the single particles. Thus the distance which the particles have to travel before entering the gel or before reaching the equilibrium distribution can be reduced to a few tenths of a millimetre, whilst the gel-layer provides automatic separation of the 'sediment' from the 'supernatant', or of two levels of the equilibrium distribution, when the rotation is stopped.

In the experimental work done so far, the 'closed bowl' of the Sharples-Super-Centrifuge (inner radius 2 cm., height 20 cm., speed up to 32,000 r.p.m.) has been used without modification. A solution containing 1–2 per cent agar (in water, broth, etc., for simple fractionation, in the suspension itself when sedimentation measurements were intended) was introduced into the warmed bowl and allowed to set with the centrifuge running; the suspension was then introduced, and the spinning continued. Two per cent agar was used for particles less than 20 mμ in diameter and 1 per cent for those less than 60 mμ in diameter.

The assumption of free entrance and motion of the particles in these dilute gels appears to be justified so long as the particles in question are present in sufficiently high dilution, as is the case with most biological agents. With higher concentrations, however, the sedimentation may be hampered by a phenomenon related to the 'blocking' of filters. Therefore—working with serum for example—in spite of the small particle size, 1 per cent agar has been used. That adsorption plays no role in the effects obtained has been controlled by mincing the agar layer in the supernatant: the gel-free filtrate shows again the initial concentration.

The sedimentation in the very thin liquid layers used appears to be quite normal, and the calculation of the rate of sedimentation requires no elaboration here.

When the sedimentation equilibrium is established, the value of k, equivalent to $\frac{N}{RT} \cdot V(\sigma-\sigma_1)g$, in Perrin's equation can be calculated from the measured average concentration, C_S, in the liquid layer, and C_W the average concentration in the whole system, liquid plus gel.

Now

$$C_S = \frac{1}{x_1} \cdot \int_0^{x_1} C_0 \, . \, e^{kx} \, . \, dx,$$

where x_1 = thickness of liquid layer.

x_2 = thickness of gel layer.

C_0 = equilibrium concentration when $x = 0$, that is, at the surface of the liquid.

$$C_W = \frac{1}{x_1+x_2} \cdot \int_0^{x_1+x_2} C_0 \, . \, e^{kx} \, . \, dx.$$

Hence

$$\frac{e^{kx_1}-1}{e^{k(x_1+x_2)}-1} = \frac{x_1}{x_1+x_2} \cdot \frac{C_S}{C_W}, \qquad (1)$$

(x_1+x_2) being considered very small compared with the radius of rotation.

If $e^{kx_1} \gg 1$, then the solution of equation (1) is with good approximation.

$$k = \frac{1}{x_2} \, . \, \ln \, . \, \frac{x_1+x_2}{x} \, . \, \frac{C_W}{C_S}.$$

Otherwise the solution can be made very simple by arranging that $x_1 = x_2$, or that $x_1 = x_2/2$.

Working with the smallest bacteriophage, *S*13, for example, drops of 60–80 per cent in the concentration of the supernatant were found using 2·5 c.c. liquid and a centrifugal force of 10,000 × gravity, in 2–3 minutes time. This leads to a sedimentation constant of about $s = 5 \times 10^{-12}$. The 'molecular weight'—about $2\text{–}3 \times 10^6$—obtained for this phage from the estimation of the sedimentation equilibrium using centrifugal forces of 2,500–10,000 × gravity is in good agreement with the value derived from the sedimentation rate.

In experiments made with Dr. Elford on Type I-pneumococcus anti-serum (horse), 60–70 per cent of the antibody was spun down in thirty minutes (force, 20,000 × gravity); the drop in the total protein content determined refractimetrically was about 30 per cent. No further change was obtained by continued spinning. The calculation from this equilibrium leads to a value of about 4×10^5 for the 'molecular weight' of the antibody (corresponding to the globulin fraction of largest particle size). This confirms previous results obtained by Elford and his collaborators by filtration[1], and recent findings on concentrated purified antibody preparations using air-driven[2] and Svedberg centrifuges[3].

Besides the examples mentioned, the new method is being used in collaboration with Drs. Elford, Galloway and Andrewes for the purification of viruses and for the estimation of the specific gravity of viruses and bacteriophages. Some of the results have been mentioned at the Second International Congress for Microbiology. A more detailed account will be given later.

M. SCHLESINGER.

National Institute for Medical Research,
London, N.W.3.
Aug. 8.

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[1] W. J. Elford, P. Grabar and W. Fischer, *Biochem. J.*, 30, 92 (1936).

[2] J. Biscoe, F. Herčík and W. G. Wyckoff, *Science*, 83, 602 (1936).

[3] M. Heidelberger, K. O. Pedersen and A. Tiselius, NATURE, 138, 165 (1936).

Regeneration in Arachnida

DURING last year I noticed that Harvestmen (Opiliones) do not regenerate lost legs when they moult, and this summer I have determined that they do not regenerate pedipalpi either. It seemed possible that this surprising deviation from a general character of the Arachnida might be related to the contrast between the length of the limbs and the shortness of the cephalothorax, within which it would be impossible to develop a leg long enough to be useful when exposed by ecdysis, and that, if this were so, the same peculiarity might be shown by spiders with very long legs. A specimen of the spider *Pholcus phalangioides*, sent to me by Dr. W. S. Bristowe, has just cast its skin and shows no trace of a new leg to replace one which I removed four weeks ago.

Such failure to regenerate is, I think, a previously unrecorded feature among Arachnida, and it is intended to repeat the investigation with other spiders, such as *Phyllonethis* and *Tetragnatha*, which also have long legs.

THEODORE H. SAVORY.

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Great Malvern.
Sept. 2.

Chromosome Number of *Eucalyptus globulus* and *Eucalyptus Johnstoni*

WE have endeavoured to determine the chromosome numbers of certain species of *Eucalyptus*, using radicles, root tips and anthers. Although clear-cut mitotic figures were obtained with radicles and root tips, consistent with one another under different conditions of fixation and staining, we were not successful in determining the chromosome number with certainty, owing to the tendency of the chromosomes to remain attached to each other throughout the cycle.

Greater success was achieved with pollen mother cells, although here also the above tendency was to some extent troublesome. Diakinesis gave the most unambiguous results, but checks were obtained with metaphase I and anaphase I.

The haploid number for both *E. Johnstoni* and *E. globulus* is eleven. There appears to be an interesting tendency to secondary pairing in *E. globulus* which makes the determination of the number in metaphase I and anaphase I less certain than with *E. Johnstoni*; but the diakinesis figures seem conclusive.

Work is proceeding with the view of tracing the course of the whole meiotic series of changes. These show interesting variations from the normal.

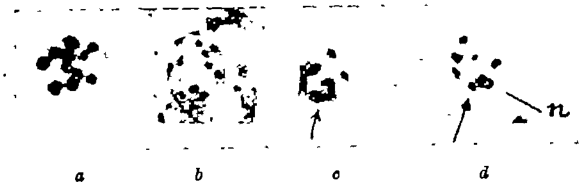


FIG. 1. (*a*) Metaphase I of *E. Johnstoni* × 2000. (*b*) Late diakinesis of *E. Johnstoni*. Two photographs of the same cell, focused on different planes, are superimposed. The nucleolus has disappeared. × 1000.

(*c*) and (*d*) Two photographs of the same cell in early diakinesis (*E. globulus*) The nucleolus is seen in (*d*) in close conjunction with a chromosome (*n*). The chromosome marked by the arrow appears in both photographs. × 1000.

Figs. 1 *a* and *b* show a typical metaphase I, and a composite photograph of diakinesis in *E. Johnstoni*; figs. 1 *c* and *d* are two photographs focused on different planes in a nucleus in diakinesis in *E. globulus*.

Our best thanks are due to the trustees of the Science and Industry Endowment Fund for a grant, without which this work would not have been possible.

A. L. McAulay.
F. D. Cruickshank.
R. G. Brett.

University of Tasmania.
July 10.

Carbohydrate Metabolism

EXPERIMENTS which have been in progress in this laboratory during the past six months have had results very similar to those described by Krebs[1] in a recent letter. The formation of α-ketoglutaric acid in the course of pyruvic acid oxidation was made very probable by my earlier results[2]. In recent experiments the formation of succinic acid from pyruvic acid, acetic acid and α-ketoglutaric acid could be demonstrated both anærobically in minced brain and ærobically in the minced brain poisoned with malonic acid. Two explanations of these facts are possible: (1) there are two alternative paths of succinic acid formation from pyruvic acid, one leading to α-ketoglutaric acid by the condensation of two molecules of pyruvic acid and subsequent decarboxylation[2], the other starting with decarboxylation of pyruvic acid to acetic acid and subsequent condensation of two molecules of acetic acid[3]; (2) α-ketoglutaric acid is formed by condensation of one molecule of pyruvic acid and one molecule of acetic acid. It has not yet been possible to decide which is correct.

The decarboxylation of α-ketoglutaric acid by brain slices under anærobic conditions depends on the presence of suitable hydrogen acceptors. The carbon dioxide evolution is increased on addition of a neutralized dye (Brillant cresyl blue) and reduced to the initial value as soon as the dye is decolorized (Fig. 1). The carbon dioxide evolution due to the reduction of the dye[4] is very small in the case of Brillant cresyl blue and can easily be allowed for. The amount of carbon dioxide given off by decarboxylation of α-ketoglutaric acid is almost exactly equivalent to half the amount of the added dye. Since two molecules of dye correspond to one molecule of oxygen, the *R.Q.* under these conditions is 1, the same as in ærobic experiments. Since the amount of hydrogen acceptor is the limiting factor of the decarboxylation, it is concluded that a dehydrogenation precedes the decarboxylation, thus excluding the possibility of an aldehyde as intermediate. In analogy to the oxidative deamination, the following mechanism of decarboxylation may be suggested:

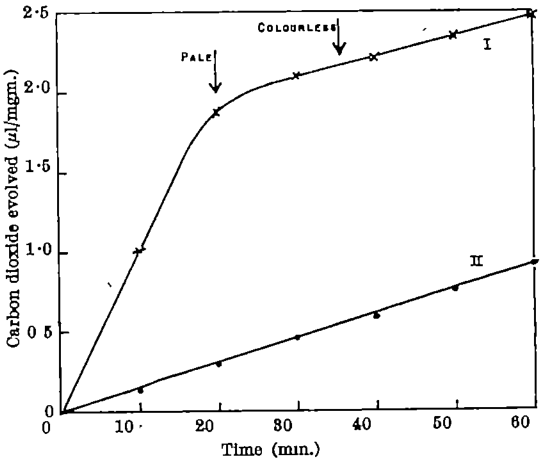
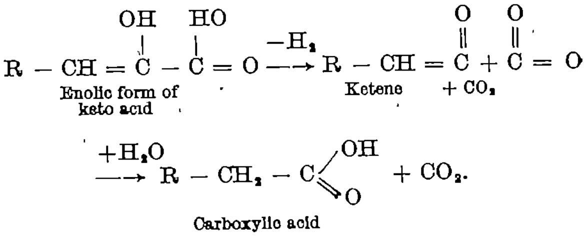


FIG. 1. Carbon dioxide evolution by slices of guinea pig brain in nitrogen in presence of *m*/50 α-ketoglutaric acid; I, after addition of Brillant cresyl blue (0·15 ml. of *m*/50 sol.; carbon dioxide corrected for the amount due to reduction of the dye); II, without Brillant cresyl blue.



$$\underset{\text{Enolic form of keto acid}}{\mathrm{R-CH}=\overset{\mathrm{OH}}{\overset{|}{\mathrm{C}}}-\overset{\mathrm{HO}}{\overset{|}{\mathrm{C}}}=\mathrm{O}}\xrightarrow{-\mathrm{H_2}}\underset{\text{Ketene}}{\mathrm{R-CH}=\overset{\mathrm{O}}{\overset{\|}{\mathrm{C}}}}+\underset{+\,\mathrm{CO_2}}{\overset{\mathrm{O}}{\overset{\|}{\mathrm{C}}}=\mathrm{O}}$$

$$\xrightarrow{+\mathrm{H_2O}}\underset{\text{Carboxylic acid}}{\mathrm{R-CH_2-C}\begin{matrix}\diagup\mathrm{OH}\\ \diagdown\mathrm{O}\end{matrix}}+\mathrm{CO_2}.$$

Glucose, which provides suitable hydrogen acceptors, can replace the dye, as shown by anærobic succinic acid formation from α-ketoglutaric acid. Pyruvic acid liberates carbon dioxide and forms succinic acid anærobically even in absence of glucose or other hydrogen acceptors, no doubt because it acts itself as hydrogen acceptor, being partly reduced to lactic acid. The system β-hydroxybutyric acid⇄acetoacetic acid, quoted by Krebs, is only one of many reversible oxidation-reduction systems in the cell, which act as reserve hydrogen acceptors guaranteeing the progress of vital oxidations independently of the varying oxygen supply.

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Sept. 2.

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[1] Krebs, NATURE, 138, 288 (1936).
[2] Weil-Malherbe, *Biochem. J.*, 30, 665 (1936).
[3] Thunberg, *Skand. Arch. Physiol.*, 40, 1 (1920).
[4] Reid, *Biochem. Z.*, 242, 159 (1931).

KREBS[1] stated recently that vitamin B_1 is a co-enzyme for two anærobic reactions, of which one is the following:

$$\alpha\text{-ketoglutaric acid} + \text{'ketonic' acid } (A) + H_2O \rightarrow \text{succinic acid} + CO_2 + \text{'hydroxy' acid} \ldots (3)$$

where the reaction is common to carbohydrate metabolizing animal tissues, and where A can be pyruvic acid; the ærobic oxidation of pyruvic acid is considered to be preceded by an anærobic stage.

These conclusions would not seem to be general for the following reasons. We happen to have tested Krebs's reaction 3 already among others, using avitaminous pigeon's brain tissue in presence and absence of vitamin B_1. Our tests were ærobic, but they cover the point because any succinic acid formed should be detectable by an increased oxygen uptake in the presence of the abundant succinoxidase present. No increased (or decreased) vitamin B_1 effect was observed by adding α-ketoglutaric to pyruvic acid. Hence in our brain systems, the extra oxygen uptake catalyzed by vitamin B_1 in presence of pyruvic acid does not follow the lines of the above equation.

We are not yet in a position to make a statement about Krebs's reaction (1) as regards our system; but we can say that we have definite evidence against the view that the oxidation of pyruvic acid proceeds through the stage of succinic acid, which has been suggested for muscle[2] and for kidney[3].

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Sept. 7.

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[1] Krebs, NATURE, 133, 288 (1936).
[2] Toenissen and Brinkman, *Z physiol. Chem.*, 187, 137 (1930).
[3] Elliott and Schroeder. *Biochem J*, 28, 1930 (1934).

Points from Foregoing Letters

THE content of oxygen by volume at high altitudes, obtained by means of registering balloons with a new device for air sampling, is found by Prof. E. Regener to decrease from 20·9 per cent at 14 km. to 20·4 per cent at 28 km. At heights above 20 km. there are relatively great variations in composition, due probably to weather conditions.

No increase in the normal amount of cosmic rays that could be attributed to the appearance of Nova Lacertæ was observed by Drs. J. Barnóthy and M. Forró between June 19 and July 17 on pointing their 'counters' towards the new star at its highest position in the sky.

The ionization current due to slow neutrons produced in a boron-coated chamber has been measured by J. Rotblat in absence and in presence of absorbers of cadmium, silver, gold and iodine. The diminution of the ionization current for each element is proportional to the number of neutrons selectively absorbed in this element, and to their coefficient of absorption in boron. Assuming that this coefficient is inversely proportional to the velocity of neutrons, and that the 'cadmium' neutrons possess thermal energies, that is 0·025 e.v., Mr. Rotblat finds that the 'silver' neutrons have an energy of about 3 e.v., the 'gold' neutrons about 4·5 e.v., and that the energy of 'iodine' neutrons is essentially higher.

By plotting the strength of the current induced in a supraconducting ring of tin against the field intensity, L. Shubnikov deduces, as a necessary condition of supraconductivity, that the magnetic field should be zero in the whole of the volume and its effective tangential component should not exceed a critical value at any point of the surface of the supraconductor.

Small quantities of nitric oxide reduce the rate of thermal decomposition of dimethyl ether, but larger quantities increase it. P. F. Gay and Prof. M. W. Travers find that the end products in the two cases are different, and they consider that the effect observed with nitric oxide cannot be attributed to catalysis. They postulate the formation of short-lived intermediates.

Mandelic acid loses its optical activity (becomes 'racemized') when heated at 140° in heavy water. Prof. H. Erlenmeyer, H. Schenkel and A. Epprecht find that the number of heavy hydrogen atoms which replace ordinary hydrogens in the mandelic acid molecule during this transformation supports the Werner-Hund conception of the mechanism of racemization. They also report the influence of the heavy hydrogen on the optical activity of the mandelic acid.

The properties and reactions of two sulphur-containing camphor derivatives (*l*- and *dl*-*bis*-thiocamphor), synthesized by D. C. Sen, are reported by Sir P. C. Rây.

An example of the effects of slow erosive shift of surface soil material on the zoning of soil types around high points in a region of peneplain topography is adduced by G. Milne from the central plateau of Tanganyika Territory. Comment is made on the use to which the word *profile* has been put in soil terminology.

Dr. M. Schlesinger describes the use of hollow cylinders coated with a thin gel layer, and rotating with the axis vertical, for the study of systems of high dispersity. The distance which the particles have to travel being reduced to a few tenths of a millimetre, the effect of a given centrifugal force is increased many hundredfold if compared with usual conditions. The use of the gel provides satisfactory separation of 'supernatant' and 'sediment', and the possibility of estimating sedimentation rates and equilibria on substances not subject to direct optical observation. The method is proving particularly useful for the study of biological agents (viruses, bacteriophages, antibodies).

Photomicrographs of pollen mother cells of *Eucalyptus Johnstoni* and *E. globulus* are submitted by Prof. A. L. McAulay, F. D. Cruickshank and R. G. Brett; they show that the haploid number of chromosomes for both those species is eleven.

Dr. H. Weil-Malherbe reports the formation of succinic acid from pyruvic, acetic and α-ketoglutaric acids by brain tissue, both under anærobic and ærobic conditions. It is claimed that decarboxylation is an oxidative process, with ketene as possible intermediate. The reversible oxidation-reduction systems in these reactions are held to function as reserve hydrogen acceptors, which may replace oxygen.

Research Items

Population of the Northern Plains Indians

DR. CLARK WISSLER has made a study of the size of certain American Plains Indians tribes during the period of the fur trade and under the reservation system (*Yale Univ. Publications in Anthropology*, No. 1). He reviews the available data in time sequence, dealing with the Blackfoot group, the Assiniboin, and the Western Cree, who became Plains Indians before the close of the fur trade period, and then wandered about, like the Assiniboin, in bands. The fur trade period is taken as extending from 1670 to 1870. Certain general conclusions emerge. There were repeated expansions into the area of the Northern Plains, largely by Algonkin speaking tribes, such as the Blackfeet, Arapaho, Gros Ventres, etc. These expansions seem to have had a common source. The Blackfeet, apparently, were the first. The Gros Ventre held most of the Saskatchewan area in 1754, but then began to retract, when the Assiniboin were expanding into the area. These reached their maximum in 1830. The great expansion of the Cree began about 1800 and culminated in 1875. The study of population suggests that these expansions were accompanied by an increase in population; and when the tribes retracted, population shrank. The expansions from the Lake country were not all in historic times and not all due to white pressure. The coming of the horse, firearms and the expansion of the fur trade were stimuli. Diminishing returns in buffalo and fur began about 1850. The disappearance of the buffalo and the taking up of reservation life were severe blows to numbers and culture. However, recovery set in at an early date, and a few tribes seem to have suffered little population loss. The reservation system may be considered a stabilizer, and saved many tribes from destruction. Instead of proving a quick method of absorbing the Indian, as was anticipated, it has proved the reverse. At present the national Indian policy is to conserve tribal culture rather than to destroy it.

Fossil Men of Engis

A RE-EXAMINATION by Dr. Charles Fraipont of the evidence relating to the discovery by Philippe Charles Schmerling in 1830 of two human skulls associated with a fossil fauna and flint implements in caves at Engis, near Liège, has established the fact that Schmerling was the first to discover an example of Neanderthal man (*Archives de l'Inst. Pal. Humaine, Mém.*, 16). The first skull, the only one described hitherto, is well known as a member of the Cro-Magnon race, but of a less specialized type, belonging to the group Brnŏ, Vistonič and Combe-Capelle. The second, however, never previously described, is now shown to be the skull of a Neanderthal child. The association of the two different types in a single stratum is explained as due to an Aurignacian burial. The stratigraphy of the cave shows no trace of occupation after Aurignacian. The industry is Aurignacian overlying Mousterian. Associated with the Aurignacian implements were the bones, intentionally broken, of *Equus*, *Bos* and *Rangifer*, while in the stratum below, where an Aurignacian industry overlies Mousterian, the human remains were associated with *Elephas primigenius*, *Rhinoceros tichorhinus*, *Hyaena spelaea*, *Ursus spelaeus*, etc., belonging to Middle or Upper Quaternary. The age of the Neanderthal child of Engis, as indicated by the dentition, is probably less than seven years. None of the milk teeth had fallen. The molars had not yet erupted. The median permanent incisors are enormous and their pulp cavity much larger than in *Homo sapiens*. The enamel of the molars shows the characteristic creases found in the child's skull of Gibraltar and of La Quina, as well as in the anthropoids and *Sinanthropus*. The Engis child shows an acceleration in the development of the cranial skeleton, which is still sometimes found in the inferior races, and is characteristic of the great apes; and it also shows the characteristic position of the foramen in which Neanderthal man approaches the apes. The temporal bone, and in particular the tympanum, shows primitive characters which disappear in the adult, but are found in the human fœtus, in *Sinanthropus* and to some degree in certain species of apes.

Archæological Excavations in Moravia

SOME further important archæological discoveries have just been made, according to an announcement in the Central European Press, at Věstonice in the valley of the Dyje, Moravia, near the place where the 20,000 years old 'Věstonice Venus' was unearthed some six years ago. Large numbers of stone and bone implements, some of them of a unique type, have been unearthed. One of the objects is a spear, thirteen inches long, carved out of a horn from a diluvial stag in excellent condition, and, like the five-inch female figure of the Moravian mammoth hunters, testifies to the skill of the artists of that period. Handsome pendants and carved ornaments of mammoth bone, crystal spheres and implements chipped out of quartz, and a stone borer unique for the Moravian diluvium are among other interesting finds.

Swallows in Britain

FOR two years an inquiry covering many aspects of the life of the swallow has been conducted in Britain under the auspices of the British Trust for Ornithology. The results of the 1935 inquiry are summarized in *British Birds* (30, 98, Sept. 1936) by A. W. Boyd. It would appear that swallows in the Lowlands of Scotland and north England lay larger clutches and rear larger broods than birds breeding in the southern part of England, and the suggestion is made that the fact may be associated with longer hours of daylight in northern latitudes. But we surmise that amount of food must be involved, and that no increase of daylight in the absence of increase of food would affect the clutches. How many eggs do swallows lay in the extreme north of their breeding range? Heavier rainfall cannot be shown to have any adverse effect upon size of clutches. The average brood for the whole country is just over four; the normal clutch is five, but six eggs, usually found in the northern counties, are not infrequent. The density of swallows varies enormously, from 40 pairs to 1,000 acres in well-populated rural districts of Norfolk and Anglesey where nesting-sites are common; to between 20 and 33 pairs in the cattle-raising districts of western England and Wales; and low numbers, 2 to 6 pairs, in industrial areas, in a large area of the Lake District, and on the downs of Sussex and moors of Suffolk.

The Migrations of Birds

A VALUABLE summary of the voluminous and scattered literature upon the migratory movements of birds in 1926–35 is given by Dr. A. Landsborough Thomson in the *Ibis* (p. 472, July 1936). The report classifies and groups the findings of field observations and experiments, and shows in what respects old theories must be modified to meet new knowledge. The portion which ought to make the greatest appeal to ornithologists in general is that dealing with recent experiments devised to elucidate the fundamental problems of migration, its purposes and origin, the stimuli which set migrants on their journeys, and the forces which guide them; for experimental evidence has greatly narrowed down some of these problems in recent years.

American Land and Freshwater Isopods

A MOST useful monograph recently published is Willard G. Van Name's "The American Land and Fresh-Water Isopod Crustacea" (*Bull. Amer. Mus. Nat. Hist.*, 71; 1936). The author gives a description and figure, or figures, of all species known from North and South America and the neighbouring islands, and also describes many new species. The introductory remarks on the general characters and relationships of the group are clear and simply written, enabling a beginner to benefit by them, and yet the whole is a handbook for any specialist to use. There are 254 land isopods, very nearly 75 per cent of which are found in that part of America which lies within or close to the tropics, including the West Indies as well as the continental areas, and there are 49 freshwater species, 17 being tropical. There are no freshwater isopods known from Bermuda, Galapagos and Juan Fernandez Islands, and the few land forms are largely species from the Old World and littoral forms, a few species being peculiar to the islands. It is satisfactory that the genus *Ligia* is used here instead of *Ligydia*, and we heartily agree that to upset and abandon so well established a genus as *Ligia* Fabricius on such insufficient grounds is unjustifiable.

Fasciation in Plants

A COMMUNICATION has been received from Mr. C. J. Bond, of Fernshaw, Springfield Road, Leicester, which raises the question as to whether the hæmagglutinating substance present in the watery extract of the seeds of the runner bean, *Phaseolus multiflorus*, but absent from the seeds of the broad bean, *Vicia Faba*, may have any connexion with a fasciation he has observed to occur when the axillary shoots grow out, after the amputation of plumule and cotyledon, in the runner bean but not in the broad bean. Mr. Bond finds that the hæmagglutinating substance is present in the cotyledons of the seed of the runner bean but not in the cotyledons of the seedling, which are 'exhausted' by the demands of the growing seedling. It remains for further work, however, to show whether this substance is causally connected with the fasciation of the axillary shoots forced into vigorous growth after amputation of the plumule and one or both cotyledons.

Mosses of Fiji

THE strategic position of the Fiji Islands in connexion with the geographical distribution of flowering plants applies equally to the mosses. A strong thrust of typical south-eastern Malaysian species indicates a migratory current through the region. Mr. Edwin B. Bartram has recently dealt with two hundred numbers collected by Dr. A. C. Smith in 1933–34 on outlying islands, previously unvisited by a botanist, and difficult of access, and with a few small specimens separated from J. W. Gillespie's plants in the Herbarium of Bernice P. Bishop Museum ("Contribution to the Mosses of Fiji", by Edwin B. Bartram: *Bernice P. Bishop Museum Occasional Papers*, 11, No. 20, March 20, 1936). Additional records of nineteen established species and twelve new species increase the total of known mosses from Fiji to approximately two hundred and thirty-five.

Ecology of Alkaline Lakes of the Rift Valley

IN the final report on the work of the Percy Sladen Expedition to some of the Rift Valley Lakes in Kenya in 1929, Penelope M. Jenkin deals with the general ecology of the alkaline lakes in particular (*Ann. Mag. Nat. Hist.*, S. 10, 18, 133, July and Aug. 1936). The number of species in the alkaline lakes is small: 17 species of algæ, 11 of invertebrates, no fish or amphibia, but a large number of flamingos which come to feed upon the blue-green algæ. The paucity of the inhabitants is the more remarkable because in a neighbouring fresh-water lake, Naivasha, there were 89 species of algæ and 70 of invertebrates. The peculiar conditions of the alkaline environment apparently make for variation, since ten of the seventeen species of algæ and nine of the invertebrates were new to science. A characteristic feature of the alkaline lakes is a 'water-bloom' due to the seasonal rapid multiplication of the blue-green alga, *Arthrospira platensis*.

Paulin Aneroids

AN account of the aneroids constructed on the Paulin System appeared in NATURE of February 23, 1929 (p. 298). Since that time the instruments have been improved and their use has been extended. Their manufacture is now in the hands of a well-known Swedish firm, Telephonaktiebolaget L. M. Ericsson, of Stockholm, and their distribution in the United Kingdom is in the hands of C. E. Johansson, Ltd., 12 Queen's Road, Coventry. The null reading principle is retained. The total range of movement of the diaphragm of these aneroids is still restricted by stops to a maximum of 1/40 mm. The diaphragm is kept expanded by a spiral spring the tension of which is altered by a micrometer screw. The spring is set until the diaphragm is in a certain normal position which can be observed on a small scale marked with a zero line, and the movements of a pointer attached to the micrometer screw are read on a large circular scale graduated to give the atmospheric pressure, the variations of which are compensated for by the variations of the tension of the spiral spring effected by hand. It is claimed that the errors of hysteresis, which constitute the worst defect of the ordinary aneroid, are practically eliminated by this null method, and that great sensitivity is attained without the production of frictional errors of the size of those introduced when the movements of a diaphragm are greatly magnified by a system of levers. The latest catalogue does not say how the problem of correcting this mechanism for changes of temperature has been solved, but states that such errors have been greatly reduced, and that the temperature coefficient is not only very low but also much more constant over the ordinary range of temperature than in the ordinary type of aneroid.

Cloud Chamber Observations of Cosmic Rays

C. D. ANDERSON and S. H. Neddermeyer (*Phys. Rev.*, 50, 263; 1936) have taken a large number of Wilson cloud chamber photographs of cosmic ray phenomena on Pike's Peak at an elevation of 4,300 metres. The chamber was set off automatically by the cosmic rays through the usual coincidence counter control, and a magnetic field of 8,000 gauss was maintained by a solenoid. The tracks obtained are similar to those at ground level, but 'showers' are more frequent in relation to the general cosmic radiation. It seems furthermore that showers containing a large number of tracks increase more rapidly with altitude than smaller showers. Some measurements of the energy loss of fast particles going through lead plates in the chamber were made. A certain number of strongly ionized tracks were found, corresponding probably to 'heavy' particles and most probably to protons. They appear to be ejected in all directions, and to be secondary rays produced by nuclear disintegrations. The high energies of these particles show that they must be produced by the cosmic rays. A search at sea-level for protons made with a special ionization chamber by C. G. and D. D. Montgomery, W. E. Ramsey and W. F. G. Swann (*Phys. Rev.*, 50, 403) showed that these did not exceed 5 per cent of the total rays.

Separation of Gaseous Isotopes by Diffusion

THE automatic multiple diffusion apparatus invented some years ago by G. Hertz has been studied in considerable detail by D. E. Wooldridge and W. R. Smythe (*Phys. Rev.*, 50, 233; 1936). It consists of porous diffusion tubes with diffusion pumps arranged to collect the gas as it diffuses through and to return it to the appropriate part of the fractionation system. In order to examine the behaviour of the apparatus, it was used to separate mixtures of nitrogen and carbon dioxide. The separation obtained with an apparatus of twenty-four elements agreed well with theory. An apparatus with thirty-four elements was used to concentrate ^{13}C in methane and ^{15}N in nitrogen gas.

A Middle-Babylonian Chemical Text

C. J. GADD and R. Campbell Thompson (*Iraq*, 2 (1), 87; 1936) describe a cuneiform tablet from Tall 'Umar (Seleucia) of the reign of Gulkishar, not later than the seventeenth century B.C., written in an intentionally obscure way by a supposed member of a guild of glassmakers. This is much earlier than the well-known Assyrian chemical texts from Nineveh (seventh century B.C.), and contains the oldest known record of actual formulæ for making glazes. The cuneiform text, its transliteration, and an attempted translation are given. Two glazes, called "lead copper" and "Assyrian copper", are composed of specified amounts of *zukû*-glass, lead, copper, lime and *mil'u* (translated 'saltpetre'). The clay for the body of a pot is then steeped for three days in a mixture of vinegar and copper, which gives a 'bloom' (verdigris). The pot is fired, and then a melted mixture of the two glazes, together with some of a similar composition, is made. A sacrifice to the "incomplete dead" (perhaps the embryo) is made, the glaze is applied and the pot is fired twice, with an addition to the glaze of a composition as before but without lime.

Modern Treatment of Burns

IN the first-aid treatment of severe burns and scalds time is an essential factor, and the treatment applied in the early stages determines to a large extent the subsequent course of healing and recovery. The former almost universal first-aid treatment by the application of 'carron oil' seems likely to be superseded by the use of tannic acid. This agent, in the form of a 2·5–5 per cent solution, sprayed over the burnt area hourly for 8–12 hours, forms with the exudate a protective coagulum, allaying pain and preventing subsequent sepsis, which is so troublesome and dangerous. Various preparations of tannic acid have been compounded for immediate first-aid treatment, such as the "Tanna-Flavine Jelly" prepared by British Drug Houses, Ltd., Gresham Street, London, N.1. This is a non-oily preparation of tannic acid with the antiseptic dye 'acriflavine', which is put up ready for use in collapsible metal tubes suitable to form part of the equipment of first-aid outfits in works, schools and other institutions.

Electrically Driven Steering Gear

A PAPER read to the Institute of Marine Engineers by H. G. Leivesley on marine electrical installations in service is reprinted in the *Metropolitan Vickers Gazette* for August. Steam steering gear has the advantage of low initial cost over steering gear electrically driven. The steam consumption is high and is constantly taking place even when the helm is at zero. This is due to lag in the transmission scheme and to the failure of the valves to close fully. The lack of synchronism between the helm position and the steering engine and consequently the actual position of the rudder is improved by the provision of a rudder indicator. This device operated from the rudder post gives a reading on a large-scale instrument in the wheelhouse. This affords the helmsman a definite indication of the rudder's position. As rudder angle means steam consumption, this affords some means of correction, and the consumption of the steering engine can be reduced. In long steam lines the losses due to condensation still continue. Water rates taken on a general cargo ship of 3,000 h.p. showed that the steering engine was responsible for seven per cent of the total fuel consumption. In motor ships and passenger liners, steering gear of the electro-hydraulic type is now standard practice because of the overall economy and convenience. In large ships the steering equipment is run continuously in one direction and at almost the same speed throughout the load range. In this case the motor is not subjected to any heavy stresses consequent upon starting, putting on a sudden load or reversal. For cross-channel steamers the horse power of the steering gear is 10, for a cargo ship 15 and for a liner 40. Curves obtained by tests show the ability of the modern steering motor to deal with sudden and heavy overloads when putting the helm hard over from varying degrees of rudder angle under full power steaming conditions.

Science and the Glasshouse Industry

IN connexion with the Blackpool meeting of the British Association, Dr. W. F. Bewley delivered a public lecture on "Science and the Glasshouse Industry" at Blackpool South on September 11. Dr. Bewley prefaced his remarks by directing attention to the importance of protected crops in any scheme of food production which might become necessary if Great Britain should ever be faced with another war, and argued that new land should be broken with the plough and brought into the high state of fertility which is essential for the successful cultivation of vegetables. He also stressed the value of such crops in the diet of the people.

To form an accurate opinion of the way in which science has helped the glasshouse industry to overcome the pests and diseases which once threatened its very existence, and the way in which it has directed progress, it is necessary to consider the position prior to 1914, when organized research became possible through the establishment of the Cheshunt Research Station.

Dr. Bewley described the serious damage once caused by the tomato moth caterpillar *Polia oleracea* (£40,000 per annum in the Lea Valley alone), the white fly, *Trialeurodes vaporariorum* (£25,000 per annum), and the red spider mite, *Tetranychus telarius*. These pests were quickly controlled by measures devised at Cheshunt, and special note must be made of the importance of the chalcid parasite, *Encarsia formosa*, in controlling the white fly. Diseases such as 'damping off' and 'foot rot' caused by *Phytophthora* spp., which destroyed thousands of plants in glasshouses, *Verticillium* wilt of the tomato (*Verticillium albo-atrum*), tomato leaf mould (*Cladosporium fulvum*) and many other diseases of glasshouse plants, which once extracted an enormous annual toll, were also brought under control.

Dr. Bewley directed attention to the importance of using a clean water supply in connexion with glasshouse plants and described the work done at Cheshunt on this problem.

The 'damping off' work was the means of discovering a soil drench (Cheshunt compound) which has since been applied on a large scale for the purpose of destroying certain fungi in the soil without injuring the growing plant. A large amount of work has also been done in connexion with virus diseases, which have attracted much attention during the past ten years. Virus diseases of the tomato were described in detail, and methods for identification, prevention and control were discussed. The importance of using virus-free seeds was emphasized. It was stated that scientific research has been pursued so effectively that it is now possible to control most of the serious pests and diseases of glasshouse plants.

Passing to the question of fungicides and insecticides, Dr. Bewley paid tribute to the work of many investigators in research institutes, universities and chemical firms, whose labours have provided the vegetable growers with new sprays of greater effectiveness. He mentioned the importance of the new sulphonated oil wetting agents and the work which is being done with regard to the use of insecticidal and fungicidal compounds carried in emulsified oils.

Soil sterilization has played an important part in glasshouse work, and the processes of chemical and heat sterilization were described. Sterilization by heat is the most effective and widely used, because it destroys a wide range of organisms, whereas chemical compounds are specific in action and it is difficult to obtain satisfactory penetration of the soil in practice. The latest method of steam sterilization, by means of the 'Hoddesdon' pipe system, was described.

Work at Cheshunt has included the breeding and selection of better varieties of tomatoes and lettuce, and of tomatoes resistant to *Cladosporium fulvum*. The tomato variety E.S.1 was distributed ten years ago and is widely used, for it yields a heavy crop of good quality fruit. The work on resistant varieties has been in progress for nine years, and it now seems that the goal is in sight, for good types have been grown this year which possess a high degree of resistance to leaf mould.

The lettuce Cheshunt Early Giant is one of the triumphs of the Station. It fills a long-felt want, for it can be grown in heated glasshouses from September until March and produces large well-hearted lettuce, even at Christmas. It has provided the English growers with a splendid opportunity for beating their foreign competitors, by providing fresh well-hearted lettuce during the autumn and winter.

In glasshouse work the physical condition of the soil is of great importance. Clean straw placed in the soil with the haulms vertical has proved beneficial, as has also the use of peat either mixed with the top soil or applied as a rooting medium to the surface of the soil during the summer.

Dr. Bewley also discussed the latest methods for warming the soil by circulating hot water in pipes buried two feet below the surface. This is a new development which will no doubt become general practice in the future. Soil warming increases the rate of root production, provides large clean root systems and heavy crops. It also increases the weight of crop picked during the first few months.

The workers at Cheshunt have also investigated the use of artificial light during the propagation stages. Useful results have been obtained with cucumbers but not with tomatoes. This application of light is being held up because a suitable source of light has yet to be found. This is a task for the engineers. Engineering science has helped the glasshouse industry in the question of heating, and Dr. Bewley discussed the use of oil firing, automatic underfed stokers, gravity boilers and the steam-cum-water system.

Great importance is placed at Cheshunt upon the question of quality in vegetables of all kinds, and recently the question of tomato marketing packages was investigated. It was found that high temperatures cause the fruit to be disfigured by a yellow mottle known as 'high temperature mottle' and that bad ventilation causes softness. A new wooden box and perforated lining paper have been devised which allows the fruit to be adequately ventilated and kept in a cooler condition. It has been tested thoroughly during the past season and has given excellent results.

Chemistry and the Community

PROF. J. C. PHILIP'S presidential address to Section B (Chemistry) of the British Association delivered on September 10, on the function and training of the chemist in the service of the community, was of much more general interest than many recent addresses or discussions in this Section but was ill-rewarded by a rather smaller attendance than is usual at the presidential address to the Section. While this may be due in part to the counter-attraction of several other discussions of wide appeal taking place at the same time, the attendance at least suggests that chemists are a long way from being alive to the social implications of their work. Prof. Philip's address, however, received the strong support of the Section, and apart from its endorsement by subsequent speeches, the approval which met many of his pertinent remarks, such as those concerning the abuse of chemistry for destructive purposes and his criticism of premature specialization and the absurdity of a university department of chemistry finding it necessary to teach its students German, was plainly manifest. Sir Josiah Stamp, who was present, spoke briefly but emphatically in agreement with Prof. Philip's views.

Mr. M. P. Applebey, who followed, discussed the particular relations between industry and the profession of chemistry. In dealing with the scope of the chemist in industry, he quoted from the joint Report of the Chemical Societies of the North East Coast to the District Commissioner for the Special Areas, which forms such an admirable example of the way in which the profession can assist in handling social problems. Despite the wide scope of the chemist's work in industry his importance is not fully realized in some industries, and industry in Great Britain does not employ its due proportion of trained chemists. The chemist is most widely recognized as an analyst, but even for this purpose men of meagre qualifications are often employed, while some firms seem to consider that analytical work exhausts the possibilities of trained assistance from the chemist. As a plant manager, he has equally important functions, and chemical processes in operation require study by controllers who understand their scientific basis if efficiency and progress are to be secured. With the wider recognition of the value of technical knowledge in sales service, the chemist is finding another outlet for his services. Mr. Applebey also commented on the purchase of processes from abroad by firms in Great Britain, and pointed out that such a policy can never be a substitute for a research policy. In the absence of a research department, considerable sums may be spent on processes which prove to be impracticable, and even perfectly good processes may require much research to adapt them to the particular conditions or to acquire the intimate knowledge of their chemistry essential for successful operation.

Mr. Applebey went beyond Prof. Philip in his remarks about the place of the chemist in management, strongly maintaining that an education in chemistry or any of the exact sciences affords as good a mental training for management as some longer established courses of education. Turning to the relations between industry and chemical education, he urged that industry first requires strong and active schools of research engaged in the pursuit of knowledge and the discovery of principles from which applications may flow. Industry also looks to the schools of chemistry for a supply of suitably trained chemists to fill such posts as have been indicated. For this purpose a good honours degree is desirable, but the honours course in chemistry should be soundly based on fundamentals, giving a firm grasp of principles. Preferably the recruit should have had two or three years of advanced experimental work, usually research, designed to develop perseverance and resource as well as technique. An industrial basis in such research is neither necessary nor desirable. Industry's obligations to chemical education are best discharged by the subsidizing of research through research scholarships, by grants for special apparatus and chemicals and the support of fundamental work and of chemical publications, both directly and through encouraging its technical staff to become members of one or more societies and participate in their work.

Mr. C. J. T. Cronshaw prefaced his paper on "the Benign Gifts of Organic Chemistry" with an endorsement of Prof. Philip's remarks regarding the need for a broad scientific basis of training. The better chemists entering the organic chemical industry are acquainted with neighbouring and borderland sciences, the better fitted they are for their job. The chemist should understand the uses to which his products are put and be able to measure and assess such properties so as to be able to improve them. Early specialization is a danger; the study of science alone is liable to produce men lacking in general culture, with little literary ability and incapable of expressing themselves clearly. General culture, he suggested, may be improved by a study of history from the angle of the rise of industries in modern times under the influence of scientific developments. Finally, Mr. Cronshaw urged that the industrial recruit should cultivate the power of criticism and of co-operating with others in a team.

Mr. Cronshaw then gave a brilliant review of the development of industrial organic chemistry, commencing with the development of the dyestuffs industry and describing the myriad contributions of organic chemistry to our comfort and well-being to-day. The quest for colour, which in itself ministers to the need of many industries, has led the industrial organic chemist into many other fields, such as those of medicine in the provision of anæsthetics, and of remedies for sleeping sickness. As with dyestuffs, the tendency with progress is to advance from the general to the specific. The motor-car industry owes much to the organic chemist alike in the improvement of tyres, oil, petrol and the finishes used for it. Organic chemistry has given the textile industry two new fibres, and in its recent work on detergents and products for the control of pests and in the field of vitamins it is continuing to confer benefits on mankind.

Sir Henry Dale, in discussing the training of chemists for work in the fields of biochemistry and medicine, referred to the way in which chemistry in recent years has invaded the fields of functional biology and the sciences related to medicine. Even in the complex field of immunity, in recent years we have seen the beginning of exact description in terms of organic and physical chemistry. In the last few years a whole series of hormones has been isolated chemically and several synthesized. Four or five vitamins have been identified chemically and at least three synthesized. Sex hormones, one vitamin, carcinogenic substances and heart tonics have been chemically related to the typically inert sterols. Already new substances have been synthesized which promise to give control over some of the most deadly infections of man, especially in the tropics. The whole orientation of therapeutics is being shifted from the effects to the causes of disease. Sir Henry Dale suggested that the greatest service of chemistry to the community lies in this new and increasing domination of biological and medical research by chemical methods and ideas. In urging the necessity for co-operation between the chemist and those trained primarily in biology and the medical sciences, he protested strongly against the neglect in Great Britain of the study of tropical diseases. While we control more of the tropics than any other country in the world, we have done comparatively little in attacking the problems of tropical disease. It is unlikely that we shall be able to justify permanently the possession of large sections of the globe, and depend on the efforts of other nations to make them habitable.

The Mediterranean Littoral

THE Consiglio Nazionale delle Ricerche has undertaken, through the agency of the National Committee for Geography in conjunction with the Institute of General Geography of the University of Pisa, an inquiry into recent conditions affecting sandy beaches along the Italian littoral, and in this connexion is publishing a series of monographs dealing with the coastline in ten regional sections, each of which is to form the subject of a separate volume. In this way, reviving the studies of eminent physiographers of the past, it is intended to present a chain of facts which will serve for a systematic research into the regimen of Italian beaches and so foster the advancement of scientific geography, at the same time aiding in the development of maritime engineering.

The opening volume of the series, forming an introduction to the whole subject, has been prepared by Signor Agatino D'Arrigo*, an engineer of acknowledged competence and merit, who has received the distinction of the award of a premium from the Royal Academy of Italy for his publications on coastline phenomena. He has produced an excellent historical review of the subject, giving an account of the earlier investigations of Italian observers from Leonardo da Vinci, Montanari, Marsili and Paleocapa to Cialdi and Cornaglia, including at the same time appropriate references to the facts recorded by writers of other nationalities. The first part of the volume is taken up with this disquisition, and is followed by certain deductions of a general order to which limitations of space do not permit reference in detail.

The second part consists of a series of comparative morpholithological studies of the regimen of various parts of the Mediterranean littoral, including the Nile Delta, the Delta of the Po and the adjacent Venetian region, the Delta of the Rhone, the Delta of the Tiber, the Bay of Taormina, the Algerian Littoral and the Argentarian Promontory, with a final chapter embodying the conclusions of the author.

The investigations are obviously spread over a wide field and while they serve as an admirable introduction to a further and more complete survey, their immediate value is perhaps best assessed, as stated by Prof. Toniolo in his preface to the volume, as a general confirmation of the hypothesis already advanced of the probable reversibility of the cycle of evolution of the Mediterranean littoral. For physiographers of other nationalities, the book contains a great deal of serviceable information, with useful references to the work of Italian investigators. The treatise, in fact, is commendably documented, and there is an excellent set of coloured charts showing coastline changes at various dates. B. C.

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* Ricerche sul Regime dei Litorali nel Mediterraneo. By Agatino D'Arrigo. Pp. 172. (Rome: Stabilimento Tipografico "Aternum".) 50 lire

Educational Topics and Events

WILD-BARFIELD ELECTRIC FURNACES, LTD., Elecfurn Works, North Road, Holloway, London, N.7, have prepared a series of lantern slides illustrating many types of electric furnaces for heat-treatment, together with notes regarding the various slides. These form the basis of a paper on such equipment, and sets and lecture are available for societies, technical schools or other interested bodies.

FORMAL education for marriage is advocated by Paul H. Landis of the State College of Washington in an article on "Control of the Romantic Impulse through Education" published in *School and Society* of August 15. The mounting divorce rate in the United States, now higher than in any other country, is, he suggests, attributable in some measure to the frequency of romantic marriages, and of this the chief cause is the mobility characteristic of contemporary American life, especially in the West, where the divorce rate is highest. "In most fields now we believe in giving experience vicariously through books and the school curriculum, yet in the field of marriage and the family we let youth learn by experience." We need courses in high school and college in eugenics and the essentials of happy family life, to set up new barriers to the free exercise of the romantic urge.

THE Education Act 1936 throws upon local education committees a heavy addition to their responsibilities. In persistently agitating for the raising of the obligatory school age, for which the new Act provides, they have, as an editorial in their official organ, *Education*, of September 4, points out, created for themselves a vast moral obligation. The issues involved in adjudicating upon applications for exemption closely concern the well-being of the community: the health and physical condition of the child; the 'beneficial' nature of the proposed employment, including its prospective benefit; the opportunities to be afforded of free education; the time available for recreation; and the case of each individual child will call for careful consideration. The grant of an employment certificate in respect of an exempted child is clearly intended to be a deliberate judicial act, not the routine application of a rough and ready test. An incidental advantage of this procedure will be that members of the committees will be constantly face to face with the question—what is the content of this final year of compulsory schooling and what is its probable value in any particular case? It is, the article points out, in this connexion, that loyal and willing co-operation between the Board of Education, local authorities and teachers will be specially desirable. A series of articles by Dr. Percival Sharp, secretary of the Association of Education Committees, on the problems presented by the administration of the new Act, is promised.

THE 'brain trust' in American politics is symptomatic of that pronounced swing towards the social sciences which has been one of the most noticeable features of university life in the United States in recent years. Commenting on this movement, the president of Yale University in an Alumni Day address urged the frank and definite recognition by universities of the "preponderant importance for our day and for the immediate future of the crucial problems of the industrial and economic order and of the individual human life in all its physical, social and spiritual aspects". Failing such recognition and energetic fulfilment of the universities' correlative obligations to the social order, they may have to face "the destruction of all that we and our predecessors have given our lives to create". But the 'brain trust', in so far as it involves the exploitation of university faculties by Government departments, is obviously liable to abuse, and a public protest has, according to *School and Society* of July 25, been made by Mr. Walter Lippmann and eight other prominent alumni of Harvard against the consequential neglect by professors of their academic duties. In Great Britain, on the other hand, one doubts whether Government departments make sufficient use of the brains of university staffs and advanced students. In the Ministry of Labour's report for 1935, for example, there is no evidence of contact between the Ministry and university departments concerned with cognate matters, although these doubtless study the masses of statistics provided by the Ministry.

THE president of Columbia University, New York, Dr. Nicholas Murray Butler, in his recent "Commencement Day" address on "The Decline and Fall of Morals", quoted Thomas Jefferson's prophecy that the cult of the "almighty dollar" would lead to heavier and heavier shackling of the people's freedom "till our rights shall revive or expire in a convulsion" —an alternative which is, Dr. Butler declared, the one dominant question before the world to-day. With this question is also bound up the fate of morals, for the destruction of liberty would make morals impossible. He referred to the German people's once powerful influence in the intellectual and economic life of the world, forfeited for the time being under a self-confident tyranny that boasts (Dr. Goebbels, on March 19) "we do not have to appeal to the people, we have the army, the police, the wireless, the press, the Nazi organization". He noted the utter disregard by Japan and Italy of moral obligation and their recourse to mass murder, and the strange mutation of Mussolini's principles since 1913, when he rebuked his countrymen for the "stupid orgy . . . in which the Italian press is now letting itself go with mad exaltation. Strong peoples have some sense of measure. Italy, rationalist and militarist, shows that it lacks this sense . . . a miserable war of conquest (the conquest of Tripoli) is acclaimed as if it were a Roman triumph." Another university president, Dr. Sproul of the University of California, speaking on June 30 on "America's Answer to Youth's Appeal", similarly stressed the preponderant importance for our day of safeguarding "freedom and tolerance, respect for the individual, regard for the rights of minorities. . . ."

Science News a Century Ago

J. D. Forbes and Auguste de la Rive

THE enthusiasm shown at the Bristol meeting of the British Association in the experiments of Andrew Crosse, referred to in NATURE last week, was not shared by J. D. Forbes, who shortly after returning from Bristol, on September 26, 1836, wrote to Auguste de la Rive: "The subject of Mr. Cross is, I confess, rather a disagreeable one to me. You will readily enough conceive how much people more conversant with geology than electricity must have been struck by hearing most eloquently expounded a series of experimental discoveries, for they were perfectly original to Mr. Cross, silently prosecuted for many years by a retired country gentleman in Somersetshire, and only elicited by chance in the course of discussion. From the first moment that the matter was mentioned to me, and on every succeeding occasion, I really believe not less than fifty times, I have patiently vindicated the claims of Becquerel, which only require to be mentioned to be acknowledged. I own I felt somewhat indignant on the subject, because having seen Becquerel's magnificent preparations and conversed at great length with him on the subject, I had been led at various times, publicly and privately, for several years, to draw the attention of geologists to one of the very best things ever done for their science. . . ."

Medical Museum at King's College, London

ON September 30, 1836, *The Times* said: "The Society of Apothecaries has lately enriched the various collections in the medical school [of King's College] by the presentation of a large and beautiful series of specimens of the materia medica, being duplicates of those selected from their own collections at Apothecaries-hall. As much care is required in choosing the purest and best specimens, many of which it requires time to procure, it is not expected the collection will be quite complete for many months. A new room has been opened in the college for their now extensive museum of materia medica. The dormitories for the students, fully furnished, and abundantly ventilated, a new medical reading room, as well as dining-hall or refectory, to be opened early in October, are among the newest improvements in the college."

Sturgeon's *Annals of Electricity*

IN October 1836 appeared the first number of the periodical "The Annals of Electricity, Magnetism, and Chemistry and Guardian of Experimental Science, conducted by William Sturgeon, Lecturer on Experimental Philosophy at the Honorable East India Company's Seminary, Addiscombe, etc., and assisted by gentlemen eminent in these departments of philosophy". The greater part of the number appears to have been written by Sturgeon himself. There were articles on the galvanometer, electro-chemical action exercised by simple metals in fluids, electro-pulsation and electro-momentum, a letter from Sturgeon to Faraday and a description of an electro-magnetic engine for turning machinery.

Sturgeon was undoubtedly one of the most industrious men of science of his day. He was born in a village near Kirkby Lonsdale, Lancashire, in 1783, and at thirteen years of age he was placed under a shoemaker who starved and ill-used him; at nineteen he entered the militia, at twenty-one became a private in the Royal Artillery and at thirty-seven left the army with a pension of a shilling a day. He had meanwhile taught himself mathematics, Greek and Latin, and begun his electrical experiments. On leaving the army he set up as a bootmaker at 8 Artillery Place, Woolwich. In 1823 he began contributing to the *Philosophical Magazine*, and in the following year, mainly through Olinthus Gregory, S. H. Christie and Peter Barlow, was appointed to the lectureship at Addiscombe. He was also connected with the Adelaide Gallery of Practical Science in Adelaide Street, London, and in 1840 removed to Manchester to superintend the Royal Victoria Gallery of Practical Science, an institution which, however, had but a short life. His writings were very numerous and to him we owe the construction of the first soft-iron electro-magnet. In his later days he felt the pinch of poverty, and a year before his death in 1850, he was granted a Civil List Pension of £50 a year.

Darwin's Reflections on Travel

On October 2, 1836, H.M.S. *Beagle* arrived at Falmouth after a voyage which had taken her round the world and had lasted nearly five years. In concluding his "Journal of Researches", Darwin gave a short retrospect of "the advantages and disadvantages, the pains and pleasures, of our circumnavigation of the world". In concluding this retrospect, he said: "it appears to me that nothing can be more improving to a young naturalist, than a journey in distant countries. It both sharpens, and partly allays that want and craving, which, as Sir J. Herschel remarks, a man experiences although every corporeal sense be fully satisfied. The excitement from the novelty of objects, and the chance of success, stimulate him to increased activity. Moreover, as a number of isolated facts soon become uninteresting, the habit of comparison leads to generalisation. On the other hand, as the traveller stays but a short time in each place, his descriptions must generally consist of mere sketches, instead of detailed observations. Hence arises, as I have found to my cost, a constant tendency to fill up the wide gaps of knowledge, by inaccurate and superficial hypotheses.

"But I have too deeply enjoyed the voyage, not to recommend any naturalist, although he must not expect to be so fortunate in his companions as I have been, to take all chances, and to start, on travels by land if possible, if otherwise on a long voyage. He may feel assured he will meet with no difficulties or dangers, excepting in rare cases, nearly so bad as he beforehand anticipates. In a moral point of view, the effect ought to be, to teach him good-humoured patience, freedom from selfishness, the habit of acting for himself, and of making the best of every occurrence. In short, he ought to partake of the characteristic qualities of most sailors. . ."

Societies and Academies

Paris

Academy of Sciences, August 3 (*C.R.*, 203, 353–392).

Emil J. Gumbel: The extreme periods between radioactive emissions. Comparison of theory and experiment for polonium. The good agreement between the frequencies found and the probabilities proves that the extreme periods between the radioactive emissions follow the theory of the greatest value.

S. Lechnitski: Some problems of elasticity of anisotropic bodies.

Kyrille Popoff: The solution of the differential equations of the pendular movement of a projectile.

Daniel Chalonge: A remarkable variation in the spectrum of γ-Cassiopeia. An appreciable increase in the brightness of this star was noted on the night of July 25–26 last: spectroscopic observations made on July 30–31 and August 1–2 showed a change in the spectrum mainly due to a large increase in the emission of Balmer lines.

René Rivault: Experimental researches on the propagation of short electric television waves ($\lambda = 41 \cdot 5$ metres, $\lambda' = 74$ metres).

Maurice Dodé: The thermochemistry of the nitrites of the alkalis and alkaline earths.

Basile Fedoroff: The conductivity of the double sulphates of the magnesium series in aqueous solution. Eight double sulphates have been studied. Except at very low concentrations, the double salt is always less dissociated than the simple salts.

Clément Courty: The increase of the magnetism of ferric oxide by ignition in the presence of ash-free filter paper.

Gabriel Bertrand: Observations on the preceding communication concerning the discovery of iron in plant ash.

Georges Jouravsky: The optical properties, densities and degree of corrosion of the alumino-magnesium titanomagnetites.

Henri Ringard and André Duparque: The microscopic characters of Courrières coals.

Fernand Jacquet: The middle Eocene with Nummulites of Senegal.

Yves Milon: The fossil *yardangs* of Saint-Pierre-la-Cour (Mayenne).

Conrad Kilian and Théodore Monod: The discovery in the western Sahara of fossil micro-organisms forming an indicator as regards age and marine nature of the Koundeloungou (Congo) series.

Lucien Cayeux: Remarks on the preceding note.

Jean Dufay: The Huggins bands in the spectrum of the blue sky and the temperature of atmospheric ozone.

Paul Budker: The destruction and fall of the mandibular teeth in *Squalus*.

Jean Jacques Bounhiol: Metamorphosis after ablation of the *corpora allata* in the silkworm (*Bombyx mori*).

Stig Veibel and Franciska Eriksen: The influence of aglucone on the velocity of hydrolysis of the β-glucosides by emulsine.

August 10 (*C.R.*, 203, 393–416).

Lucien Daniel: Acquired heredity in bulb producing leek.

David Belorizky: Some peculiarities of Nova Lacertæ, 1936. The radiation of this star is monochromatic and almost entirely concentrated in $H\alpha$ radiation.

MLLE. YVETTE CAUCHOIS: Observation and measurements of the $L\alpha$ satellites for the elements 68, 70 and 71.

HORIA HULUBEI: Observation and measurement of the L spectrum of radium (88) I.

JOSEPH CATHALA and JEAN CLUZEL: The spectrophotometric study of the hydrolysis of ferric salts.

ETIENNE VASSY: Spectrographic method for the study of the thermal decomposition of ozone.

LOUIS FAUCOUNAU: A new method for the preparation of catalysts. The Raney method of preparing active nickel by attacking a nickel-aluminium alloy with alkali has been extended to alloys of copper and cobalt.

HENRI COUPIN: The germination of pollen grains.

LOUIS GALLIEN and MARC DE LARAMBERGUE: Cycle and sexual dimorphism of *Lacuna pallidula*.

CHARLES DHÉRÉ and OSCAR BIERMACHER: The living geranium leaf emits a fluorescence radiation which extends in the infra-red to λ 830 mμ.

RENÉ WOLF, MAURICE RANGIER and MLLE. ANDRÉE BOURQUARD: The relations existing between the magnesium of muscle and chronaxy.

August 18 (*C.R.*, 203, 417–444).

VITO VOLTERRA: The principle of least action in biology.

HERMAN AUERBACH: The analytical representation of Lie groups.

CAÏUS JACOB: A gaseous jet.

JULIEN KRAVTCHENKO: The problems of conformal representation of Helmholtz.

GINO ARRIGHI: The movements of a deformable body associated with general electro-magnetic fields.

NY TSI-ZÉ and WENG WEN-PO: The absorption spectrum of potassium. In addition to the lines or bands already described by H. Kuhn and by Datta and Chakravarty, new lines or bands have been found, and these have been empirically classified in series.

HENRI LONGCHAMBON and GEORGES MIGEON: The sepiolites. Results of a physical and chemical examination of three specimens of sepiolite from different sources and remarkable for their purity and crystal formation. Reasons are given for not adopting the theoretical interpretation recently proposed for sepiolites by J. de Lapparent.

ROBERT LAFFITTE: The Neocomian in Aurès (Algeria).

MLLE. MARIA LEJEUNE: A means of isolating the micro-fossils included in flints. Attack by gaseous hydrofluoric acid under the conditions specified gives better results than the aqueous acid proposed by other workers in the same field.

THEODOR SOLACOLU and DEMETRE CONSTANTINESCO: The action of β-indolylacetic acid on the development of seedlings.

M. SUREAU and P. GRANDADAM: The spectrophotometric estimation of α-œstrone and its derivatives.

Brussels

Royal Academy (*Bull. Classe Sci.*, 22, No. 6, 1936).

L. GODEAUX: A property of Green's first straight line of a surface.

P. GÉRARD: The significance of the terminal nerve according to observations made on *Polypterus Weeksi*.

C. PATERNOSTER: The advances and retardations of the transits of Mercury across the solar disk.

M. LINSMAN: The singularities of the elementary curves in finite geometry.

F. BACKES: R congruences.

T. H. J. LEPAGE: Geodesic fields of the calculus of variations.

C. PERELMAN: M. Gödel's antinomy.

J. PASTEELS: Analysis of the morphogenic movements of gastrulation in birds.

J. THOREAU: Crystalline calcic rocks of Kivu.

Moscow

Academy of Sciences (*C.R.*, 2, No. 5, 1936).

V. S. IGNATOVSKIJ: The Laplace transformation (2).

A. MITKEVITCH: Magnetic viscosity at different points of the magnetization curve.

A. A. GRUNBERG and J. L. MICHELS: Determination of iridium by potassium ferrocyanide titration.

P. PANJUTIN, L. HINDIN and O. VASILJEVA: An investigation of the autoxidation of carbohydrates. (1) A new method for the quantitative analysis of peroxide compounds.

A. EBERZIN and O. VJALOV: An ancient Euxinian terrace in the environs of Tuapse.

I. SMORODINCEV and K. BEBESHIN: The glycogen content of ascarids. Ascarids contains twelve times as much glycogen as the higher vertebrates, but only one tenth of their lipoids.

N. A. ŠČIBRIA: Hybrids between the Jerusalem artichoke (*Helianthus tuberosus* L.) and the sunflower (*Helianthus anmius* L.).

M. A. SIZOVA: Structural changes in chromosomes induced by irradiation of physiologically modified cells.

L. V. MICHAJLOVA: (1) Reaction of the drumhead cabbage to lowering of temperature. (2) Light regime requirements of tomatoes.

N. V. NASSONOV: Peculiarities and causes of the development of additional growths in Amphibia.

(*C.R.*, 2, No. 6, 1936).

I. NATANSON: Some remarks on the theorem of Stekloff-Severini.

G. KRUTKOW: Statically indefinite systems. The ultra-definite system.

B. FESENKOV: Absolute photometry of the solar corona. A method is discussed that makes it possible to eliminate completely the influence of the atmosphere.

N. SELJAKOV: Some remarks on α- and β-ice.

S. RYTOV: The diffraction of light by ultrasounds.

N. DOBROTIN: Absorption of neutrons in silver and cadmium.

V. M. KATUNSKIJ: (1) Intensity of geotropic reaction as a quantitative index of the content of growth-promoting substance. Intensity of geotropic curvatures of the coleoptiles of oats and the seedlings of castor-oil plants varies directly as the quantity of growth-promoting substance. (2) Growth-promoting substance and the formative action of light on vegetation in plants.

A. I. GREČUŠNIKOV: The physiology of the incubation period in rust infections.

G. D. ADLER: New data on the geological structure of the region of the Taimyr folding.

S. S. ELIZAROVA: The influence of hydrogen ion activity and of salinity on the eggs of *Engraulis encrasicholus* L. (anchovy). The limits of toleration to the pH concentration and the salinity of water differ in the Black Sea and the Azov Sea races of the anchovy.

Rome

Royal National Academy of the Lincei (*Atti*, 23, 161–249; 1936).

L. TONELLI : A fundamental proposition of mathematical analysis.

G. ARMELLINI : Eccentricity of binary systems in the case of masses which vary with time.

G. GIORGI : Concerning electric and magnetic inductivities.

E. BORTOLOTTI : Non-linear relations : geometry of a system of equations with partial derivatives of the second order (3). Other intrinsic differential operators. Descriptive properties of the system.

G. SCORZA DRAGONI : Some theorems on Jordan's curves.

A. TERRACINI : Space varieties of ∞^1 spaces.

G. USIGLIO : New interpretation of propagation in the second medium in total reflection.

G. BERGAMI, P. BAER and E. BOERI : Variation of the excretion of allantoin by rats in relation to ketogenic and anti-ketogenic diets.

A. C. BLANC : Pleistocene beach with *Strombus bubonius* near Palidoro (Rome).

A. DESIO : New geological bases for search of phosphates in Lybia.

M. PITOTTI : Gastrulation of the egg of Lampreda (*Lampetra fluviatilis* L.). Displacement of substances during gastrulation.

M. LAPORTA and C. VACCA : Biological and chemical tests on the product of the irradiation of follicular hormone with ultra-violet rays.

A. CARTENÌ and C. VACCA : Chemical composition and energy value of diets consumed in two marine colonies.

C. GUARESCHI : Experiments with X-rays and with radium on the nymphosis of insects.

E. FAGIOLO : Researches on the pronephros in amphibia (2).

A. SPIRITO : New experiments on the influence of a continuous electric current on the meristems of roots.

A. CESARIS-DEMEL : Memorial lecture on Ettore Marchiafava.

Vienna

Academy of Sciences, June 25.

HEINZ TH. GRAZIADEI : Cosmic rays and solar activity. The correlation coefficient between cosmic ray intensity and activity of solar flocculi is $-0{\cdot}48$. There is a 27-day periodicity in the cosmic ray intensity.

L. KAHOVEC and K. W. F. KOHLRAUSCH : Raman spectrum of hydrazine and its hydrate. A Raman frequency of 1620 cm.$^{-1}$ occurs in hydrazine and its hydrate if the violet light be filtered out from the exciting light. This may be due to traces of diimide, HN : NH, which is decomposed by violet light.

K. W. F. KOHLRAUSCH and ROMAN SKRABAL : Vibration spectrum of cyclobutane.

W. FLEISCHMANN, H. GOLDHAMMER and S. KANN : Physiology of hibernation.

HANS PRZIBRAM and LEONORE BRECHER : Inhibition of the red coloration of the fore-legs of *Dixippus*.

ATMA MALABOTTI : Functional and histological behaviour of the stick insect (*Dixippus morosus* Br. and Redt.) after severing the nerves of the head.

RUDOLF KANITSCHEIDER : Evaluation of the magnetic data of the Austrian expedition to Jan Mayen in the polar year 1932–33 (2). The diurnal variation of the magnetic elements.

Official Publications Received

Great Britain and Ireland

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 38 : The Standardisation of Photo-electric Cells for the Measurement of Energy By H. H. Poole and W. R. G. Atkins. Pp. 363–379 (Dublin : Hodges, Figgis and Co. ; London : Williams and Norgate, Ltd.) 1*s*. 6*d*. [318

Mines Department. Fourteenth Annual Report of the Safety in Mines Research Board, including a Report of Matters dealt with by the Health Advisory Committee, 1935. Pp. 144+10 plates. (London : H.M Stationery Office.) 2*s*. net. [19

London Shellac Research Bureau. Technical Paper No. 10 : Fundamental Physical Properties of Lac. Part 4 : Optical Properties. By Dr. L. C. Verman. Pp. 16. (London : London Shellac Research Bureau.) [19

The National Institution of the Boot and Shoe Industry (Incorporated). Bibliographical Index : Boots and Shoes, Leather, Rubber and other Materials. Pp. xv+97. (London : National Institution of the Boot and Shoe Industry.) [19

County of Armagh Education Committee. Portadown and District Technical Schools. Time Table of Afternoon and Evening Classes, Session 1936–37. Pp. 24. (Portadown : Technical School.) [29

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Leadership in Industry

THE wide attention now being given to training for management in industry is indicated by the discussion in Section F (Economics) of the British Association at the recent Blackpool meeting on the subject. This interest finds ample justification in a pregnant passage in the introduction to the recent annual report of the Industrial Health Research Board. The aim of the research work directed by the Board is to advance knowledge which may be used in the prevention of industrial misfits, the complex causes of which offer a wide field for investigation. While many factors enter into industrial fitness, advancing knowledge now offers the prospect of being able to lay down, though not rigidly, reasonable physical and mental standards for various occupations which should ensure for the operative entering industry a greater chance of maintaining good health, in the broadest sense of the word, during his working life.

Given, however, the best conditions of work and the most carefully selected body of employees, the final responsibility for the maintenance of health and contentment lies with the supervising staff. Accordingly, the greatest practical contribution of vocational tests to industry would be proof of their value in selecting such staff, from foremen to managers.

Scientific and technical matters are nevertheless not the only factors which increase the onus and responsibilities of management. The very demand of industry for alert, smart, active men, rather than men of brawn and muscle, brings fresh problems. While such men are more adaptable to the needs of modern industry, they are also more responsive to variations in their environment, more aggressive, quicker to make trouble, and to demand their rights, as well as more liable to forget their duties. Thus, as the Report points out, the modern manager of a labour force must be awake to the changes, physical and mental, which are taking place. He can no longer be a dictator or afford to be tactless.

Many of the investigations of the Industrial Health Research Board point to the conclusion that selection and training are especially needed for management. Corroborative evidence is provided by those passages of the recent report of H.M. Chief Inspector of Factories, in which reference is made to the opportunity of improvement in regard to the prevention of accidents in the education of the smaller and often non-associated employers.

The rising accident incidence rates among young workers affords another illustration of the extent to which scientific management has still to make its influence felt in industry. Similarly, the existence of gross overwork reported under hours of employment further indicates the many problems, such as the extension of the five-day week or the two-shift system, which call for scientific assistance both in the investigation and in the application of the results obtained.

If the importance of training for management is now fully realized in many quarters, the practical question of how such training is to be given is far from being solved, as the discussion at Blackpool referred to above clearly showed. Already academic courses of study are prolonged, and with their crowded time-tables tend to inculcate ready-made ideas without sufficient stress being laid upon a general background of fundamental natural laws, so that the average student readily loses his sense of individuality and the desire for original thought.

Merely to add a further course of lectures or classes to an overcrowded syllabus is unlikely to assist either the undergraduate or the young graduate to qualify for positions of responsibility in which clarity of judgment, a sense of values, and a knowledge of fundamental principles are among the first qualifications demanded.

In a valuable paper on accident prevention in industry, contributed to the Chemical Engineering Congress of the World Power Conference last July, Messrs. C. S. Robinson and H. R. Payne pointed out, for example, that most young technical men take up their first post in a works without having heard of accident prevention during their academic careers. Accordingly, in their keenness on their work they were liable, through inexperience, to endanger at first the safety traditions which their employers had been at pains to establish. Messrs. Robinson and Payne suggest accordingly that there is scope for the inclusion of accident principles in the training given to men destined for executive work in manufacturing industries.

This, of course, is not to suggest that training in accident prevention should be included in the curriculum of the university or technical college. It is rather a definite plea for closely thought out plans of training for all those entering the management or executive side of industry. The most important contribution which the university could make in this field is probably that of stripping its courses of study so that they stimulate originality and initiative. If, by divesting the syllabuses of much of their minutiæ, concentrating on the fundamental principles and leaving the student adequate time to think for himself, the university can supply recruits for industry who are characterized less by knowledge of unassimilated facts than by their grasp of principles, freshness of outlook and capacity for independent and critical thought, the most important first step in training for management will have been taken.

From such recruits, the training courses which many industries normally give will enable the more promising material to be sifted readily, while the general standard of assimilation and adjustment to the industry's requirements will be considerably raised. The question of further training and selection remains. Whether it is best to recruit a specially selected small group of individuals, providing them with special opportunities for acquiring experience, and promoting them rapidly as occasion offers to the higher administrative posts, is at least debatable. Frequently administrative ability, even of the highest order, develops only with experience, and accordingly it is of advantage to select staff for training for promotion to the highest positions of management not from the recruits entering the organization, but from those of a few years' service, whose record indicates sufficient promise.

For such promising employees some firms have used the Department of Business Administration at the London School of Economics as a kind of staff college, to give them a wider view of their work. The combination of training of this type, either external or, with the larger firms, internal, with the provision of special opportunities for acquiring experience for those whose ability has been further demonstrated in the training course, appears to offer special promise. There still remains, however, the necessity for the chief executives of the firm to devote their own time to the training of those destined to occupy the higher positions, and upon the quality and thoroughness of this training at present as much depends as on anything else.

The problem is, in fact, only partly that of recruiting the right type of material and providing the promising recruit with opportunities for sufficiently rapid promotion. It is also that of securing in the organization the tradition and atmosphere in which efficient management is possible. The highest possible type of recruit will prove largely ineffective if sound principles of business management are continually being violated in the organization, whether on the plea of privilege or expediency or anything else. Indifference to such matters undermines the efficiency of many firms to-day, and is a fatal obstacle in building for to-morrow an alert and efficient management competent to assess the many intricate factors involved, and to meet with knowledge and resource the ever-changing conditions of industry.

For this reason, the continued penetration of the professional spirit in the sphere of management, with its sense of social and professional responsibility and insistence on the linking of action to facts, is highly important. Even yet the lessons of the industrial revolution of the last century and more are largely unlearnt, and machinery tends to be our master and not our servant. Only as something of the scientific spirit takes charge, seeking to develop methods which eliminate the loss and inefficiency in the sphere of human or social relations and distribution, which have so far largely annulled or even outweighed the advantages which have come from the greater mechanical efficiency of power production and modern machinery, can we hope for the evolution of organization in which the machine is assimilated to human purposes.

The management of to-morrow cannot be content to think of efficiency in terms of mechanical and physical production alone. As Sir Josiah Stamp's presidential address at Blackpool suggests, it must take account of the direct and indirect consequences of mass production, monotony of work, nervous tension, leading to mechanization of mind and diminished creative power. In the narrowest sense, industrial efficiency cannot long be maintained at a high mechanical level if the social efficiency of the worker or consumer is low. Here, as much as in the field of distribution, are questions calling for close investigation if we are to evolve an industrial and social order in which the possibilities of higher standards of living now within our reach through power production are really utilized.

The fundamental demand, therefore, in industry as elsewhere, is for those who can bring to these problems of administration minds not only capable of grasping all the relevant facts and assessing values accurately, sympathetically and impartially, but also imaginatively alive to the future possibilities and free from the bondage of past traditions, whether in the economic or any other sphere. No less in the industrial than in the political world the creative mind is required, ready to adventure and experiment in a scientific spirit, unhampered by outworn conventions and traditional practices.

The Early Cultures of China

The Birth of China:
a Survey of the Formative Period of Chinese Civilization. By Herrlee Glessner Creel. Pp. 396+16 plates. (London: Jonathan Cape, Ltd., 1936.) 15s. net.

IT may seem remarkable that the Chinese with their passion for 'antiques' should have neglected their antiquities. The reason is not far to seek. Their intense interest in the past has been æsthetic and ethical, rather than archæological: chefs d'œuvre of art and literary sources, especially those of a philosophical cast or concerned with great personalities, exclusively absorbed their attention. In this we should be the last to blame them, for the history of study of the past in China runs closely parallel with that of similar studies in Britain. When once the researches of foreign scholars and students of geology, palæontology and anthropology had laid open other fields to their interest, the national pride in Chinese culture turned to research and exploration in the field. Since 1927, the National Institute of Research in History and Philology has pursued a policy of conservation and investigation, of which the remarkable results achieved recently in Chinese pre-history and history are presented in Dr. Creel's "The Birth of China".

In 1921 Dr. J. Gunnar Andersson, then attached to the Chinese Geological Survey, began an archæological exploration of northern China, which has now produced evidence of a neolithic culture on a large number of sites. One of the earliest and most interesting results to emerge was the existence there of a painted pottery of the highest quality, comparable to the painted pottery which had been found in western Asia, now known to be characteristic of a chalcolithic civilization and to extend from southern Russia to northern China. Further research, as yet, has by no means solved the problem of the relation of the Chinese neolithic culture with the West, nor has its internal development been fully demonstrated. The finds hitherto are regarded as late; but of these, what is apparently the earliest phase is characterized by a greyish coarse ware, which is followed by the culture of the painted pottery, presumably intrusive, but with a local centre of diffusion in north-west China. The painted pottery in its turn is followed by a 'black pottery culture', of which the first indication was found in Shantung in 1930 and 1931. Certain elements peculiar to China, and appearing more or less constantly throughout the neolithic, point to a certain continuity of culture, but the 'black pottery culture' introduces elements which are new to China, while its resemblances to later developments, notably in pottery technique, make it something of a connecting link between the earlier neolithic and the succeeding bronze age cultures.

Archæologists in Europe have had little opportunity of studying in detail the great development in the study of the civilization of the bronze age which has followed on the excavations of the National Institute of Research since 1928 at Anyang in northern Honan, North China. Indeed, the most remarkable of the results from this site, from which Dr. Creel derives a great part of his account of the civilization of the Shang dynasty in the work under notice, was obtained only in the excavations of the season 1934–35, which closed in June 1935. A great deal of this material is still unpublished, and detailed accounts of the previous excavations are available only in Chinese. Dr. Creel, who has inspected all the archæological sites of China and has made a close study of all the 'finds', has in preparation a detailed account and discussion of the evidence. In the meantime, his present summary is the only first-hand account of the material available, in part, even for those who may have access to the reports in Chinese.

Before systematic excavation was undertaken at Anyang by the Chinese authorities, at first in conjunction with the Freer Gallery of Art of Washington, D.C., it was not entirely unsuspected that the Chinese had attained a high degree of culture in the bronze age. Antiquities, mostly bronzes, for which a high antiquity was claimed, were of comparatively frequent occurrence in the 'curio' market; but in view of the complete lack of information as to the conditions of discovery, their archæological value, as evidence, was small. The authenticity of many was questioned, not least, perhaps, on account of the advanced character of their technique. When, however, a primitive form of Chinese script was recognized in 1899 in the engravings on ancient bones which, like the fossil tooth which led ultimately to the discovery of Peking man, were exposed for sale in a chemist's shop as "dragons' bones" to be used as medicine, it became apparent after prolonged study of these inscriptions that the bones had been used for divinatory purposes and were part of royal archives, in which were mentioned rulers of the Shang dynasty, dating in the Chinese reckoning from 1765 B.C. to 1122 B.C.

It thus became evident that a basis of archæological fact had been provided for part, at least, of Chinese records hitherto regarded outside Chinese circles as legendary. Fifteen thousand inscriptions in this early script, out of more than a hundred thousand known, have now been published in facsimile. They have afforded a wealth of information relating to early Chinese language, system of writing, religious belief and social organization, as well as on the history of the Shang dynasty and its relations with neighbouring peoples. A great part of the material evidence relating to this period, the choice pieces, in fact, was the loot from grave robberies at Anyang, and it was not until the excavations of 1934–35 that comparative material, accurately dated in the archæological sense, was available to establish its chronological position and evidential value. It is now known to go back not earlier than about the fourteenth century B.C.

In 1934 the Chinese authorities, following up the investigations of previous seasons, embarked on scientific excavation at Anyang on an extended scale, a large burial ground being examined. Some three hundred graves were opened, four of them being royal tombs of a vast size. The evidence obtained is of extraordinary importance and throws a flood of light on early Chinese material culture. Some scores of ritual bronze vessels were found, of which the technical excellence in metal work is nowhere surpassed. Of special importance to the anthropologist is the evidence of the physical characters of the early peoples of China, of which nothing was known previously. The skeletal remains of eleven hundred individuals were recovered, some of them in an excellent state of preservation. The greater part of this evidence was obtained from undisturbed ground and is, archæologically, accurately datable. One of the most surprising finds was an unsuspected art of sculpture in stone, of which a number of examples of high artistic merit were found.

In describing the civilization of China under the Shang dynasty, Dr. Creel has told only half his story. In 1122 B.C., the Shangs fell before the attacks of the Chou, a confederacy of peoples from the Wei valley to the west, of whom some had been described in Shang records previously as captives, slaves and tributaries. It is probable that in comparison with the highly civilized Shang people, they really merited the title of 'barbarian'; but apparently they readily adopted Shang culture, though, as the archæological evidence shows, with certain differences. If, however, they could then add little to the material culture of China, intellectual development and growth in social and political organization under the Chou dynasty was enormous. It was in this period that China attained what was to prove its highest development in literature and philosophy, and it was under the Chou that, after a period of feudalism, the Chinese were first consolidated in the sixth century B.C. into an empire, in which political administration and influence had been transferred to the scholarly class, and principles of government were laid down which not only endured, but also served to preserve Chinese culture continuously for more than two thousand years. It is the story of this period which Dr. Creel tells in the second half of his book, reinterpreting the evidence relating to this second great phase in the birth of China in relation to its archæology, in a reconstruction in which the Chinese so-called historical literature is regarded as an ideal picture rather than as a statement of fact.

The Parsons Steam Turbine

The Development of the Parsons Steam Turbine Part 1: Turbo-Generating Machinery; Part 2: Industrial Turbo-Machinery. By R. H. Parsons. Pp. viii + 420 + 96 plates. (London: Constable and Co., Ltd., 1936.) 42*s.* net.

IT has often been remarked that the invention and the development of the steam turbine have brought about a revolution in the generation of power both ashore and afloat. That revolution was entirely unforeseen, and when Sir Charles Parsons in 1884 took out his first patents and constructed the historic little turbo-generator now preserved in the Science Museum, South Kensington, there were few who recognized the significance of the invention and none but Parsons himself who dreamt of the changes it was destined to bring about. The ideas involved were so novel, the difficulties to be overcome so great and the problems to be solved so numerous that it can now create no surprise that only the inventor himself and one or two associated with him were prepared to harness their fortunes to the turbine.

However, though its early years were very anxious ones, the turbine slowly gained a place for itself as a prime mover of singular adaptability, and with the opening of the present century began that wonderful series of advances which has led to the steam turbine being without a rival for driving large electric generators and for propelling fast vessels. Parsons was thirty years old when he took out his first patents, and for the remaining forty-six years of his life, although he had many other interests, he was associated with every fresh advance and, as Sir Alfred Ewing said, was "the active and incessant *deus ex machina*". Others, too, made their contributions towards the progress of the turbine, but Parsons was ever in the forefront in all that concerned the design, manufacture, application and operation of turbine machinery. It was said in 1920, when he was awarded the Franklin Medal of the Franklin Institute of Philadelphia, that "it is no exaggeration to say that the work of Sir Charles Parsons has halved the cost of producing electric power and reduced in still greater proportion the capital cost of generating machinery". If that was true in 1920, it was still truer in 1931 when he died.

The early history of the turbine was dealt with by the late Sir Alexander Richardson in his excellent work "The Evolution of the Parsons Steam Turbine", published in 1911, at which time the finest turbines were to be found in battleships and liners such as the *Dreadnought* and *Mauretania*. The publication of this work has been followed by numerous papers read to technical societies and articles printed in technical journals, and now Mr. R. H. Parsons in this valuable volume on the development of the Parsons steam turbine has given a most able review of the history of the steam turbine as used in power stations, factories, works and mines during the past half-century.

It is explained in the preface that the contents of the book first appeared in a series of articles in the *Engineer* in 1934 and 1935, and that these articles described in chronological order most of the outstanding machines of their day. When they appeared, the articles were regarded as a notable addition to engineering history, and republished in book form they will be much more readily accessible for study and reference.

About two-thirds of the book is devoted to turbo-generators. Beginning with the early machines, Mr. Parsons deals in turn with radial flow turbines, parallel-flow turbines, single cylinder, two cylinder and tandem machines, and concludes with post-War developments and representative modern designs. There are numerous photographs and line drawings, particulars of tests and much interesting information on the design of the various details of both turbines and generators.

The story begins with the 7 kw. machine of 1884 and ends with the 50,000 kw. machines at Dunston and Chicago. Many of our finest power stations have been erected in the last ten years and therefore have but a short history, but there are others which have been supplied with turbines of various sizes over a period of thirty years. One of these is the Derby Power Station, and when describing the 20,000 kw. turbo-generator supplied to this station in 1928, Mr. Parsons gives a table showing particulars of twelve machines supplied between 1903 and 1928. This table is accompanied by curves illustrating the successive reduction in heat consumption and the improvement in thermal efficiency. The first machine at Derby, a 350 kw. direct current generator, had a heat consumption per kilowatt of more than 25,000 B.Th.U., while the corresponding figure for the 1928 machine was 11,710 B.Th.U.

From the first, Sir Charles Parsons saw that the turbine could be applied to marine propulsion and to various industrial purposes. With the second of these, Mr. Parsons treats in the latter part of his book, where he describes and illustrates turbine-driven pumps, blowers, compressors and the like.

Seen as a whole, the history of the steam turbine is a remarkable record of the result of inventive ingenuity combined with scientific investigation devoted to the solution of an urgent, practical problem. To some extent it has features in common with the history of the Watt engine. But whereas Watt worked at a time when mechanical engineering was in its infancy, Parsons began life when machine tools, workshop processes and steam machinery had reached a high stage of development. The difficulties Watt had to contend with were, in the circumstances, greater even than those Parsons had to face, but the histories of their respective inventions will ever remain as monuments to human genius.

Developments in Industrial Chemistry

(1) Sulfuric Acid Manufacture

By Andrew M. Fairlie. (American Chemical Society Monograph Series, No. 69.) Pp. 669. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1936.) 48*s.* 6*d.* net.

(2) Cours de chimie industrielle

Par Prof. G. Dupont. Tome 1: Généralités, les combustibles. Pp. vi+184. 35 francs. Tome 2: Les industries minérales. Pp. iv+337. 55 francs. (Paris: Gauthier-Villars, 1936.)

(1) ALTHOUGH the United States has for many years been the chief sulphuric acid-producing country in the world yet, curiously, its technical experts have, hitherto, omitted to make any notable contribution to the standard works dealing with the manufacture of this commodity. The advent of this monograph not only repairs this omission but also gives a welcome insight into the recent developments which have taken place in America.

The author has not intended to cover his subject exhaustively but has confined himself to a thorough treatment of the present-day manufacture of sulphuric acid. Although the work deals principally with American practice, nevertheless full descriptions are given, and adequate tribute is paid, in those cases where European methods differ from, or have advanced further than, those in the United States. Such differences are mainly to be found in those nitration processes which employ either the more intensive and space-saving chambers of the Mills-Packard and Gaillard-Parrish types or use towers instead of chambers.

In describing both the nitration and contact processes, the author first deals in detail with each step of the manufacture; these steps are then linked up and the working of the plant as a whole is discussed, together with the precautions to be observed when commencing operations, and the control which is necessary in order to secure maximum efficiency.

Considerable space is devoted to a thorough examination of the contact process, and the principal types of plant are illustrated from descriptions of actual installations. The various kinds of catalysts are set forth and their preparation given whenever this is known; there is also a highly interesting discussion on the advantages and disadvantages of platinum and vanadium catalysts.

Other sections deal with the concentration of sulphuric acid, the manufacture of oleum, hazards and safety measures, the shipping of acid and a system of cost accounting. The author also gives his opinion regarding the choice of process and the trend of future developments in the industry.

The book is profusely illustrated with photographs and diagrams, while a number of graphs and tables make it even more valuable to those actually engaged in the manufacture of sulphuric acid.

(2) These volumes represent part of a course given to students in the Faculty of Science at the University of Bordeaux, and in them the author has aimed at providing a link between pure and applied chemistry by endeavouring to show how the facts and theories of the former have been utilized industrially. Although such a course must of necessity deal comparatively briefly with the numerous industries described, yet Prof. Dupont has succeeded in including most of the recent developments. The work is thus admirably adapted to those embarking on a career either as technical chemists or chemical engineers, while it is also of value to anyone wishing to obtain a concise review of modern chemical manufacture.

The first volume is divided into two sections, the first of which deals with French company and patent laws and the administration and planning of factories; descriptions are also given of representative types of plant employed. The second part, which occupies about two thirds of the book, is given over to a wonderfully concise yet comprehensive study of natural and artificial fuels. Here are described the gas, tar-distilling and petroleum-refining industries, together with various kinds of producers and furnaces. The theoretical treatment is very thorough.

In the second volume are set forth the different inorganic chemical industries. The author first describes the liquefaction of air, the separation of its components and their uses, the production of oxygen, ozone and inorganic peroxides. The numerous processes for the preparation of industrial hydrogen are then discussed, while a subsection is devoted to the purification of water. The three following chapters, which deal respectively with the industries derived from nitrogen, sulphur and common salt, are probably the most important in this volume, covering as they do the bulk of the heavy chemical manufacture. They are excellently written, being models of terse description, although the theoretical considerations underlying the different processes receive adequate treatment. The remaining sections deal with fertilizers, with cements and with the glass and ceramic industries.

In view of the utility of these two volumes, it is a pity that they are but indifferently bound in paper covers and have uncut pages. Apart from the question of durability, even a mere chemist takes pleasure in the appearance of his library, and likes sometimes to say with Samuel Pepys, "My book is brought home handsomely bound, to my full content". G. R. D.

General Smuts

General Smuts
By Sarah Gertrude Millin. Vol. 1. Pp. xv + 394 + 12 plates. Vol. 2. Pp. xi + 496 + 11 plates. (London: Faber and Faber, Ltd., 1936.) 18*s*. net each.

FEW careers provide such a romantic story as that of General Smuts, and a biographer could scarcely fail to give a fascinating narrative from such a wealth of material. Yet with a man so versatile and manysided as General Smuts, that very wealth of material may prove the biographer's undoing, and while the scientific worker will appreciate the picture Mrs. Millin gives of the statesman, he can scarcely fail to lay down these volumes with a feeling of disappointment that so little justice has been done to the philosopher. One searches these volumes in vain for any comment upon the selection of General Smuts by the British Association to fill the office of president in its centenary year, and the philosophical views which Smuts has expounded under the name of holism receive scanty treatment.

Here as elsewhere Mrs. Millin fails in her interpretation, and gives rather a series of brilliant snapshots than the intimate and discerning study for which one had hoped. The book undoubtedly gives an arresting picture of the soldier and statesman, but Mrs. Millin's opinions are scarcely held sufficiently in check and at times she seems to lack the essential sympathy with her subject. Nor does she show full appreciation of some of the most significant of his contributions in the field of statesmanship. Only the briefest quotation is given from his outstanding Sidgwick Memorial Lecture on "Democracy" in which probably even more than in his later rectorial address on "Freedom" at St. Andrews, General Smuts gave the fullest expression to his political thought and his vision of the way in which the scientific and technical expert might be associated with the task of government in a democracy That conception may well prove to be one of Smuts's outstanding contributions to political thought if civilization proves able to weather the storms which immediately beset it. So, too, one might have expected a more generous account of Smuts's share in the shaping of the League Covenant and of the mandates article in particular, of his views on native policy and the relations between black and white races in Africa and of the contribution of science in the administration of the backward races.

The scientific worker cannot but regret that so little justice has been done to Smuts's constructive thought in such matters. None the less, he will appreciate to the full the moving picture which Mrs. Mullin has given us of one who throughout his varied experiences has brought steadily to bear on life a spirit of adventure, of willingness to face change, to abide by the results of scientific inquiry —a genuine capacity to see life steadily and to see it whole. These are of the spirit of science, and no one can lay aside the book without reflecting that in a like union of character and the capacity for generous co-operation and scientific insight may well lie our hope of leadership adequate to save the world from the dictatorships which threaten its noblest heritage of liberty and culture.

R. BRIGHTMAN.

An Illustrated Manual of Pacific Coast Trees

By Prof. Howard E. McMinn and Evelyn Maino. With List of Trees recommended for various uses on the Pacific Coast, by Prof. H. W. Shepherd. Pp. xii+409. (Berkeley, Calif.: University of California Press; London: Cambridge University Press, 1935.) 16*s*. net.

Of the numerous works dealing with trees and shrubs, there are few of pocket size which cater specially for the needs of the amateur botanist and garden enthusiast. Prof. McMinn's small manual is to be welcomed accordingly. Though intended primarily for use on the pacific seaboard of North America from British Columbia southward, the inclusion of a large number of cultivated trees will extend its sphere of usefulness. It will not, however, be of special value in Great Britain.

Artificial keys are used for distinguishing both genera and species. The generic key makes almost exclusive use of vegetative characters, and is simple and easy to use. Characters of the reproductive parts are employed more often for identifying the species. The keys are generally accurate, but exception must be taken to the separation of the English elm from the slippery elm by the presence of corky wings on the branches. It is curious indeed if the somewhat rare corky-barked variety of the British *Ulmus procera* Salisb. should be the common type in cultivation west of the Rockies. The ambiguous name *U. campestris* L. is adopted for this species, with *U. procera* Salisb. bracketed as a synonym. A number of similar errors are caused by following the list of "Standardised Plant Names" of the American Joint Committee on Horticultural Nomenclature. To the fault of the same authority is due the decapitalization without exception of all specific names.

The book is liberally illustrated with original line drawings of leaves, fruits and flowers, which supplement the short descriptions in the text. The marginal veinlets are frequently drawn in the leaves with great care, although no use is made of vein characters for diagnosis. A further interesting feature is an appendix of twenty-nine pages. This gives lists of trees suitable for particular purposes and adapted for growth in a variety of soil types from dune sand to alkali soils.

Les races humaines

Par P. Lester et Prof. J. Millot. (Collection Armand Colin: Section de biologie, No. 192.) Pp. 223. (Paris: Armand Colin, 1936.) 10.50 francs.

Repercussions of political events have brought about a general stocktaking in racial studies, of which the most important result has been that it has constrained anthropologists to clarify and restate their views on the definition of race, the essential qualities, or characters, on which racial classification is based, and on the classification of existing races. Numerous manuals have appeared with the object of removing misapprehensions among the general public as to the character and implications of the term, when used in the strict and only sense which can be regarded as applicable to *Homo sapiens* according to his physical characters.

Among such manuals a high place can be assigned to "Les Races Humaines" by MM. Lester and Millot. It is eminently sane and well-balanced; and it has the advantage for the layman that it does not confine itself to anatomical characters. By its treatment of the racial aspect of physiological studies, in such matters as growth, the blood-groups, metabolism, the nervous system and a number of related subjects of investigation, it indicates that racial studies cover an extremely wide and varied group of phenomena, which, as yet, affords little ground for confident generalization.

Here the view of the authors, put briefly, is that 'race' is not stable, and that as a basis of classification of the varieties of man, it has, so far as our present knowledge goes, little more than methodological validity.

Textbook of Quantitative Analysis

By Prof. William Thomas Hall. Second edition. Pp. ix+350. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 15*s*. net.

Prof. Hall's book, which is divided into two parts, provides a course of elementary quantitative analysis and a course of analyses of technical products corresponding with works laboratory practice. In both parts it is marked by careful description and emphasis on points which usually give trouble to students. A large amount of very sensible practical advice is given without running into the fault of some American practical books of labouring the obvious.

The theory is equally satisfactory; as examples, the discussions on *p*H values and indicators, on oxidation and reduction, and on the theory of electrolytic separations may be mentioned. The descriptions of the manipulations give all the necessary details, so that the student using the book should be able to make good progress without too much personal attention from the demonstrator. The reasonable price of the book is deserving of mention.

Distillation

By Prof. Joseph Reilly. (Methuen's Monographs on Chemical Subjects.) Pp. viii+120. (London: Methuen and Co., Ltd., 1936.) 3*s*. 6*d*. net.

The book under notice contains a mathematical account of the theory of distillation, the theory of fractionating columns, and a discussion of the apparatus and methods involved in distillation, both laboratory and industrial. The section on low-pressure distillation is of particular interest, since some modern industrial processes, such as the purification of vitamins, depend upon this process. The separation of liquids by the principle of azeotropic mixtures is dealt with fairly fully, especially as it concerns the dehydration of alcohol, which is becoming important with the use of 99–100 per cent alcohol for motor fuel.

There are also sections on destructive distillation and on sublimation. The book is well illustrated and gives a competent survey of the modern processes of distillation.

Natural Selection and Evolutionary Progress*

By Dr. J. S. Huxley

MULTIFORMITY OF EVOLUTION

THE students of a particular aspect of evolution are prone to think that their conclusions are generally applicable, whereas they usually are not. The palæontologists unearth long evolutionary series and claim that evolution is always gradual. However, their conclusions apply almost entirely to abundant and mostly to marine animals. In some land plants, on the contrary, we now have evidence of a wholly different method of evolution —namely, the discontinuous and abrupt formation of new species. In rare forms the course of evolution will not run in the same way as in abundant and dominant types.

Meanwhile the naturalist and the comparative physiologist are struck by the adaptive characters of animals and plants: to them the problem of evolution becomes synonymous with the problem of the origin of adaptation. The systematist, on the other hand, is struck by the apparent uselessness of the characters on which he distinguishes species and genera.

The palæontologist, confronted with his continuous and long-range trends, is prone to misunderstand the implications of a discontinuous theory of change such as mutation, and to invoke orthogenesis or Lamarckism as explanatory agencies: and, since there exist more rare than abundant species, the biogeographer will have to discount the fact that he is dealing mainly with processes irrelevant to the major trends of evolution regarded as a long-range process.

SELECTION IN A MENDELIAN WORLD

In our attack upon the problem, we must first mention some implications of recent genetics. Essentially, the modern conception may be put as follows. The notion of Mendelian *characters* has been entirely dropped. Instead of a given gene having a constant effect, its actual effect is dependent upon the co-operative action of a number of other genes. Mutations which in one gene-complex are pathological, in another may be perfectly harmless, and in yet another advantageous. The adjustment of such mutations to the needs of the organism may occur entirely through recombination of existing modifiers, or, after a preliminary and partial buffering by this means, the final adjustment may have to wait upon further mutation.

Thus, evolution need not occur by a series of sharp single steps; each such step is immediately *buffered* by ancillary changes in genes and gene-combinations. What evolves is the gene-complex; and it can do so in a series of small if irregular steps so finely graded as to constitute a continuous ramp.

Nor is the pathological character of many mutations at their first appearance necessarily a bar to their final evolutionary utilization by the species. The mutant gene *eyeless* in *Drosophila* was originally described as considerably reducing the size of the eyes, in some cases to complete absence, markedly decreasing fertility, and depressing viability. When, however, a stock for eyeless was inbred for a number of generations, it was found that practically all had normal eyes and showed little reduction in either fertility or viability. On outcrossing to the normal wild type and re-extracting the recessives in *F*2, it was found that these once more manifested the original characters of eyeless, though in even more variable degree.

The explanation of these facts is that the manifestations of eyeless are readily influenced by other genes, and that in general those modifiers which make for normal viability and fertility also make for normality in eye-size. Thus, natural selection acting upon the recombinations of modifiers present in the stock speedily saw to it that the combinations making for the manifestation of reduced eyes were eliminated. In competition with the wild-type allelomorph, eyeless would be eliminated; but in stocks pure for eyeless, the genes to be eliminated will be the plus modifiers of the mutation.

Selection of this type, it now appears, is a constant and indeed normal process. It has become almost a commonplace in animals used for genetic analysis to find that mutant types which at first are extremely difficult to keep going, after a few generations become quite viable. This has repeatedly occurred in *Gammarus*, for example, as well as in *Drosophila*, and is also known in mice and nasturtiums. R. A. Fisher has extended this concept to explain dominance and recessiveness in general. These are to be regarded as modifiable characters, not as unalterable inherent properties. Dominant genes, or most of them, are not born dominant: they have dominance thrust upon them. Mutations *become* dominant or recessive, through the action of other genes in the gene-complex.

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* From the presidential address to Section D (Zoology) of the British Association, delivered at Blackpool on September 10.

In addition to the initial or intrinsic usefulness of a few small mutations, we have also the fact that mutations which are initially deleterious may become advantageous either in an altered environment or in an altered genic background, and the further fact that many mutations or Mendelizing variations cannot be described as intrinsically useful or harmful, but vary in their selective effects with variation in environmental conditions.

We must now discuss the processes of evolution and the role which selection may play in them. Darwin himself happened to confuse the issue by calling his greatest book the "Origin of Species". Evolution, however, must be dealt with under several rather distinct heads. Of these, one is the origin of species—or we had better say the origins of minor systematic diversity. Another is the origin of adaptations. A third is extinction. A fourth, and in many ways the most important, is the origin and maintenance of long-range evolutionary trends.

THE ORIGINS OF SPECIES

First, then, we have the origin of species. It is logically obvious that every existing species must have originated from some pre-existing species, but equally clear on the basis of recent research that it may do so in one of several quite different ways. A single species as a whole may become transformed gradually until it comes to merit a new specific name. Or it may separate, also gradually, into two or more divergent lines. Or it may hybridize with another species and the hybrid product then, by doubling of the chromosomes (allopolyploidy), give rise at one bound to a new species. Here, instead of one species diverging to form two, two converge to form one. So far, convergent species-formation is known only in plants. In these cases hybridization, apparently involving many more than two forms, together with recombination, chromosome-doubling and apogamy, appears to have been, and still to be, at work. A similar process, but without chromosome-doubling and apogamy, occurs in man. Thus species-formation may be continuous and unilinear; continuous and divergent; abrupt and convergent; or what, following a recent writer, we may call reticulate, dependent on constant intercrossing and recombination between a number of lines, and thus both convergent and divergent at once.

Divergent splitting must clearly be postulated on a large scale, if only to account for the rapid increase of the number of forms in newly evolved groups such as the higher placental orders. What without question are different stages of the process are yielded by a study of geographical distribution. Physiological subspecies are of a similar nature.

In all these cases isolation, whether geographical or physiological, is involved. We cannot be sure whether isolation simply makes it easier for selection to cause adaptive divergence in relation to local conditions, or whether in some cases at least, by some method as yet obscure, it permits the fruition of mere random and biologically useless variation. It does not matter in principle whether isolation is effected gradually or abruptly; in any case subsequent divergence will be gradual (except the cases of convergent species-formation, where the isolating process itself produces marked differences in appearance).

Biologists have realized for some time that the term *species* is loose and difficult of definition. However, whether we can define species or not, or whether we ought to emphasize the distinctions between different kinds of species by refinements of terminology, it remains true that species are genuine biological units. On the other hand, we can distinguish in principle between the causes of their isolation and the causes of their divergence.

From the point of view of natural selection, species will then fall into two contrasted categories. On one hand we have those in which natural selection can have had nothing to do with the origin of the basic specific characters, but merely acts upon the species as given, in competition with its relatives. These include all species in which character-divergence is abrupt and initial. On the other hand, we have those forms in which character-modification is gradual. Here natural selection may, and on both deductive and inductive grounds often must, play a part in producing the characters of the species. This helps to bring home the heterogeneity of the processes which we lump together as 'evolution'.

ADAPTATION AND SELECTION

We next come to the origin of adaptations. How has adaptation been brought about? Most biologists look askance at orthogenesis *sensu stricto*, and also at Lamarckism. As Fisher has cogently pointed out, the implications both of Lamarckism and of orthogenesis run directly counter to the observed fact that the great majority of mutations are deleterious.

There remains natural selection. We must invoke natural selection whenever an adaptive structure involves a number of separate steps for its origin. A one-character, single-step adaptation might clearly be the result of mutation. But when several or many steps are involved, it becomes inconceivable that they shall have originated simultaneously. The improbability is therefore enormous that they can have arisen without the operation of some agency which can gradually accumulate and combine a number of contributory changes: and natural selection is the only such agency that we know. Natural selection achieves its results by giving probability to combinations which would otherwise be in the highest degree improbable.

This important principle clearly removes all force from the 'argument from improbability' used by many anti-Darwinians, such as Bergson. It helps us also to detect the fallacy sponsored by T. H. Morgan, who has asserted that natural selection merely preserves certain among the hosts of recombinations, and that, in the absence of natural selection, in addition to the known forms of life a vast assemblage of other types would exist which have been destroyed by selection.

According to the view of the pre-adaptationists, variations occur which would be adaptive in some new environment or way of life, and their possessors then find their way into that environment or take up that way of life. What we have previously said makes it clear that this can only apply to the early stages of an elaborate adaptation, not to its whole history. Mutations, however, do occur which may be described as *potentially pre-adaptive*.

In general, the evidence that we possess goes to show, first, that selection can be very efficacious in altering the mean of a population within the range of existing variability; secondly, that a relaxation of selection will allow the type to deviate away from adaptive perfection, quite outside the range of variability to be found where selection is more stringent; and thirdly, that adaptive characters may advantage their possessors in such a way as to exert definite selection-pressure in their favour, and that accordingly selection can have a continuous guiding effect towards adaptive perfection.

EVOLUTIONARY TRENDS

We must now consider long-range evolutionary trends. It is quite clear that many of these are adaptive. So obvious is this fact that it has found expression in the current phrase *adaptive radiation*.

It is hard to understand why the trends seen in adaptive radiation have been adduced as proof of internally determined orthogenesis. Whenever they lead to improvement in the mechanical or neural basis for some particular mode of life, they will confer advantage on their possessors and will come under the influence of selection; and the selection will continue to push the stock further and further along the line of development until a limit of perfection, usually determined by quite simple mechanical principles, has been reached.

The only feature inviting orthogenetic explanation is the directive character of the trends. But on reflection this too is seen to be not only explicable but also expected on a selectionist point of view. Specialization, in so far as it is a product of natural selection, automatically protects itself against the likelihood of any change save further change in the same direction.

However, that this apparent orthogenesis is determined functionally is excellently shown by the evolution of the elephants, during which the effective reach of the animals for their food was continuously increased, but the structural basis was wholly altered. It is impossible to stretch the principle of internal orthogenesis to cover a process of this type.

The same principles would seem to apply in general to small-scale adaptations as to long-range adaptive trends, except that since such adaptations frequently concern only one particular function and not the organism's main way of life, it should be easier for evolutionary direction to be changed, and for adaptation to set off on a new tack.

An important difference will be found between abundant and scarce species. In the latter, competition will be more with other species, while in the former it will be more between members of the species itself. In general, this latter or *intra-specific* type of selection is more widespread than the inter-specific.

It is a common fallacy to think of natural selection as first and foremost a direct struggle with adverse weather, with enemies, or with the elusive qualities of prey. The most important feature of the struggle for existence is intra-specific competition.

It is another fallacy to imagine that because the major elimination of individuals occurs in one period of life, therefore selection cannot act with any intensity on the phase of minimum numbers. Selection, in fact, can, and does, operate equally effectively at any stage of the life-cycle. Further, elimination is far from being the only tool with which selection operates. Differential fertility of the survivors is also important, and in man and many plants is probably the more influential.

(*To be continued.*)

The Engineer and the Nation

IN his presidential address to Section G (Engineering) of the British Association, delivered on September 10, Prof. William Cramp took as his subject "The Engineer and the Nation" and, in the course of a very human and entertaining sketch, found opportunity to define the special functions of the engineer, to claim for him an appropriate degree of authority and independence in his own domain and to discourage the prevalent repression of technical knowledge and skill in the interest of commercial advantage or in favour of false standards of economy. The activities of the engineer, he holds, are closely linked with the national life and its progress and, to a very large extent, take the form of applying and bringing to the service of the community the knowledge previously gained by the physicist, the chemist and the metallurgist. He is not, however, detached from the work of fundamental research, for his training is in close touch with it and enables him frequently to bring to a conclusion the unfinished work of his collaborators in the field of pure science. As an instance of this, Prof. Cramp ascribed to the engineer the evolution of the Cooper-Hewitt arc rectifier from its humble beginnings to its present outstanding position as the most important converter in heavy electrical engineering.

The fundamental differences between those engaged in the pursuit of pure science and the engineer are to be found in the conditions under which they must work and in the ends toward which they strive. For the investigation and study of natural phenomena and their laws, the scientific worker requires quiet detachment and, for him, the main purposes are to know what is unknown, to observe behaviour, to determine natural laws, to construct a framework of principles fitting the collected observations. The engineer, on the other hand, must keep in close touch with the life and interests of the community, and the major part of his work is done under the conditions of intense and orderly bustle associated with construction. His aim is to apply knowledge, to link it with the experience of the ages, to utilize and to conserve the energy that is available for the increase of the amenities of life. In this way, engineering has become the greatest instrument of civilization the world has known; at least three-fourths of its work consists in making, maintaining and developing communications.

While it may not be possible to accede to Prof. Cramp's claim that, left undisturbed by politicians, scaremongers and patriots, the engineer would render war impossible, the thoughtful will be able to appreciate from the context of examples and suggestions the underlying truth and moral of his case. But whether in peace or in war, the products of the knowledge and skill of the engineer as a pioneer are vitally important, so to the nations and to the world at large his activities and the ends to which he directs them are matters of supreme concern. Thus it is that the man, the engineer, is at all times closely associated with human relationships, and his opportunities for development or loss of character are great; his chances of salvation and his risks of damnation are increased, for character does not mature in cloisters, and exposure is necessary for the proof of it.

Finding the engineer so privileged in the nature of the services he can render to the community, Prof. Cramp then asks to what extent do his fellow men recognize his real and potential importance, and how far does he abuse his position or allow himself to be made the tool of less scrupulous men. Although the period and extent of his training correspond to those of the doctor and lawyer, the engineer has no similar status nationally recognized, nor does he on the average receive the same rewards. Men responsible for the design of high-speed turbo-generators or for other work transcending that of the doctor in respect of the safety, not merely of individuals but of masses, may never receive more than £750 per annum. On the other side of the account, instances are given of unprofessional conduct; while it is out of place here to recapitulate details of the commercial practices of individuals, firms, and associations to which Prof. Cramp referred, it is to be hoped that his plea for a higher standard of integrity may have good effect and may assist in promoting the reforms he suggested.

In the forefront of these reforms Prof. Cramp places the need for a body with statutory powers to define the qualifications and status of those who may use the titles at present freely adopted, to prevent unqualified persons from jeopardizing life and also to check unprofessional conduct. Expressly it is stated that such a measure of immunity as has been achieved by the legal and medical professions is not desired. An urgent reform also is the proper representation of science on governing bodies in industry and in technical departments in the State and municipalities; and here it was suggested that the British Associations should take steps and also appoint a committee. Some means by which the engineer shall not be over-ruled in technical matters by the commercial man, drastic alteration of the patents procedure in the law courts and a suggestion for the revision of the constitution of the councils of the trade associations by making them representative of makers, contractors and buyers are also urged as much needed reforms.

Finally, there is the question of the general professional code. Backsliding, Prof. Cramp finds, can only be corrected by a higher training of character and, in his concluding words, "The remedy lies in the hands of parents and those who control educational institutions: it is urgent and of national importance. I commend its consideration to the Board of Education, the Committee of Vice-Chancellors, and to the members of Section L. British engineers have, in the past, earned a great reputation for reliability and straight dealing. This is a national asset of real value, which can only be maintained if, as in our national games, we learn to place integrity before self-interest".

The Place of Science in General History

A MARKED change has taken place in recent years in the attitude of the 'general historian' to natural science. Fifty, or even forty years ago, it was possible for S. R. Gardiner to write a history of England covering the life of Newton, and to allude to Newton only as Master of the Mint. To-day, in every book of similar scope and size, something would be said about the achievements of science in the seventeenth century, as well, probably, as something about the connexion of science with the industrial developments of the eighteenth and nineteenth. This is all to the good, and in the same direction should be noted the recent great interest in 'pre-history'. The last will probably prove in the end the decisive factor in changing the focus from which we regard the past, or rather—to use a more appropriate metaphor—the centre of gravity on which the past and present repose. As this is the capital point in the discussion, it will be best to make it clear at starting.

The older, and still prevalent, view regarded the agents and the machinery by which the government of nations is carried on as the dominant factor in human affairs. Hence, in practically all historical works of a general kind, the writer spent his chief, often his whole, pains in describing this type of action and the characters of those who did it. For this reason all of us have some sort of picture in the mind of the most eminent and interesting kings, emperors, soldiers and statesmen. They serve, of course, a very useful function as landmarks in the course of time, as *points-de-repère* round which we may collect the other fragments of knowledge which we possess. But the newer and truer point of view carries the matter a good deal further back. The really determinant factors in human life in the long run are more profound, more obscure and, above all, more purely mental. The revelations of pre-history make this clear. We find, probe as far as we may, that, millenniums ago, the mind of early man was at work making inventions and observations which laid the foundation of all the civilization which has followed. When we grasp this, we must be led on to see that the mental process is a continuous one and that the abstract-thinking mind becomes more, and not less, dominant as history proceeds.

The question, therefore, which every honest person must put to himself is this: Do we really desire to know the true connexions of things in the past, the authentic structure of the society of which we are a part, or do we prefer the superficially more exciting incidents which the novelist historians are always ready to turn out? Is it the 'private life of Henry VIII' and the mistresses of Charles II, or the scientific revolution which took place between those monarchs, which really interests us the most? All are a part of history, and all historians and readers of history must select.

One must not be understood to belittle the importance of the governmental side of history, or to be attempting to identify it with the personal foibles of its prominent actors. But it is necessary in the interest of truth to assert that hitherto there has been a vast miscarriage of interest and attention in this matter, which is a vital one for the intellectual integrity of the race.

How may the correction be best carried out, without revolution, and without lessening the total amount of interest which the thinking public is inclined to give to history?

In the first place, the change must take place gradually and by the mental conversion, both of those who write and those who read history. This follows from the very thesis that we are maintaining. Mind rules the world, and this is a case of men's minds awakening to the real nature of the process. Evidence is abundant that most of the competent minds which have turned to the subject now realize, more or less dimly, the nature of the truth, and the truth is spreading. Lord

Acton at Cambridge was the turning point in England. Few would now contend, with Seeley, that "history *is* political history". Or if a stray campaigner, like Sir John Marriott, is found to say so, he can only be understood to mean that 'the history *I* write, or am interested in, is political history'. Most students of history would now admit our general thesis on Acton's lines and add that they personally, not being competent in mathematics or physical science, prefer to leave such parts of the historical field to those who are. Thus, though the battle has been won in the main strongholds, it remains to carry out the organization and administration of the conquered area in the new spirit, and this will take time and various expedients. A few may be suggested.

In large encyclopædic works, like the "Cambridge Modern History", separate chapters may be, and are, included on science, as on art, etc., by specialist writers, in the midst of the main current or political and social history. This is much better than nothing, but does not meet the need of synthesis in treatment, or of showing how the scientific spirit has made itself felt in the realms of government, religion or social life. The work is much better done when the historian, though he may not have had a scientific training in his youth, applies his own mind to the subject and does his best as one man. G. N. Clark's "History of the Seventeenth Century" is a very spirited and successful essay of that kind. On a much larger scale, Preserved Smith's "History of Modern Culture" goes even too far in the other direction, for, by not preserving any political outline, it rather loses the sequence and position of events. Some such outline is necessary to keep our minds in order, though there is no need that it should be the old dates of kings and queens, and increasingly, in the future, history will need fresh landmarks.

That the student and writer of history should be, if not personally trained in science, at least in constant mental contact with those who are, is of course the only right way. But it should not be forgotten that the student of science may be himself as much of a narrow specialist as any student in the Record Office. Both need the philosophic view, that is, the constant and sincere attempt to see things whole and in their relation to the whole.

Now seeing things whole in history leads to sociology, if indeed it is not the best definition of what sociology aims at. Therefore it is relevant to our subject to point out that there is at present only one chair of sociology in Great Britain, that founded at the London School of Economics by the late Mr. Martin White. It would undoubtedly tend to a more synthetic view of history (which includes putting science in its due place) if wealthy and enlightened donors could be found to institute other chairs, and above all at the two older universities. Meanwhile the keen prosecution of anthropology, fostered especially at Oxford by Dr. R. R. Marett, is doing something to fill the gap. It is not suggested that sociology should control the teaching of history but, being essentially philosophic and connected with all the branches of the study of man, it acts as a link and promotes the synthetic view among all who come in contact with it.

For this must be the final and guiding thought in the minds of those who wish to see science occupy its true place in our view of the past. We welcome its recognition, even in the disconnected form in which it generally appears. But this is merely the first step, and by itself not of much significance. Integration is needed: not the extra chapter inserted in the general survey, narrating the discovery of the spinning jenny or even how Watt was helped by Black in developing the steam-engine, but a consideration of the social origin and social effect of these things. They go back to the roots of man's thinking; they go forward indefinitely, modifying the way in which he lives and regards the world.

The line of demarcation does not seem too difficult between what may be expected in general history about science and technology and what is properly left to specialist works. It would be improper and absurd to include the detailed theorems of Euclid or the drawings for Watt's steam-engine in a work on general history. But one should be able to gain some idea of how Greek geometry arose and what it meant for the unification of ancient thought, and, in the latter instance, it is essential that one should be led to think how modern inventions have been conditioned by science and what changes and problems have been laid upon us by a mechanized world.

The students and writers of history are still only at the threshold of this inquiry, but it is a welcome advance to have come in sight of it. There is now a lively demand for some teaching as to the history of science, which is taking shape in Cambridge this term in a new series of regular lectures. Prof. Lancelot Hogben expressed the same desire in his recent lecture on the "Retreat from Reason". But most vital of all would be the enlistment of the body of general historians in the cause. They have the historical spirit and the technique. We owe mainly to them the general interest and respect for the past which distinguishes our country. An alliance between the two forces, and an enlargement of the old historical discipline, would be an educational revolution of the most far-reaching type.

F. S. M.

Obituary

The Right Hon. Lord Moynihan, K.C.M.G., C.B.

LORD MOYNIHAN died on September 7 at his home, Carr Manor, Leeds, in his seventy-first year. His fame was world-wide, and great gifts with which he was endowed made him the greatest surgeon of the day both in Great Britain and abroad. His father was Captain Moynihan of the 8th Foot, who gained the Victoria Cross in the Crimean War. Ten years later, on October 2, 1865, Berkeley Moynihan, his only son, was born at Malta. He was educated at the Royal Naval School and entered the Leeds Medical School for his professional training. He took his M.B. at the University of London in 1887 and the fellowship of the Royal College of Surgeons of England in 1890. After graduation he started teaching anatomy in the Leeds Medical School; later he was appointed assistant surgeon to the Leeds General Infirmary and then in due course surgeon and consulting surgeon and professor of surgery in the University of Leeds.

Moynihan's success as a teacher and reputation as a surgeon brought him early a lucrative practice in the north of England, and he was rewarded with a knighthood in 1912. During the Great War he was appointed consulting surgeon to the Northern Command, and later, consulting surgeon to the British Expeditionary Force, with the rank of Major-General A.M.S. He was made K.C.M.G. in 1918 and a baronet in 1922. In 1929 he was created Baron Moynihan of Leeds, the only surgeon with the exception of Lister to receive a peerage. At the Royal College of Surgeons he passed successively through all the offices and held the post of president for six years (1926–32), a longer time than any of his predecessors.

Many qualities contributed to make Moynihan the man he was. Physically he was strong, rarely ailing and possessed of abundant energy and vitality. Cheerful in disposition and willing to please, he was eager to be liked. Perhaps this was the Irish element coming out in him. It is to his credit that though he loved to please, he was just as pleasant to an omnibus conductor as he was to a titled patient. Mentally he was alert, quick-witted and ready to seize a new idea, make it his own and improve on it. As a speaker he was pre-eminent. His addresses and speeches, of which he made many, though carefully prepared, were delivered in faultless manner without a note, and their charm and persuasiveness were enhanced by a full melodious voice.

These attributes, great as they were, would not have led to Moynihan's high position if it had not been for his great powers as a surgeon. In the early years of this century his fame was growing, and a visit to Leeds to see Moynihan at work became a routine for surgeons visiting England from abroad and especially for surgeons from the United States, amongst whom he had many friends and with whom his reputation stood high.

The reason for this high reputation may be ascribed in the first instance to technical skill. Moynihan was a master in technique and it was a joy to watch him at work. There was nothing of the slapdash, cut-and-thrust method of the pre-Listerine surgeon. Instead infinite patience and infinite gentleness, by which means difficult and dangerous operations were brought in his hands to a happy issue where more rapid but rougher surgeons failed. Moynihan saw also the great value of careful preparation before operation so as to bring the patients into the most favourable condition, and to this end he devoted as much attention as to the operation itself. To use his own words, he raised his surgery to the sanctity of a sacrament.

But Moynihan was more than a deft user of his hands. He was intensely interested in the scientific side of his profession and made considerable contributions to clinical science which of themselves entitle him to fame and to rank with the Masters of Medicine. The most important of these are in connexion with diseases of the duodenum, stomach and gall bladder. The recognition of duodenal ulcer and its successful treatment we owe to Moynihan. By skilfully correlating the symptoms as related by patients and observations made in the operating theatre, he drew a clinical picture of the disease by which it can now be recognized with ease and accuracy.

The operation of gastrectomy for gastric ulcer received a great impetus in the hands of Moynihan. He picked up the idea, probably, from Polya, but he modified and improved it and, what is more, taught other surgeons to do it too. Other important contributions were made on diseases of the spleen, pancreas and gall bladder, and again he showed that the morbid condition was characterized by a definite clinical picture.

By these means Moynihan was led to inculcate a doctrine, the truth of which is being but slowly admitted, that there is a pathology of the living, distinct from the autopsy chamber. He held that the beginnings of disease processes should be studied while patients are yet alive, and that the best place to study these is the operating theatre, which he termed his laboratory.

Associated with this technical excellency was a power of organizing ability. Many years ago Moynihan realized that in order to raise the standard of surgery throughout Great Britain—and this ideal was very near his heart—it was essential not only to have a high individual standard, but also to create a free intercommunication and a comradeship between surgeons. He described these ideas in a letter written only last May. He writes:

"In my early days I was struck by the lack of cohesion among members of my profession. Surgeons in one town knew little or nothing of surgeons elsewhere. A surgeon from Manchester had never, so far as I could hear, visited an operation theatre in Leeds, nor had one ever been called in consultation.

As a consequence it was not infrequent to listen to disparagement of one surgeon by another and jealousies openly expressed were too often heard. I thought this all wrong. If we were indeed members of a 'noble profession' as we most certainly were, then it was clearly an obligation upon us to speak well of one another. It seemed to me that if by any means we could be brought together, it would be a great advantage to us all and that we should then be made to realize that we were not competitors, one working against another, but comrades, each working with the others against the common enemy, disease."

The means that Moynihan took to accomplish his ideal were three. First came the foundation of the Provincial Chirurgical Club (since 1929 called the Moynihan Chirurgical Club). This body of surgeons met among themselves, visited each other's clinics as well as foreign cities. In this way the most important surgeons all over the world were visited, and Moynihan may be regarded as the finest medical ambassador England ever had. The second method was the establishment of the *British Journal of Surgery*, which under his chairmanship reached the proud position of the premier surgical journal. The third means and the most important, and one in which Moynihan took a prominent part, was the foundation of the Association of the Surgeons of Great Britain and Ireland. This has proved a great success and drawn together surgeons from all over the country, raised the standard of British surgery and removed the reproach of "lack of cohesion" among members of the profession.

One of the most important works of Moynihan's life and one of which he did not live to see the full fruits was the introduction of the study of experimental surgery. Moynihan saw that if surgery is to continue active and progressive, an intensive and direct study must be made of the many problems which confront the surgeon. During his time as president of the Royal College of Surgeons, he devoted time and energy to securing surgical research scholarships and laboratory accommodation where young men entering on the surgical profession might be trained in methods of research. His efforts were rewarded, and a flourishing school of this new science is growing up, the importance of which it is hard to predict.

Moynihan's life may be described as a success, a victorious success, and the world is the richer for his being. G. E. G.

Mr. E. R. Deacon, O.B.E.

We regret to record the death of Mr. Edgar Reginald Deacon on August 29. It may be recalled that during the early months of the Great War there was a serious shortage of high explosives; in particular, the supply of T.N.T. (trinitrotoluene) available was totally inadequate to meet the enormous requirements. It was early in 1915 that Deacon, whose province at the Research Department, Woolwich, had been the study of high-explosive munitions, made the suggestion that by mixing the available T.N.T. with ammonium nitrate it could be made to go much farther without loss of efficiency, a fact which he demonstrated experimentally. At the outset he suggested the mixture of equal weights of these materials, this mixture having the advantage that it could be filled into shell by casting in a manner similar to that hitherto used for lyddite. Within two months he had worked out the more difficult problem of preparing and filling a mixture of 80 parts of ammonium nitrate and 20 of T.N.T., which contained too much ammonium nitrate to be cast. This advance made it possible to fill five times the number of shell hitherto possible with a given weight of T.N.T.

The importance of these suggestions was immediately recognized by his chief, Dr. (now Sir) Robert Robertson, who took steps to develop these mixtures further and brought them to the notice of the Ordnance Committee and Lord Moulton. In this way, birth was given to that important series of explosives later known as the amatols. Rapid expansion of the use of amatol followed in the national filling factories under the Ministry of Munitions, and many individuals contributed with great skill and ingenuity in furthering its successful application. It was used not only for shell but also for other munitions such as bombs, mines and torpedoes, and it has been estimated that no less than 600,000 tons were used by the British Services during the War.

The importance of the introduction of amatol is indicated by a speech made by Lord Moulton in 1917 in which he referred to two inventions brought forward by the Research Department, 40/60 and 80/20 amatol. By means of these he was enabled to meet his obligations, especially with 80/20, which effected such a great saving in the use of T.N.T. He recalled the advocacy of the Research Department of this explosive, which he considered to be "the greatest single thing in importance in the supply of that wealth of munitions that has enabled our armies to expend shell to an unlimited extent".

Edgar Reginald Deacon was born in 1881 at Frome, educated at Sexey's School, Bruton, Somerset, and later studied at the Finsbury Technical College. For some time he held appointments as assistant to the late Mr. Chaston Chapman and as assistant chemist at the Clinical Research Association. In 1902 he joined the staff of the recently formed Experimental Establishment (now Research Department) at the Royal Arsenal, Woolwich, in which he remained until his death.

Deacon devoted many years to the study of high-explosive munitions and for more than twenty years was head of the high-explosives branch of the Directorate of Explosives Research. He was elected fellow of the Institute of Chemistry in 1917 and awarded the O.B.E. in 1918.

Deacon was highly original and full of resource, and many important improvements in the efficiency and safety of munitions are due to his work. The Fighting Services have lost a most valuable servant. To quote from a letter received from another Government Department: "All who had official dealings with Mr. Deacon will gratefully remember his wide knowledge, wise counsel and willing helpfulness."

News and Views

Awards for Cancer Research

THE International Union against Cancer, of which the headquarters is in Paris, has awarded a prize for scientific work on cancer to Profs. E. L. Kennaway and J. W. Cook of the Research Institute of the Royal Cancer Hospital (Free), Fulham Road, London. The prize, which is the gift of the Union Minière du Haut Katanga, the well-known Belgian firm engaged in the production of various metals including radium, consists of 50,000 francs together with 50 milligrams of radium for use in research work. The presentation was made last week in Brussels during the Second International Congress on Cancer by Dr. Jacques Bandaline, the director of the Bureau of the International Union against Cancer, in the presence of the Prime Minister of Belgium and numerous delegates to the Congress. Mr. Cecil Rowntree, senior surgeon to the Royal Cancer Hospital, and a representative of Great Britain on the International Union, read a telegram of congratulation from the Earl of Granard, the president of the Hospital. Prof. Cook, in expressing thanks for the award, paid a tribute to the essential part played in the development of the research by four colleagues, Drs. Mayneord, Hieger, Hewett and Haslewood. Prof. Kennaway was educated at University College, London, New College, Oxford, and the Middlesex Hospital. He is professor of experimental pathology in the University of London and director of the Research Institute of the Royal Cancer Hospital (Free), London, and is author of several papers on biological chemistry and cancer. Prof. Cook, who was educated at University College, London, is research chemist at the Royal Cancer Hospital, and is professor of chemistry in the University of London. He is also an honorary secretary of the Chemical Society. He has written numerous papers on organic chemistry, particularly in relation to cancer.

Bust of Kelvin for the Smithsonian Institution

THE presentation of the bronze bust of Lord Kelvin, by the late Herbert Hampton, to the Smithsonian Institution, is to take place on October 8 at Washington, D.C. The English-speaking Union has arranged a luncheon at the Hotel Willard, Washington, in honour of the occasion, at which Dr. C. G. Abbot, Secretary of the Smithsonian, will receive the bust. Mr. V. A. L. Mallet, counsellor of the British Embassy at Washington, will transfer the bust on behalf of the English-Speaking Union of the British Empire to the English-Speaking Union of the United States. Dr. W. F. G. Swann, of the Bartol Research Foundation, acting as the American Union's spokesman, will then officially make the presentation to the Smithsonian Museum, and Dr. Abbot will reply. The bust was dispatched from England on September 23. It is to receive a prominent position at the Smithsonian Institution, and it is hoped that it will form the nucleus of a permanent exhibit to be collected indicative of Lord Kelvin's contributions to various branches of science on both sides of the Atlantic. The late Herbert Hampton, the famous sculptor and friend of Lord Kelvin, made this bust from life in 1902, five years before Lord Kelvin's death. It has never been cast before, although it was used as a model for the bas-relief on the Queen Victoria Memorial at Ipswich. The plaster cast was carefully preserved by the sculptor's widow, from which a bronze has now been cast for the Smithsonian. Hampton was well known for his public memorials and portrait busts of celebrated people. His works include five memorials to Queen Victoria, statues of King Edward VII and King George V, the well-known figure of the Duke of Devonshire in Whitehall, the Marquess of Salisbury (at the Foreign Office) and Lord Hardinge (at Bombay).

Wilhelm von Waldeyer (1836–1921)

OCTOBER 6 marks the centenary of the birth of the eminent anatomist, embryologist and anthropologist, Wilhelm von Waldeyer, who was born in the village of Hehlen in Brunswick, and died on January 23, 1921. He first devoted his attention to natural science and mathematics, but under the influence of Henle took up medicine, which he studied at Göttingen, Greifswald and Berlin, where he qualified in 1861. After acting as von Wittich's assistant at the Konigsberg Physiological Institute, he went to Breslau in 1864 where he was first assistant to Heidenhain; then he became extraordinary professor of morbid anatomy in 1865 and full professor in 1867. In 1872, he was appointed professor of normal anatomy at Strasbourg and was transferred in 1883 to the corresponding chair at Berlin, which he occupied until 1917. His literary output was considerable, as is shown by the bibliography of 269 references in Sobotta's memoir (*Anatom. Anzeiger*, 1923). His principal works were on the ovary and ovum (1872), sclerotic, cornea and conjunctiva (1874), an atlas of human and animal hairs (1884), a history of anatomical instruction in Berlin (1899) and Darwin's doctrine (1910). He also made important contributions to our knowledge of cancer, retroperitoneal hernia and pelvic viscera, and was the first to describe the neuron theory, the ring of lymphoid tissue in the pharynx and chromosomes. He was co-editor with La Vallette St. George of *Archiv für mikroskopische Anatomie*, Virchow-Hirsch *Jahresbericht* and *Archiv für Anatomie und Physiologie*.

"Natives" in Western Australia

UNDER the provisions of an Aborigines Bill introduced in the Legislative Council of Western Australia on September 23, it is now proposed that all people of colour in Western Australia, whether full-blooded or of mixed origin, shall no longer be known as "aborigines", "half-castes", or "near whites", but shall be termed "natives". While this proposal no doubt removes what has been felt in certain circumstances to be a stigma, it perpetuates and gives official approval to a troublesome ambiguity. The Bill was introduced on behalf of the Western Australian Government by the Chief Secretary, Mr. W. H. Kitson (*The Times*, Sept. 24). As it stands, the proposals deal with certain matters affecting the natives to which attention was directed recently in the drastic report of a commission of inquiry criticizing native conditions and the organization and functioning of the Western Australian Government's provision for the protection of the aborigines (see NATURE, **135**, 798). A better system of control of the natives is to be introduced; and a serious attempt is to be made to grapple with the grave problem of the conditions affecting native mothers and their children; while the employment of young females will be regulated to prevent exploitation by their employers. Other matters which come under view or revision are the terms of native tenure of property and land, the prohibition of the sale of intoxicants to natives, and the delicate question of the curtailment of tribal custom and practices which "are calculated to cause bodily injury or to militate against the Department's work of amelioration". Finally, and in view of past history, perhaps most important of all, native courts are to be established for the trial of offences committed by one native against another. From the brief summary which so far has been transmitted by cable, it would appear that the Government is making a determined effort to remedy the graver defects of its system to which attention has been directed, and that in certain respects the practice of the State will be brought into line with that of the Federal Government in its relations with the aborigines of the Northern Territory.

Foundation Rites at Maiden Castle, Dorchester

Two important discoveries mark the approach of the closing week of excavation at Maiden Castle, Dorchester, where Dr. R. E. Mortimer Wheeler is at work on behalf of the Society of Antiquaries and the Dorset Natural History and Archæological Society. The adult burial (see NATURE, Sept. 5, p. 395) is now found to date from the Iron Age *c.* 300 B.C. and to be situated at the base of the rampart of the earlier enclosure at the point of contact with the rampart of the larger and later Maiden Castle. The character of the filling of the grave indicates that it is contemporary with the construction of the latter, and its position, as well as the fact that it is the only adult burial so far discovered within the enclosure, fully justify the view taken by Dr. Wheeler that it may possibly have been a ceremonial burial connected with foundation rites, such as are known to have been observed elsewhere, to mark the first great extension of Maiden Castle. The second discovery is that of a third structure on the summit of the hill adjoining the Roman temple and contemporary with it. It is built of dry stone walling, without mortar, and is circular or polyhedral in form. Its character is still under investigation. Further details connected with the east gate have now been made clear. The southern of the two openings, which was previously thought to be an addition, has now been shown, it is reported in *The Times* of September 26, to be an original feature of the earliest structure, as a causeway of unexcavated chalk runs across the line of the ditch in front of it. This causeway was much mutilated in late Roman times, when the entrance was blocked by a masonry wall built with a core of chalk quarried from the causeway. The line of quarrying, associated with Roman material, has been discovered, and the excavation here is now nearly completed.

Archæological Investigations in the Northern Transvaal

REMARKABLE results obtained since 1933 in the excavation of two sites in the Zoutpansberg District, Northern Transvaal, have evoked so many inquiries that Prof. C. van Riet Lowe, director of the Bureau of Archæology, University of South Africa, has been authorized by the Archæological Committee of the University of Pretoria, the body conducting the investigation, to prepare a preliminary report, which appears in *Antiquity* of September. The two sites, Mapungubwe, and the adjacent and earlier site, Bambandianalo, are situated on a farm near the junction of the Shashi and Limpopo rivers, about one hundred and sixty miles south-west of Zimbabwe, and just over fifty miles due west of Messina, where there are extensive remains of pre-European copper workings. The farm is now the property of the Union Government, having been purchased on the urgent representations of Prof. Leo Fouché. This public-spirited action has proved of inestimable benefit to the advancement of archæological studies in South Africa by making possible the scientific excavation of sites hitherto undisturbed. Notwithstanding the spectacular situation of the Mapungubwe fortress with its dry-stone walling on an inaccessible sandstone cliff, one hundred feet high, and the wealth of gold and other cultural objects found here, in the associated cemetery, and on the earlier site of Bambandianalo (see NATURE, **137**, 1024), these sites do not differ essentially from other sites in the region and in Rhodesia, including the Zimbabwe explored by Dr. D. Randall-MacIver and Miss Caton-Thompson; but these latter have suffered from the disturbance of treasure hunters and unauthorized excavation. Hence it has now been possible to establish with certainty a cultural sequence, from which it is inferred that the earlier of the two cultures found here, that of a copper-working pastoral people, may represent the earliest wave of the incursion into what is now South Africa of the Bantu-speaking peoples.

New Aeroplane Height Record

ON September 28, Squadron Leader F. R. D. Swain, a test pilot at the Royal Aircraft Establishment, Farnborough, set up a new height record for aeroplanes when he ascended to 49,967 ft. According to *The Times* of September 30, Squadron Leader Swain was flying a low wing monoplane of wing span 66 ft. and length 44 ft. with a super-charged Pegasus engine designed to give 370 h.p. at the start, 457 h.p. at 40,000 ft. and 380 h.p. at 50,000 ft. The pilot was enclosed in an air-tight two-piece suit of fabric covered on both sides with rubber and surmounted by a helmet with a transparent window. His air supply was fed into the right side of the helmet and passed out on the left to a canister in which water vapour and carbon dioxide were removed before the air returned to the circulation. The cockpit of the aeroplane was also enclosed, and warmed from the engine exhaust. It appears that Squadron Leader Swain found no particular difficulty in the ascent, but when coming down, the window of his helmet and the cover of the cockpit were badly obscured by frost. He also experienced unpleasant sensations of suffocation accompanied by weakness, and was obliged to use his emergency knife to rip open his helmet. He landed safely after a flight lasting nearly three and a half hours. The height reached was nearly thirteen hundred feet above that attained last month by M. Georges Détré at Villacoublay, France.

Crop-growing without Soil

ATTENTION has recently been given to production of green fodder for cattle and other farm stock without the intermediary of the soil. In Great Britain the method advocated is apparently of German origin, and it is claimed that the fodder is grown from seed in ten days. According to published accounts, a layer of seed (maize or other grain) is spread on a perforated metal tray, and the tray is placed in a cabinet, constructed to hold a series of trays. The seed is damped daily by water, containing a small percentage of nutrient salts, from a tank placed on the top of the cabinet, and, when an adequate temperature is maintained, the seed germinates and in 10 days a growth of shoots some 12 inches high is obtained. This growth of shoots, with the mass of rootlets, is then given to the stock. Several trials have shown that this fodder is readily eaten by stock, but carefully controlled experiments are necessary to demonstrate the full nutritive value and the costs of production of this fodder. At the University of California experiments have been carried out by Prof. W. F. Gericke on the growing of vegetables and flowers in tanks of water to which the necessary chemical fertilizers have been added. The seeds are sown in a layer of sawdust or moss supported by wire netting above the water; the roots grow downwards and remarkably rapid growth and a high yield has been demonstrated. Although still in the experimental stage, this process has attracted the attention of commercial vegetable and flower growers in California.

Huskless Oats

DURING the past two years considerable public interest has been aroused in a variety of huskless oats introduced by Mr. William Parker of Babingley Hall, near King's Lynn. In 1936, with the agreement of the introducer, the National Institute of Agricultural Botany carried out accurate yield trials of this variety in Cambridgeshire, Somerset, Shropshire, Hampshire, Norfolk and Yorkshire. The rate of seeding (45 lb. per acre) and the sowing times (end of March and beginning of April) were those recommended by the introducer. The variety with which the oat was compared was Victory, and at each centre both were sown on the same day. Victory, however, was sown at the normal seed rate for that variety—3–4 bushels per acre. On the basis of grain as threshed, Victory outyielded Parker's Huskless oat by 97 per cent, but to obtain a true comparison 28 per cent must be deducted from the grain weights of Victory, this being the normal husk percentage of that variety. On this basis, at only one centre—Cambridge—did Parker's Huskless oat outyield Victory, and then by the insignificant amount of 2 per cent. Averaging the results from all six centres, taking both on the above basis of naked grain, the grain yield of Victory was 41·2 per cent heavier than Parker's Huskless oat. No shattering at harvest took place in either variety.

Research and the Jute Industry

A PARAGRAPH under this heading appeared in NATURE of August 22 (p. 322), based on an article in *Science and Culture* discussing Dr. S. G. Barker's recommendations for research in the industry. Dr. Barker has written to point out that his report was on "Jute Research" as affecting jute *manufacture*, and should not be confused with the report of the Bengal Jute Enquiry Committee, which was concerned with *agricultural* aspects. His report was submitted to the Indian Jute Mills Association, which is at present considering it. Whether it will be submitted to the Government of India is a domestic matter for the jute manufacturers to decide. On the other hand, the suggestions of the Bengal Jute Enquiry Committee regarding jute agriculture have been accepted by the Government of India and a committee formed to implement them. So far as manufacturing research is concerned, this is still under sympathetic consideration by the Indian Jute Mills Association.

Social Life in a Rural Community

A STUDY of the activities, interests and problems of young married men and women, 15–29 years of age, in the rural sections of Tompkins County, has been published by the Cornell University Agriculture Experiment Station, as part of a study of youth problems. The data were acquired by direct personal interview with each of the 347 persons included in the study. One third of the persons interviewed were men and two thirds were women. Of the whole group, 30 per cent lived on farms, 40 per cent in villages and 30 per cent lived in the open country but not on farms. On an average, these young people had spent more than two years at a high school, and two in five of the men and one in four of the women had received some college training. Only 4 per cent of the men were unemployed, 11 per cent being employed part time; 86 per cent of the women were employed in housework and 5 per cent had part-time work.

THE commonest leisure activities of this group were reading, card playing, chess and other games and listening to radio. Outdoor activities ranked next, and were preferred by the men, followed by household activities and then hobbies and outdoor sports. 56 per cent of the men and 48 per cent of the women had two hours or less per day of leisure, but about one half had three hours or more. Only 5 per cent of them did no reading each day, but books were read much less regularly than magazines and newspapers. 65 per cent of the men engaged in farming were members of some organization, but three quarters of the others were members of no formal organization. Emphasis was placed upon the provision for social and recreational needs. 28 per cent of the men and 45 per cent of the women wished to travel, but the only other desire expressed by a significant number was to buy or build a home or to own a good farm. The men would welcome opportunity for further training in agriculture and farming, engineering and mechanics. The women emphasized the desirability of training in business subjects, nursing and home economics. Uppermost in the problems of these young persons is the lack of sociability through group relations, and the major need is that of integrating them into a satisfying social life through the development of a consciousness of common social needs and practical local organization to satisfy them.

River Survey

IN a small pamphlet of a dozen pages ("A Note of the Work of River Flow Records." River Flow Records. 6*d*.), Capt. W. N. McClean sets out a statement of the work performed by River Flow Records, the private organization of which he is the founder and director, during the period of its existence. The aim of River Flow Records, it is stated, is to obtain, in the area of a river system, records of water-levels of so comprehensive and accurate a character as to enable full information to be deduced therefrom respecting the flow and storage of water. Surveys on these lines have been carried out on the Rivers Garry, Moriston, Foyers, Oich and Ness in the Ness Basin; on the River Arkaig and Muccomer Cut in the Lochy Basin; on the River Spey and on the Aberdeenshire Dee, with results which have been detailed in a series of papers and publications. The pamphlet goes on to discuss several aspects of survey work, including water level stations, flow gauging, rainfall, temperature and wind, the compilation and presentation of records and the analysis and use of records. The author points out the influence of the work and experience gained by River Flow Records in the promotion and institution of an Inland Water Survey for Great Britain, which has been the outcome of a discussion in 1932 at the York meeting of the British Association. There are two appendixes dealing with mechanical details of river survey work.

Herpetologia

THE Chicago Academy of Sciences has sponsored the appearance of a new magazine with the above title, to be devoted to the study of reptiles and amphibians. Parts will appear quarterly, and it is hoped that the issue of such a specialized journal will help to bring together notes and short papers upon reptiles and amphibians which otherwise would be scattered and often unavailable in a multitude of other publications. The defect of such schemes is that they tend to make their particular study more remote from the naturalist who is interested in various groups of animals and endeavours to correlate the biological discoveries in them. From such a general point of view, the most interesting of the papers in the first part of the new magazine is that by L. M. Klauber describing and illustrating two varieties of a king snake, one with ringed markings, the other with longitudinal stripes. These have hitherto been regarded as distinct species, *Lampropeltis californiæ* and *L. getulus boylii*, but the hatching of broods which contained both forms shows that they are colour varieties of one form, which must be known as *L. getulus californiæ*.

Seismology in the United States

A REPORT of the Advisory Committee on Seismology appears in the Yearbook for 1935 (pp. 361–370) of the Carnegie Institution of Washington. One of the most interesting sections deals with the operations of the Coast and Geodetic Survey during the year ending June 30, 1935. Levelling of the first and second order was carried out over routes with a total length of more than one hundred thousand miles, and triangulation of the first and second order over a length of about 17,500 miles. In California, three arcs of triangulation, altogether 300 miles in length, have been carried out, and eight lines of closely-spaced bench-marks at right angles to well-known and active faults in the State. Five of these lines cross the San Andreas fault, the movements along which are responsible for many great Californian earthquakes. Each line extends about five miles on both sides of the faults, the bench marks within the first mile being only 100 ft. apart. A short time ago, a network of levels was established in order to study the subsidence of the land round San Jose (Cal.). The levelling was repeated in the autumn of 1934 and the spring of 1935. Though the work is not yet finished, it is advanced far enough to show that the subsidence noticed in the previous interval of levelling is still continuing.

Mining in South Australia

WE have received from the Department of Mines in South Australia the mining review for the half-year ended December 31, 1935 (No. 63). It is quite in the usual form; the main matter of interest is contained in the preface, signed by the Director of Mines on April 1, 1936, in which he states that during the year 1935, the mineral production from South Australian mines and quarries exceeded in value that recorded for any previous year; the total value is 45·4 per cent higher than that recorded for 1934, which was previously the largest total. "The increase in tonnage and in value is due largely to the extraordinary rise in the production of iron ore, which has been the predominant contributor to the total during recent years." This is scarcely surprising since the value of the iron ore raised in 1934 is 84 per cent of the total value of mineral production, the output showing an increase of 50 per cent; most other minerals showed increases, the output of gold being 6·7 per cent greater than that of 1934. These statements are fairly well borne out by the reports of the Chief Inspector of Mines and the reports of the Inspector of Mines and Quarries attached as usual to this volume.

Scientific Study of Suicide

A COMMITTEE for the study of suicide consisting of ten members including Dr. Henry E. Sigerist, professor of the history of medicine at Johns Hopkins University, and Dr. Edward Sapir, professor of anthropology at Yale University, has recently been incorporated to make a comprehensive study of suicide as a social and psychological phenomenon. The following general outline has been adopted by the Committee: (1) intramural studies of individuals inclined to suicide in selected hospitals for mental diseases; (2) extramural studies of ambulatory cases with suicidal trends or with obsessional wishes for their own death; (3) social studies of suicide; (4) ethnological studies, that is, comprehensive investigation of suicide among primitive races; (5) historical studies.

Ministry of Agriculture Leaflets

FOUR advisory leaflets have recently been rewritten for the Ministry of Agriculture and Fisheries. No. 267, which replaces the former Leaflet No. 296, deals with "Potato Growing in Allotments and Gardens". The section on autumn preparation of soil directs attention to the importance of taking precautions against wireworms and leather jackets. It is not now recommended that seed be saved from a previous crop grown in the same district, owing to the depredations of virus disease, and the account of manuring is also brought into line with modern research. Advisory Leaflets No. 180, on "The Cultivation of Raspberries", and No. 268, on "Plums and Damsons", are revised mainly in the sections dealing with soils, diseases and manuring. The fourth Leaflet, No. 113, portrays, briefly, but with businesslike adequacy, modern methods of chicken rearing. The descriptions of sanitary considerations reflect modern research findings upon avian disease, the merits of the various systems of hovers and battery brooders are discussed, and the very considerable advances recently made in our knowledge of the food requirements of poultry are very evident in the section on feeding.

World Power Conference

IN accordance with the constitution of the World Power Conference, which states that the country in which a plenary meeting is held shall appoint the president, Mr. William F. Durand, chairman of the Third World Power Conference, has been appointed to serve until the next plenary meeting. Sir Harold Hartley has been re-elected chairman of the International Executive Council to hold office until the next plenary meeting, and the following have been elected vice-chairmen, to hold office for three years: *First Vice-Chairman:* Mr. O. C. Merrill (U.S.A.), director of the Third World Power Conference; *Second Vice-Chairman:* Mr. G. J. T. Bakker, president of the Royal Netherlands Institute of Engineers; *Third Vice-Chairman:* Dr. M. Kamo, professor in the Faculty of Engineering, Tokyo Imperial University. The Second Chemical Engineering Congress will be held in Berlin in 1940, by invitation of the German National Committee.

Books on Zoology

SEVERAL catalogues of books and periodicals dealing with aspects of biological science have recently appeared. Bernard Quaritch's general catalogue (No. 521) lists all classes of zoological works, to the number of 965. The most complete section is that dealing with entomology, in which is included a selection of books from the library of the late Robert Adkin. Another of Quaritch's catalogues (No. 524) contains two sections of books on early medicine and surgery, and on early science, in all 83 volumes, most of them belonging to the sixteenth, seventeenth and early eighteenth centuries. Messrs. Wheldon and Wesley's catalogue of books on ornithology (N.S. No. 43) is a useful bibliography of birds, listing 1,289 items, the majority of which are arranged geographically.

The Night Sky in October

BETWEEN October 1 and 31, the days shorten by 1^h 48^m in the southernmost part of the British Isles and by 2^h 47^m in the northernmost part. British Summer Time ends on Oct. 4^d 2^h U.T. The moon is new on Oct. 15^d $10{\cdot}3^h$, and full (the Hunter's Moon) on Oct. 30^d $6{\cdot}0^h$. Of the lunar occultations visible from Greenwich, the following may be noted: υ Tauri (mag. 4.4) on Oct. 4^d 20^h $43{\cdot}7^m$ as a re-appearance: τ Tauri (mag. 4·3) on Oct. 5^d 3^h $2{\cdot}8^m$ as a disappearance and its subsequent re-appearance at 3^h 44^m: A Tauri (mag. 4·5) on Oct. 31^d 21^h $56{\cdot}9^m$ as a disappearance and at 22^h $55{\cdot}7^m$ as a reappearance of the star. The planets visible during October are as follows: Mercury as a morning star at greatest west elongation on October 16: Venus as an evening star in gibbous phase; Jupiter as an evening star. Saturn is visible throughout the night; its ring system appears nearly closed, the minor axis being about $2''$. The apparent paths of Uranus (stellar magnitude at opposition 6·0) and Neptune (mag. 7·7) are given in graphical form in the "Handbook" of the British Astronomical Association for 1936. On October 31, Uranus is in opposition, when its distance from the earth will be about 1,745 millions of miles. Mars is in conjunction with Neptune on October 25, when the former planet will be only

0·4° north of the latter. The light variations of Algol (R.A. $3^h\ 4^m$: Dec. 40° 43′ N.) may be observed at about the following times, which represent approximately the mid-epoch of diminished light: Oct. $1^d\ 19^h$, $16^d\ 3^h$, $19^d\ 0^h$, $21^d\ 21^h$ and $24^d\ 18^h$. A nova of the 8th magnitude at discovery on September 18 has been reported from Copenhagen, the discoverer being Mr. N. Tamm of Kvistaberg, Sweden. Its position in Aquila is R.A. $19^h\ 13^m\ 59{\cdot}5^s$: Dec. 1° 36′ 31″ N., not far from the 4th magnitude star, δ Aquilæ. The nova is fading, and on Sept. $23{\cdot}8^d$ was reported by Steavenson as being of magnitude 8·8. The comet discovered on September 20 by Mr. C. Jackson at the Union Observatory, Johannesburg, is in Aquarius, but it is very faint, and invisible except to large telescopes.

Announcements

It is announced in *The Times* that Convocation of the University of Cape Town has elected General Smuts as Chancellor of the University in succession to the King, who held that office while Prince of Wales but vacated it on his accession.

The Ramsay Memorial Fellowship Trustees have made the following awards of new fellowships for the year 1936–37: Dr. E. D. Hughes, a British fellowship of £300, tenable for two years, Mr. R. R. Gordon, a Glasgow fellowship of £300, tenable for two years, and Dr. D. Porret, a Swiss fellowship of £300, all at University College, London. The Trustees have renewed the following fellowships for a second year: Dr. N. Ando (Japanese fellow), University College, London; Mr. C. S. Lees (British fellow), University of Cambridge; Dr. D. MacGillavry (Netherland fellow), University of Cambridge.

At a recent meeting the Association of German Röntgenologists and Radiologists in Czechoslovakia decided to found a Jaksch Prize on the occasion of the eightieth birthday of its president, Prof. Rudolf Jaksch Wartenhorst, to be awarded annually to young röntgenologists who have distinguished themselves by good scientific work.

The fourth European Congress of Mental Hygiene will be held at the Conference Hall, Ministry of Health, on October 5–8, when the following subjects will be discussed: mental hygiene and the cinema; mental hygiene and the nurse; and mental hygiene and the child from eleven to eighteen years. A reception will be given by the Government at Lancaster House on October 5 or 6, and visits will be paid on October 7 and 8 to various psychiatric hospitals, clinics and colonies. The official languages of the Congress will be English, French and German. Further information can be obtained from the Secretary, National Council for Mental Hygiene, Chandos House, Palmer Street, London, S.W.1.

In view of the many requests that have been received from those who attended the conference on mechanization in agriculture held in Oxford last January, it has been decided to hold a second conference at Rhodes House, Oxford, on January 5–8, 1937. A detailed programme will be sent in due course on application to the Conference Secretary, Institute for Research in Agricultural Engineering, Parks Road, Oxford.

Owing to the present condition of affairs in Spain, the third International Congress of Malaria, which was to have been held at Madrid on October 12, has been postponed, but it is hoped that it will take place in the spring or summer of 1937.

The sixth Italian Congress of Microbiology will be held at Milan in April 1937. Further information can be obtained from the secretariat, Via Darwin 20, Milan, 124.

Messrs. Francis Edwards, Ltd., have issued a useful catalogue on Africana (No. 602), which contains a long classified list including several scarce volumes and also a number of autograph letters of David Livingstone referring to his African work.

Applications are invited for the following appointments, on or before the dates mentioned:

A civil engineer and a mechanical engineer in the War Department—Under-Secretary of State (C.5), War Office, S.W.1, quoting "O.P." (October 7).

A lecturer in metal mining in the University of Birmingham—The Secretary (October 9).

A lecturer in electrical engineering at the County Technical College, Worksop—The Principal (October 10).

A male assistant (Grade II) for radio work in a Government establishment in the south of England—Secretary, Royal Engineer and Signals Board, Regent's Park Barracks, Albany Street, London, N.W.1 (October 17).

Temporary assistants (Grade III) at the Royal Aircraft Establishment, South Farnborough, Hants, for ballistic calculations—Chief Superintendent, quoting "No. A.233" (October 12).

A professor in ship design and shipbuilding at the Royal Technical College, Copenhagen—The King, Ministry of Education, Copenhagen, K (October 22).

A regius professor of pathology in the University of Aberdeen—Private Secretary, Scottish Office, Whitehall, S.W.1 (October 31).

A skilled scientific instrument maker at University College, Exeter—The Registrar.

Temporary heating assistants in the drawing office of the Works and Buildings Directorate, Air Ministry—The Secretary (W.B. 9), Air Ministry, Adastral House, Kingsway, W.C.2, by postcard.

Temporary assistants in the drawing office, Civil Engineer-in-Chief's Department, Admiralty—Civil Engineer-in-Chief, Admiralty, S.W.1, marked "Temporary Eng. Assts."

Unestablished assistants in the drawing offices at the Admiralty and H.M. Dockyards—Civil Engineer-in-Chief, Admiralty, S.W.1, marked "Grade III".

An examiner in the Aeronautical Inspection Directorate (A.I.D.) Test House, Cardington, Beds. (metallic materials section, micrographic subsection)—Secretary (S.2.d.), Air Ministry, Adastral House, Kingsway, W.C.2.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 591.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Newton's Prism in the British Museum

A GLASS prism, said to have been the property of Isaac Newton, is on exhibition in the British Museum, Medieval Collections Room, Bay XVI. It was presented in 1927 by the Rev. H. T. Inman of Grantham, a collateral descendant of Newton, and resembles quite closely the prism seen in the hand of the statue of Newton in the ante-chapel of Trinity College, Cambridge. A question which naturally occurs to men of science who see this prism is whether it is one of those which Newton used in his famous experiments on the spectrum in 1666, described in his "Optical Lectures" of 1669, pp. 58 and 75, and reported also in *Phil. Trans.*, 6, 3075 (1671).

Since Newton gave fairly explicit data on the refracting angle and index of refraction of the principal prism which he used on this notable occasion, the question of the association of the British Museum prism with Newton's early experiments might lend itself to a ready answer. Newton states, in the course of the aforementioned references, that the prism which he principally used had as its greatest angle 63° 12′ and that its index of refraction for that portion of the spectrum "tending toward the middle of the green" was 17/11 (1·545).

This question had apparently not been explored until it was recently raised by me in a letter to NATURE. The letter was referred to the British Museum authorities, whereupon Mr. N. J. Plenderleith, head of the Research Department, caused measurements to be made upon the prism which had suggested the inquiry. The report, from which I am permitted to quote, contains the following statements :

"... the characteristics differ markedly from those given by Newton in his paper (*Phil. Trans.*, 1671, Vol. 6, p. 3077).

	Newton's Famous Prism	B.M. Prism
Prism Angle	63° 12′ (max.)	60° ± ½°
Refractive Index (middle of the green)	1·545	1·5933 (5461)

The specific gravity of the B.M. prism is 3·36. . . . The final conclusion is that the prism mentioned by Newton, although undoubtedly a flint glass, cannot possibly be identical with that now preserved by the British Museum."

The question still remains whether or not the British Museum prism is one of those which, though mentioned in Newton's writings, played a less prominent part in his early researches and for which his data are less explicit. It is, possibly, scarcely worth while to investigate this point.

LLOYD W. TAYLOR.

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Relationship between Post-Natal Coat Characters and Prenatal Follicle Density as Affected by Increase in Fœtal Size

A SERIES of New Zealand Romney fœtuses have been studied with the view of showing that there is a correlation between post-natal coat characters and pre-natal follicle density as affected by increase in fœtal size.

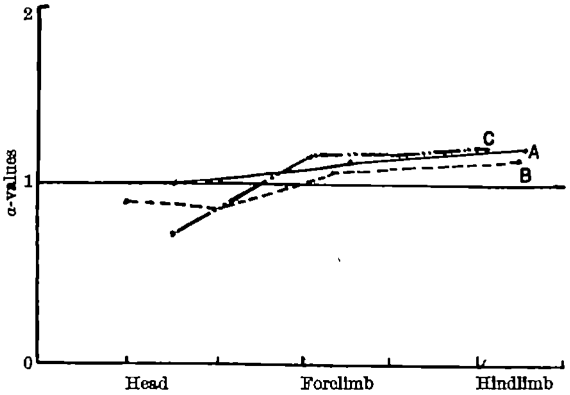

FIG. 1. Antero-posterior gradient in relative growth rate in length (*A*), width (*B*) and height (*C*) at 46–86 days.

It was found from the values of the equilibrium constant[1] α for the different body regions that there exists after the 42nd day stage an antero-posterior gradient in the fœtal relative growth rate for length, height and width. This gradient was slight up to the 80-days stage but was marked from 80 days until 127 days (Figs. 1 and 2).

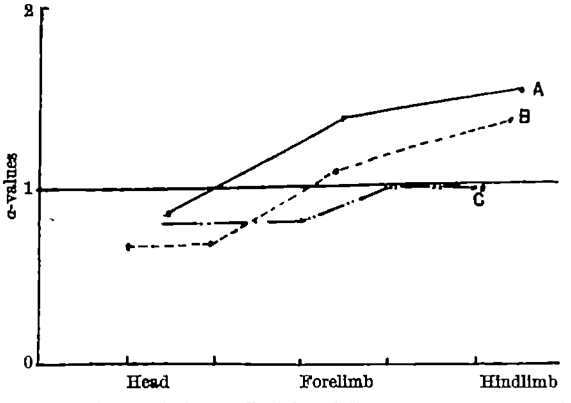

FIG. 2. Antero-posterior gradient in relative growth rate in length (*A*), width (*B*) and height (*C*) at 86–122 days.

This growth gradient was found to be comparable with the britch to poll fibre type array gradient[2] found in the fleece of the lamb. Coarse fibred arrays occurred on regions which grew much more rapidly after the 80th day, that is, after the completion of the trio stage of follicle development[3].

From 'α-with-time' calculations[4] (the curves for which did not vary markedly from the α-curves) it was possible to demonstrate that changes in follicle density regions were associated with changes in the growth rate of that region. Further, from the curves it was shown that on regions with a large number of pre-curly tip fibres—for example, poll and neck regions—follicle initiation commenced when the growth rate of that region was at a maximum.

Full details are contained in my D.Sc. thesis for the University of Edinburgh, and will be published in the form of papers.

NANCY GALPIN.

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Edinburgh.
Royal Veterinary College,
London, N.W.1.

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[1] J. S. Huxley and G. Teissier, NATURE, **137**, 780 (1936).
[2] Nancy Galpin, *Emp. J. Agric. Sci.*, **4**, No. 14 (1936).
[3] Nancy Galpin, *J. Agric. Sci.*, **25**, pt. 3 (1935).
[4] O. Richards, Carnegie Institution of Washington, Pub. No. 452.

Growth Hormones and Development of Plants

LATELY great attention has been paid to vernalization of various agricultural plants. Vernalization essentially consists in retarding the germination of seeds by means of insufficient soaking, low temperature, etc. When afterwards the seeds are subjected to normal conditions, further development of the plants proceeds at a greater rate, flowering and fruiting taking place earlier than in control plants.

The physiological nature of this phenomenon is not yet clear. Some experiments have led me to suggest that vernalization is accompanied by an increase of the concentration of growth hormone in the cells of the embryo[1].

This hypothesis suggested that it would be worth while to soak seeds in concentrated solutions of the growth hormone and examine the effect on the development of the plant. On the basis of previously published data[2] it was to be expected that in this case, at least in the Gramineæ, there would be an accumulation of the hormone in the tissues of the developing embryo.

The following sources of the growth hormone were used for the experiments: a solution of β-indolyl-acetic acid (1–2 mgm. per 10 c.c. water) and also the finely cut and moderately moistened endosperm of maize (without the embryos). The seeds of experimental plants were soaked in these substrates for 24–48 hours at 18°–20° C., and then they were planted out into the soil in flower-pots, and cultivated in a greenhouse. The seeds of the control plants were soaked for the same period of time in distilled water or in moist sawdust.

The most interesting data were obtained in the experiments with oats (Siegeshafer). The plants which developed from seeds 'hormonized' in the endosperm of maize at first lagged behind the control ones in their growth, but later on they were far ahead of them and bloomed twelve days earlier.

From the seeds of oats which were soaked in the β-indolyl-acetic acid, considerably stronger plants developed than from the control ones. Blooming took place simultaneously in both groups. The quantity of grain which was collected from the experimental plants (when calculated per plant) was greater than in the control ones by 55 per cent.

Thus we see that 'hormonization' of the seed before planting sometimes influences the further development of the plants and causes in some cases an acceleration of their development and a shortening of the vegetative period; in other cases a stimulation of growth, accompanied by an increased crop, is observed. It seems possible that treatment of seed by the concentrated solutions of various growth substances may find its application in agriculture.

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Aug. 10.

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[1] *C.R. Acad. Sci U.R.S.S.*, 1936 (in press).
[2] *Planta*, **23** (1935).

Divergent Physiological Effects of Synthetic and 'Natural' Ascorbic Acids

DEPENDING upon the concentration of the active substance, the effect of ascorbic acid upon the growth of seedlings may be either stimulatory or inhibitory. It has been noticed before[1,2] that, at a given concentration, the effects of the synthetic product and of the acid crystallized from a natural source were not identical. We have endeavoured to investigate the reason for the discrepancy.

Commercial synthetic ascorbic acid sold by British Drug Houses, Ltd., and the ascorbic acid isolated from paprika and kindly given by Prof. A. Szent-Györgyi, were compared. Pure-line Wilhelmina wheat, which we owe to the kindness of W. H. Parker of Cambridge, was germinated, after external sterilization, on filter paper in Petri dishes. 3–5 ml. of an aqueous solution of ascorbic acid was added daily to the Petri dishes, each containing 30 wheat seeds, aseptic precautions being used throughout. The experiment was concluded after 12–14 days, when the food reserves of the seeds were exhausted. The effects of substances intermediate in the synthesis were also tested. The accompanying table gives our results:

Substance	Concentration	Average length of one shoot (mm.)	Average weight of all shoots (gm.)
Ascorbic acid synthetic	5/1,000	49	0·70
Ascorbic acid natural	5/1,000	72	1·05
Ascorbic acid synthetic	1/1,000	66	1·08
Ascorbic acid natural	1/1,000	97	2·10
d-Glucose	5/1,000	104	1·84
d-Sorbite	5/1,000	80	1·48
l-Sorbose	5/1,000	68	1·25
Water (control)	—	90	1·95

The previously noticed inhibitory effect of natural ascorbic acid at a concentration of 5 in 1,000 has been confirmed. This inhibition is nevertheless much inferior to that produced by the synthetic product of the same concentration.

In previous experiments, natural ascorbic acid was found to exert optimal stimulation at a concentration of 1 in 10,000; from the above results, stimulation by the natural product can be discerned at 1 in 1,000, at which concentration the synthetic substance still shows an inhibitory effect. These remarks do not rest solely upon the measurements cited, but also upon the general behaviour of the seedlings.

As the divergencies of action seemed to point to the presence of some impurity in the synthetic ascorbic acid, we recrystallized it from petrol-ether and methanol. Although incomplete, the results obtained with the material recrystallized from methanol suggest that some impurity was indeed present.

LÁSZLÓ HAVAS.
IMRE GÁL.

Hungarian Biological Research Institute,
Tihany.

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[1] L. Havas, NATURE, 136, 435 (Sept. 14, 1935).

[2] L. Havas, NATURE, 136, 989 (Dec. 21, 1935).

Range of Action of Surface Forces

IN connexion with recent letters under the above heading[1], the following experiments may be of interest.

If two optically plane glass surfaces be worked into close contact, they seize with a force which varies inversely as the square of the distance between the plates[2]. Let rectangular plates be worked to about $1 \cdot 5 \times 10^{-5}$ cm. apart, as shown by the white of Newton's colours of thin plates. The tangential forces of seizure may then be about 100 gm. weight per sq. cm. If now a little water be applied round the edges, it creeps in between the plates, and they are forced apart by increase in the pressure of the trapped air. If the water be applied only at one of the straight edges, it creeps in at a varying rate: for horizontal plates the time t to travel a distance l is proportional to l^2. If, after all air has been forced out, the surplus water be removed from the edges with blotting paper until a narrow Newton-white border is seen all round, it will be found that the plates, with water between, seize with a force much greater than when air is between the plates. A tangential force as great as 1,700 gm. per sq. cm. has, in this way, been found to be borne apparently by a water layer $1 \cdot 5 \times 10^{-5}$ cm. thick.

This is, of course, no proof that the water layer was withstanding this great shear stress, since the glass surfaces were being held apart at the Newton-white distance by 'dirt' props, and since it is possible that the reduction in pressure within the water layer (due to surface tension at its edges) may distort the glass so that the surfaces are closer together in the water than the Newton-white distance observed at the border, and so give greater seizure in accordance with the approximate inverse square law.

It may be of further interest to point out that μ, the coefficient of viscosity of water, can be calculated approximately from its surface tension T, by timing the flow of water into the narrow gap. For a rectangular sheet of water, $\mu \doteqdot TDt/3l^2$, where D is the distance between the plates and t the time to flow in a length l. For a circular capillary tube, diameter d, $\mu \doteqdot Tdt/4l^2$. With a tube 0·036 cm. diameter, an experiment gave a good enough value for μ, namely, 0·010 C.G.S. at 16° C., but with plates about $2 \cdot 5 \times 10^{-5}$ cm. apart, μ came out at 0·11 C.G.S. Whether this high value has to be regarded as a genuine indication of increased viscosity in thin films or as an effect of 'dirt' props and of seizure forces it is hard to say. Sir Joseph Larmor[3] has recalled Kelvin's suggestion that there was experimental evidence of "a new type of intimate friction, entirely different from the smooth viscosity" of hydrodynamic theory.

JAMES M. MACAULAY.

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Aug. 25.

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[1] Derjaguin, NATURE, 138, 330 (Aug. 22, 1936). Bowden and Bastow, NATURE, 135, 828 (May 18, 1935)

[2] Macaulay, *J. Roy Tech. Coll., Glasgow*, 1935, p. 353.

[3] Sir Joseph Larmor, NATURE, 138, 74 (July 11, 1936).

Constancy of Wave-length of Light

THE recent correspondence in NATURE regarding the constancy of the velocity of light raises the auxiliary question as to the constancy of the wave-length of light. Experimentally, this is best approached by a study of the wave-length of a spectral line.

Mr. James L. Lawson and I continuously observed the 4358 A. line of mercury from June 24 until August 27, 1935, using a Fabry and Perot étalon. The wave-length of this line was found to be constant to within two parts in a million.

While this work was neither so accurate nor so comprehensive as that of R. J. Kennedy, it possessed the advantages of having the interfering beams of light travelling in identical paths and of having been taken at a time when the velocity of light should have been changing rapidly according to Edmundson's empirical law.

More complete information on these observations will soon appear in the *Astrophysical Journal*.

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University of Kansas.

Colloidal Silica in Natural Waters and the 'Silicomolybdate' Colour Test

IN the estimation of silica by the colorimetric method of Diénert and Wandenbulcke[1], the yellow colour produced by the addition of ammonium molybdate in acid solution has hitherto been attributed to the ions of a heteropolyacid. The fact, easy to establish, that silica sols do not, under these conditions, give an intensity of colour proportional to the silica present, has led to the belief that colloid micellæ of silica do not give the reaction, and that the colour intensity is proportional to the crystalloid silica. We believe this view to be incorrect.

We have made colorimetric determinations of the silica content of Nile and certain well-waters, and compared the results with gravimetric data, kindly supplied to us by Dr. W. T. H. Williamson of the Egyptian Ministry of Agriculture. In general, the former results were low. Better agreement was obtained, however, by warming the samples, before test, to 80° C. with a little silica-free caustic soda in a platinum vessel, the amount of acid added being correspondingly increased.

To see whether the colour intensity could be taken as an indication of the content of crystalloid silica, we tested the samples again after passage through Zsigmondy-Bachmann ultra-filters of different grades.

The reduction in the intensity of the colour afterwards produced was found to exceed by far the increase observed on peptizing with caustic soda, and amounted, with a 170-minute ultra-filter, to some 60 per cent. The liquid above the ultra-filter became correspondingly richer in silica as filtration proceeded, and since all sources of error—such as leakage, contamination, or the shifting of the equilibrium between ions and micellæ—would reduce the differences found, it follows that the silica in the waters examined was mainly colloidal. As silica, though a minor constituent of natural waters, is an important constituent of most deposits, this result is of some interest. In our experiments the water samples were filtered through ash-free paper before use, and waxed bottles were used for storage and transport.

Ultra-filtration experiments with the yellow 'silicomolybdate' solutions showed that the latter substance is in a higher state of aggregation than the parent silica, for passage through a relatively coarse 60-minute ultra-filter rendered them nearly colourless. This result raises doubt as to whether the coloured substance is a true heteropolyacid, like those formed by phosphoric and arsenic acids, and suggests that it may be an adsorption complex.

Experiments with a dilute dialysed Graham sol confirmed the above conclusions. The sol, containing 12 mgm. Si/litre, was passed through ultra-filters of different grades, and the molybdate test applied to the filtrates both with and without previous peptization with alkali. The results were as follows :

Ultrafilter	Apparent Si content by usual test (mgm./litre)	Apparent Si content after peptization (mgm./litre)
1 minute	1·8	12
11 minutes	1·1	7·5
63 minutes	<1·0	6·2
200 minutes	Difference indistinguishable and colour barely perceptible.	

It will be noted : (1) that the alkali treatment brought all the silica into reaction, (2) that the finest ultra-filters removed that portion of the silica which reacted without previous peptization, (3) that a 63-minute ultra-filter, though capable of rendering the yellow solution nearly colourless, yet allowed about half the silica to pass through.

With sodium metasilicate solutions, provided they were sufficiently dilute and the molybdate and acid added in sufficient quantity, the apparent silica contents as given by comparison of the colour with the buffered bichromate standards of Swank and Mellon[2] were found to be in fair agreement with the gravimetric determinations. But here also, owing to the addition of the acid necessary for the colour test, the silica which reacts with the molybdate appears to be mainly colloidal : for even with a slightly alkaline solution (pH 8·7, potentiometric determination) a 30 per cent reduction of silica content was effected by passage through a 250-minute ultra-filter.

From diffusion data Jander and Heukeshoven[3] conclude that silicic acid polymerizes rapidly when the pH falls below 10·9. Sea-water, though buffered at very much lower pH values, yet appears to exert a peptizing action, as the following experiment has shown : known volumes of a dilute Graham sol of known silica content were added to silica-poor sea-water, the quantities being such as to correspond to a silica-rich sea-water. Colorimetric tests were then made, both with and without the alkali treatment described. The former tests gave in each case the correct silica content ; the latter gave results ranging from 25 to 100 per cent of this, according to the age of the solution at the time the molybdate was added. We believe, in view of this result, that estimates of the total silica contents of sea-water by the method of Diénert and Wandenbulcke may be not widely in error, provided the silica has been held in solution for a sufficient period.

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D. H. BANGHAM.

Egyptian University,
Abbassia, Cairo.

[1] *C.R. Acad. Sci.*, **176**, 1487 (1923).
[2] *Ind. Eng. Chem., Anal. Ed.*, **6**, 384 (1934).
[3] *Z. anorg. Chem.*, **201**, 361 (1931).

Fermentation of Phosphogluconic Acid

IN their fundamental researches, Warburg and his co-workers[1] have described in detail the enzymatic oxidation of glucosemonophosphate to phosphogluconic acid. Furthermore, they found that the oxidation product is easily fermented by yeast macerate. Now, phosphogluconic acid might be a first product of carbohydrate oxidation occurring in a manner different from fermentative breakdown. Then the breakdown of phosphogluconic acid effected by yeast extract might represent a further step in the course of oxidation.

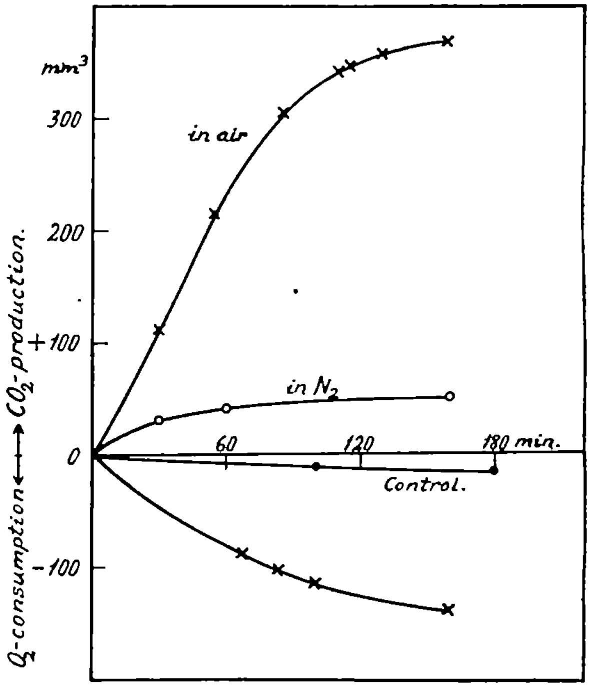

FIG. 1.

Studying this reaction, I found that, in the absence of oxygen, formation of carbon dioxide was very slow. The experiments of Warburg, Christian and Griese[1] mentioned above were done in air. According to my experiments carried out under similar conditions, the rapid formation of carbon dioxide in air was found to be accompanied by an absorption of oxygen ; per oxygen atom absorbed, 1·5–2 mol. of carbon dioxide appeared.

The experiment represented in Fig. 1 shows the ærobic and anærobic fermentation of 0·44 mgm. phosphogluconic acid–P, present in 0·5 c.c. of yeast macerate. The acid was prepared from Robison ester by bromoxidation, after Robison and King[2]. Part of the experiments was done with an almost pure preparation, which was most kindly supplied to me by Prof. R. Robison.

Bromoacetate, in a concentration which would entirely inhibit alcoholic fermentation (0·01 mol.), inactivates only partly. The oxygen consumption is almost unaffected, but carbon dioxide formation is reduced. In this case, per oxygen atom consumed nearly one mol. of carbon dioxide appeared. This might indicate that a primary oxidation and decarboxylation, unaffected by bromoacetate, is followed by a reaction, which may be of fermentative nature. This explanation seems to be corroborated by the experiments of Bernhauer and Görlich[3] on the oxidation of gluconic acid effected by bacteria. They found α-ketogluconic acid as one of the oxidation products. If now in yeast extract phosphogluconic acid is oxidized primarily to phospho-α-ketogluconic acid by one atom of oxygen, this compound, being an α-ketoacid, would easily split off carbon dioxide, giving rise to arabinosephosphate. The quotient $O : CO_2 = 1$, found in the presence of bromoacetate, would thus find its explanation.

Fluoride inhibits both oxygen absorption and carbon dioxide formation somewhat more strongly than bromoacetate.

During the oxidative fermentation of phosphogluconic acid, none or only a small amount of the phosphate is split off.

FRITZ LIPMANN.

Biological Institute of the Carlsberg Foundation,
Copenhagen.

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[1] Warburg, Christian und Griese, *Biochem. Z.*, **282**, 157 (1935).
[2] Robison and King, *Biochem. J.*, **25**, 323 (1931).
[3] Bernhauer und Gorlich, *Biochem. Z.*, **280**, 367 (1935)

A New Strigeid Parasite of the Rare Genus *Cyathocotyle*

IN the course of my studies on the avian trematodes of India, a preliminary report on which, dealing with Strigeidæ and Echinostomidæ, has already appeared[1], one complete and one incomplete specimen of a new trematode were found which could not be included in the report above referred to. As the form is very interesting, a brief account of it is furnished here.

Cyathocotyle calvusi n.sp.

Body bulb-shaped, anteriorly swollen, posteriorly narrower; total length 2·06 (all measurements in millimetres on mounted specimens), maximum breadth 1·02, breadth of narrower region 0·038. Oral sucker 0·15 × 0·19, ovoidal or circular, subterminal; pharynx 0·09 × 0·097, nearly globular; cæca simple to near posterior end, broadly arched in front; œsophagus and prepharynx absent. Holdfast organ 0·32–0·4 in diameter, centrally located in globular part, outline irregular, overlapped by vitelline follicles along outer margin; wall covered with very peculiar characteristic, hair-like, fibrous outgrowths. Testes very conspicuous, much elongated; anterior 0·56 × 0·18, alongside holdfast organ; posterior 0·65 × 0·18, in narrower part of body, separated from the hind end by about half its length. Ovary roundish, 0·28 in diameter, masked by vitelline follicles, antero-lateral to hind testis. Vitellaria grouped in large follicles of irregular shape, along intestinal cæca meeting in front. Cirrus sac 0·60 × 0·14, about one-third as long as body, posteriorly drawn out into a long neck; contains coiled seminal vesicle, surrounded by prostatic cells in anterior half, and a long tubular, eversible cirrus in its posterior half. Genital atrium short, with male and female ducts opening side by side into it; genital pore postero-terminal. Eggs about twice as long as thick, not many, 0·081–0·092 × 0·042–0·047. In intestine of King vulture, *Torgos calvus* (Scopoli), United Provinces.

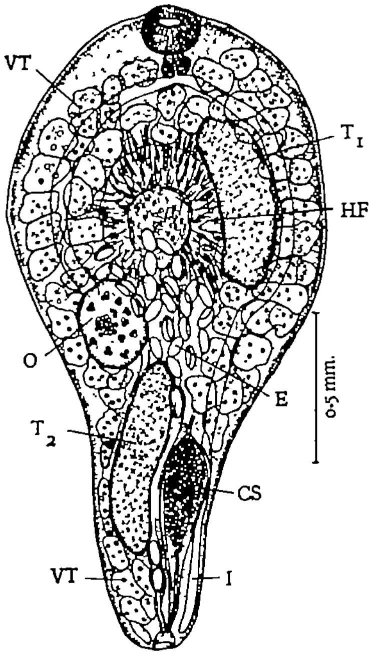

FIG. 1. *Cyathocotyle calvusi* n.sp. View of entire specimen.

Of the known species of the genus, the above worm is the largest, and stands somewhat close to *C. orientalis* Faust, 1921. But in addition to its larger size, it differs from it as well as from *C. prussica* Muehling, and *C. melanittæ* Yamaguti, in its body shape, in its much longer and differently placed testes, in the differing proportion of its cirrus to body length and in size and position of ovary and size of eggs. It would appear to be new to science.

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Aug. 8.

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[1] *Allahabad Univ. Stud.*, 12, 147–188 (1936)

Occurrence of Haploid Pollen Mother Cells in a *vulgare* Wheat

HAPLOID plants have been found in many species, but, so far as I am aware, there has been no recorded instance of haploid pollen mother cells occurring in a diploid plant. Bridges[1] has found patches of haploid tissue in *Drosophila*.

During an examination of smear preparations of the meiotic chromosomes in a seventh generation *H*44 × Reward wheat plant (*H*44 is a *vulgare* selection from the cross Yaroslav Emmer × Marquis), two 'haploid' pollen mother cells were found. One cell contained seven ring bivalents and seven univalents;

the other cell, one heteromorphic trivalent, one heteromorphic bivalent, one open bivalent, five ring bivalents and six univalents.

Apart from these two cells, each having a total of 21 chromosomes, all the other (320) cells on the slide appeared to have the normal number, 42, or thereabouts. The two cells (if none was lost) probably arose through pre-meiotic reduction. If such be the case, the pairing behaviour of the members of the genoms in the two cells is, to say the least, unexpected. Gaines and Aase[2] reported the occurrence of 0–3 bivalents in their *vulgare* wheat haploid, and Yamazaki[3] 0–4 bivalents and the occasional trivalent in his *vulgare* wheat haploid.

Dr. Lillian Hollingshead[4] mentioned the rare occurrence of aneuploid pollen mother cells in *vulgare* wheat hybrids, recording "clear instances of one bivalent and seven univalents, three bivalents and ten univalents, five bivalents and eight univalents, and eight bivalents and eight univalents". Such aneuploid cells could arise secondarily from pre-meiotic reduced cells such as are reported above.

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Aug. 25.

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[1] Bridges, *Science*, 72, 405 (1930).
[2] Gaines and Aase, *Amer. J. Bot.*, 13, 6, 373 (1926)
[3] Yamazaki, *Japan. J. Genet.*, 11, 314 (1935); Abst in *Der Zuchter*, 8, 161 (1936)
[4] Hollingshead, *Cytologia*, 3, 1, 119 (1932)

The $M_{IV,V}$-Absorption Edges of Protactinium (At. No. 91)

PROF. HAHN has put at our disposal a quantity of a protactinium preparation, which he has separated from Jàchymov pitchblende residues.

A spectrogram of the M_V-absorption edge of protactinium, showing clear secondary fine structure, is reproduced herewith. This structure has not been observed in the M-series hitherto. It has been obtained with the ionic tube for low tension[1] in connexion with the focusing method[2]. We have measured the M_V edge in the second order with reference to tungsten M-lines and obtained the values:

$$\lambda = 3601 \text{ X.U.} \quad \nu/R = 253{\cdot}1 \quad \sqrt{\nu/R} = 15{\cdot}91.$$

For the fine structure we find the following energy differences from the main edge:

(11) 16 35 51 76 volts.

In the position where the M_{IV} edge might be expected, we find an edge with similar fine structure to that of M_V, for which we have obtained:

$$\lambda = 3429 \text{ X.U.} \quad \nu/R = 265{\cdot}8 \quad \sqrt{\nu/R} = 16{\cdot}30.$$

The energy differences of the fine structure edges are:

5·4 17·5 23 36 volts.

By comparing the measured value $\nu/R = 265{\cdot}8$ with that interpolated for M_{IV} of the elements of atomic number 90 and 92, which is $\nu/R = 265{\cdot}1$, it appears, however, that there is a slight difference between them. This variance might have been caused by the fact that at the same position there appears also the K-absorption edge of potassium from the compound (K_2PaF_7). But we have not been able to find any trace of the edge precisely in the position of the interpolated value for M_{IV} and also we are unable, even after observing several spectrograms, to differentiate one from the other. So we are not in a position to decide whether this fine structure is of the M_{IV}-edge of protactinium or that of the K-edge of potassium.

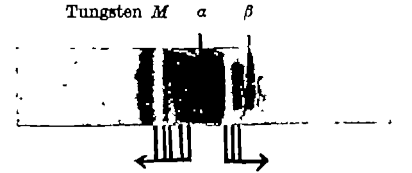
Tungsten M α β
Protactinium M_V obs.
Protactinium M_{IV} obs. + potassium K obs.

FIG 1.

If we now compare the measured values of the M_V-edge with those calculated from the values, $M_V = L_{III} - L\alpha_1$, we obtain the following results[3]:

At. No.	M_V edge (measured)	M_V edge (calculated)	Diff. (meas.—cal.)
92	261·0	261·3	−0·3
91	253·1	253 6	−0·5
90	244·8	245·0	−0·2

From these results it can be seen that, within the limits of observation, there is no difference between the measured and the calculated energy values.

It has been shown[4] that there exists a systematic difference, which is about ν/R meas. $-\ \nu/R$ cal. $= +3$, between the directly measured energy values of the M_V and M_{IV}-edges of the elements from atomic number 83 downwards and their corresponding values calculated from the L-edges. But as our results testify, such a difference does not exist in the case of the highest three elements. It can also be shown from the above results that the same fact is valid for the M_{IV}-edges of the highest three elements.

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Aug. 12.

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[1] V. Dolejšek, V. Kunzl, *Z. Phys.*, 74, 565 (1932).
[2] V. Kunzl, *C.R. Acad. Sci.*, 201, 656 (1935).
[3] V. Dolejšek und J. Marek, *Z. Phys.*, 97, 70 (1935); J. Bačkovský und V. Dolejšek, *Z Phys*, 99, 48 (1936).
[4] E Lindberg, *Nova acta reg. soc. Upsala*, 1931; M. Siegbahn, *Z. Phys.*, 67, 567 (1931).

Research and Teaching in Universities

I CANNOT pass unchallenged the remark quoted from Dr. R. Coulborn's article in the *Nineteenth Century* of July in NATURE of August 22 (p. 304), namely, "the numbing influence of research upon character". This is surely not only untrue but also dangerous. In my experience, the contact with a research problem has proved to be a fine training for a young man, as it provides just the stimulus needed to convert his mind from the text-book outlook upon life to the realities. If it be 'numbing' to teach him proper humility and the scope of his actual knowledge, then let us have more of such refrigeration. Of course, he is not so likely to deal comfortably in future with the vague and foggy generalities which so often pass for a wide humanistic outlook. Any professionalism is narrowing in the wrong hands.

Surely few things are better for redressing the dangers of specialization in research than teaching. It is true that some teachers are bad research workers, and some research workers bad exponents ; but it is my opinion that we do not want now a further separation of teaching and research ; rather we should encourage our leaders of the future to aim at the higher ideal of serving both with efficiency. It is the harder path ; but it could be made more possible if university and other authorities were reasonable in their teaching demands, and relieved their men of the really soul-destroying work, the endless board meetings and administrative checks.

By the above, I do not mean that encouragement should not be given to the development of the research institute under the right direction ; but I think that sufficient research funds should also be in the *independent* hands of universities in Great Britain. This would enable them to support adequately by efficient technical assistance and otherwise their own research enterprises, which so will form a nursery for new ideas and the kind of lively stimulus required by the rising generation.

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The 'Specific Action' of Ultra Short Wireless Waves

IN a recent issue of NATURE[1] there appeared a criticism by Prof. W. E. Curtis, Dr. F. Dickens and Mr. S. F. Evans of this topic. These authors mention experiments on tumour metabolism *in vitro* and state that the results claimed by Dr. Reiter[2] are due to heat, adequate precautions against this not having been taken by him. One of us had already come to the same conclusion and published[3] his results on the growth of rat tumours *in vivo*. Furthermore, in a subsequent paper[4] he had shown that there is no sudden change in dielectric constant of tumour tissue at 3·4 m. as might be expected if Dr. Reiter's observations were correct.

We had further shown and published[5] the fact that the frog heart, cilia and muscle, when exposed in a field of ultra high frequency, are affected only when the temperature rose to that level which is known to cause arrest of physiological action.

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[1] W. E. Curtis, F. Dickens and S. F. Evans, NATURE, 138, 63 (July 11, 1936).

[2] T. Reiter, *Deut. Med Woch.*, 59, 1497 (1933).

[3] H. J. Taylor, *Brit J. Radiol.*, 8, No. 95, 718.

[4] H J. Taylor, *Brit. J Radiol.*, 9, No. 103, 467.

[5] L. Hill and H. J. Taylor, *Lancet*, Feb. 8, 1936, p. 311.

Points from Foregoing Letters

MEASUREMENTS of the refractive index and the angle of a glass prism on exhibition in the British Museum, said to have been the property of Isaac Newton, show that, while it may have belonged to him, it is not the one to which he referred in connexion with his famous experiments on the spectrum.

The coat characters of New Zealand Romney sheep in relation to the density of hair follicles on different parts of the fœtus at various stages of growth are discussed by Dr. Nancy Galpin, who states that changes in follicle density in a given region are associated with changes in growth-rate.

Oats soaked in a solution of a growth promoting substance previous to planting produced stronger plants and 55 per cent more grain than untreated seeds, according to Prof. N. G. Cholodny.

From experiments on wheat seedlings it appears that natural ascorbic acid (vitamin C extracted from paprika) exerts an optimal stimulation of growth at a concentration of 1 : 10,000. László Havas and Imre Gál report that the beneficial effect is still observed at a concentration of 1 : 1,000, but when the concentration is increased to 1 : 200 there is an inhibitory effect. With synthetic ascorbic acid the inhibitory effect appears at a concentration of 1 : 1,000, and the authors believe that it is due to an impurity.

Experiments are reported by Dr. J. M. Macaulay which show that, if water is allowed to creep in from one edge of a rectangular glass plate which is held by seizure forces to another glass plate distant from it $1\cdot5\times10^{-5}$ cm., the shear strength of the interspace is increased from about 100 gm. to 1,700 gm. per sq. cm., provided there is no surplus water round the edges. By observing the time for the water to creep in between plates ($2\cdot5\times10^{-5}$ cm. apart), a value for the coefficient of viscosity of the water film is calculated and found to be about ten times the normal value for water.

In connexion with the problem of the constancy of the velocity of light, G. C. Omer, jun. and J. L. Lawson have kept under observation for four weeks the mercury line of wave-length 4358 A., and found it constant within two parts per million.

It has been stated that in the colorimetric determination of silica with ammonium molybdate in acid solution, only the molecularly disperse ('crystalloid') silica reacts. From experiments with silica sols which have been ultra-filtered, treated with alkali, etc., Dr. A. R. Tourky and Prof. D. H. Bangham conclude that the silica which reacts with the molybdate is mainly colloidal. The reaction, however, gives approximately correct results provided the silica has been held in solution for a sufficient period.

Graphs showing the rate of oxidation of phosphogluconic acid (in yeast macerate), in presence and in absence of oxygen, are given by F. Lipmann. In the absence of oxygen the formation of carbon dioxide is very slow. The behaviour in presence of bromoacetate suggests that a primary oxidation and decarboxylation is followed by a reaction which may be of a fermentative nature.

Dr. R. M. Love records the occurrence of two haploid pollen mother cells, amongst some 320 normal diploid cells, obtained from one flower of a seventh generation hybrid wheat, which suggests that reduction of chromosome number has occurred in the division preceding normal meiosis.

Research Items

Early Iron in Egypt

MR. CHRISTOPHER HAWKES contributes to *Antiquity* of September a note on the content of two pieces of iron, one from the Great Pyramid (Fourth Dynasty, *c.* 2900 B.C.) and one from Abydos (Sixth Dynasty, *c.* 2500 B.C.), constituting the two major items of evidence for the use of iron in Egypt before the New Kingdom, to which Mr. G. A. Wainwright referred in his article "The Coming of Iron" in *Antiquity* of March last (see NATURE, **137**, 584). It has been shown, Mr. Hawkes now points out, by tests made by Dr. H. J. Plenderleith in the British Museum laboratory in 1926 and repeated in 1932, that the Pyramid piece affords no trace of nickel, and that, although minute traces of nickel were present in two samples from the Abydos piece, these are in samples taken from the outer rust, and no nickel appears in the core. Since all meteoric iron known has been found to contain nickel, it is a reasonable inference that neither of these two pieces is of meteoric origin. Even if the date of the Pyramid specimen is doubtful, as some have maintained, though a later origin seems improbable, there can be no question about the piece from Abydos. Further, Mr. Hawkes, on submitting his material and his conclusions to Dr. C. H. Desch, was informed by him that not only was he satisfied with the result, and accepted the view that the nickel in the Abydos samples of rust was in all probability derived from the associated copper, but he also referred to further specimens of early iron "which is certainly not meteoric" lately received by him from sites in Syria and Mesopotamia. Mr. Hawkes is, therefore, of the opinion that these pieces may be taken as evidence for the occasional smelting of terrestrial iron in the Near East as early as the third millennium B.C.

The Food of Australian Birds

IN a series of articles (*Emu*, 24–35) the late A. M. Lea and J. T. Gray present a great mass of data on the food of Australian birds, based on analyses of stomach contents of 1,708 individuals covering 301 bird species. The results are classified into several main groups, such as: insects—destructive, and useful; seeds and vegetable matter; miscellaneous; and shells. Whenever possible, more detailed determinations of food items are given, while in an appendix all non-vegetable foods are classified in some detail, with lists of birds feeding on them. Although no discussion of the results is presented, the data provide ample material for judging the economic status of any given bird, as well as the relative liability of various animal groups to bird attack. In this connexion, a very high percentage of records of Rhynchota and Hymenoptera, both considered well 'protected', is worthy of notice.

Fauna of Sussex

INTERESTING records and comments upon the birds and butterflies of east Sussex, by N. F. Ticehurst, Capt. T. Dannreuther and others, appear in the *Hastings and East Sussex Naturalist* (5, 120, 157, Aug. 1936). Among the former the occurrence of Sykes's wagtail is discussed, and while it appears to be certain that birds with the characteristics of *Motacilla flava beema* have been seen on several occasions and have bred in the area, the suggestion that the colour variety may not be a true geographical race seems a likely one.

Pseudodiaptomus from South America

THREE species of this copepod genus are already known from South America. Mr. Stillman Wright adds a new one and describes the relationships, distribution and habitat of all four ("A Revision of the South American Species of *Pseudodiaptomus*", *Annaes da Academia Brasileira de Sciencias*, Rio de Janeiro, 8, No. 1; 1936). These calanoids are interesting, for the group seems to be in the process of migration from salt to fresh-water; it is widely distributed and some of the species are apparently restricted to small and nearly inaccessible areas; therefore little is known about them. The South American species are found in water of different salinities; thus, as Dahl has previously pointed out, *P. gracilis*, appeared only in the sample farthest from the sea, in practically fresh-water, and was associated with *P. richardi*. The latter species was the only one represented in slightly more saline water, whilst in waters still more saline *P. richardi* was replaced by *P. acutus*, and this in turn disappeared in sea-water. Apparently the new species, *P. marshi*, taken in the estuary of Rio Capibaribe at Recife, Pernambuco, in Bahia de São Marco at São Luiz, Maranbrao and in the estuary of Rio Jagurabe at Aracatz, Ceára, is adapted to somewhat more salty water than *P. richardi*. So far as is known, none of the South American species lives in the sea.

Mosquitoes of the Ethiopian Region

DURING the last twenty-five years or so, knowledge of mosquitoes has increased to a manifold degree—not only with respect to their relations to disease transmission but also as regards their structure and biology. This vast amount of new information is scattered through many periodicals and, in such a form, it obviously lacks co-ordination. The Trustees of the British Museum (Natural History) have, therefore, taken a step to meet this difficulty in deciding to publish a three volume monograph on the mosquitoes of the Ethiopian Region, that is, of African south of the Sahara. Part I of this work appeared in April 1936, and deals with the general ecology of mosquitoes together with the taxonomy of the larvæ belonging to the Culicine series. Its author, Mr. G. H. E. Hopkins, has spent some years in mosquito survey work in Uganda, which well qualifies him for this task. The present contribution, which runs to 250 pp., is profusely illustrated with excellent text-figures showing the chief diagnostic characters of the larvæ of the different species. The study of the morphology and classification of mosquito larvæ has progressed alongside that of the adults. The advantages of such investigations are obvious since they enable rapid determination of species to be made without the labour of rearing them to the perfect insect—a process not always successfully achieved. At the present day, therefore, knowledge of mosquitoes in the larval stage is as important as a proper acquaintance with the adults. Furthermore, an important aspect of mosquito control is eradication of the larvæ, which in its turn is founded upon a thorough knowledge of their specific habits and breeding places. In the present work these aspects of the work are dealt with as adequately as possible. It is stated in the preface that the other two sections of this work are nearing completion and will be issued next year.

Oil Treatment for Uneven Blossoming

THE influence of climatic factors during the winter months on the crop of fruit trees is examined by O. S. H. Reinecke (*J. Pom. and Hort. Sci.*, 14, 2, 164; 1936) with special reference to South African temperature conditions. Data are presented for prunes and pears which show that when the winter maxima temperatures were high, the crop was poor, and conversely, low winter maxima were associated with abundant yields. The critical temperature appears to be near 64·5° F. Certain varieties of peaches, plums, pears and apples subject to high winter temperature and a shortened dormancy period suffer from 'delayed foliation' and a protracted blossoming period which results in fruits of irregular size and also makes pest control very difficult. Successful attempts to induce even blossoming in these conditions by artificial means are described by M. W. Black (*ibid.*, 175). Apple and pear trees sprayed about four weeks before blossoming with raw linseed oil emulsion, seal oil or certain mineral oil emulsions, produced an earlier, more prolific and more even bloom, whilst fewer leaf buds remained dormant, resulting in the formation of more spurs and shoots. Varieties most susceptible to conditions favouring 'delayed foliation' responded most readily, and the response was more marked after abnormal winters conducive to this disorder. The crop of Bon Chrétien pears was considerably increased as a result of the more normal blossoming, fruit quality, especially the storage properties of the fruit, was enhanced, and the bearing capacity of the tree was increased, due to more fruit buds being differentiated on both spurs and shoots. The oil spray treatment promises to be of great value to commercial growers by virtue of its beneficial effects on fruit production and tree growth in general, whilst the insecticidal properties of some of the mineral oils may be utilized simultaneously.

Soviet Arctic Stations

IN recent years the number of Soviet Arctic observatories, as a rule functioning throughout the year, has been steadily increasing, and now they number no less than seventy-seven. In an article on hydrographic surveys along the northern shores of the Soviet Union in the *Polar Record* for July, Prof. J. Schokalsky gives some account of the institution of these stations. The movement began in 1923 with the erection of a station on Matochkin Shar, Novaya Zemlya. There are now 14 stations on the Barents Sea, 26 on the Kara Sea, 19 on the Laptev Sea, 7 on the Eastern Siberian Sea, 6 on the Chukhotsk Sea and 5 on the Bering Sea. Of the total, 5 are magnetic-meteorological observatories, 28 are first-order stations with registering instruments, 24 take eye-readings only and 11 record observations only three times a day. All stations take observations of ice movements and all have radio-telegraphy. At many of the stations high-altitude observations are regularly taken. The Soviet Union has instituted a special school to train observers for these stations. Each observer as a rule spends only one year in an arctic station.

Viscometry

THE demands made by industry in Germany for accurate standardization of technical viscometers has led the Reichsanstalt to construct an absolute viscometer for the determination of the viscosities at different temperatures of a series of mineral oils which change little with time; these can be used for the standardization of industrial viscometers. The apparatus has been described by Drs. S. Erk and A. Schmidt (*Phys. Z.*, July 15). The liquid is forced by air pressure in succession through two capillary tubes of the same diameter, one short and the other long, which connect three metal cylinders of 4–5 cm. diameter, from which vertical glass tubes ascend to serve as manometers. The pressures are read by cathetometer and their differences for the long and short tubes enable the end effects to be eliminated. The apparatus is immersed in a bath at constant temperature with the capillary tubes horizontal. It has been found that carefully selected tubes drawn in the ordinary way have smoother internal surfaces and are more suitable than tubes formed in the plastic state about a mandril. To facilitate change of capillary tubes their connexions to the metal tubes are made by pipe unions which screw against perforated steel spheres cemented to the capillaries close to their ends. The capillaries are calibrated by mercury threads. An accuracy of 0·2 per cent for the viscosity is attained.

A New Insulating Material

WE learn from the September 13 issue of *Helios*, the electrical trade journal published in Leipzig, that the scarcity of raw materials in Germany has stimulated research for home materials having like or similar qualities. This has sometimes led to the discovery of new materials which are not only better but also possess new and valuable qualities. For example, it has occurred quite recently in the case of insulating tubes, for which supplies of cotton and oil varnishes have to be obtained from foreign countries. A new material called 'isyntha' has been developed which constitutes an excellent material for insulating tubes and wires. Tubes made from this material are free from woven layers and seams and are almost perfectly homogeneous. It is fireproof and is not affected by acids or oils. When tested with a suitable oscillating crank gear testing machine it was only after five hours, when more than a million bends had been made, that a crack appeared. Heating to a temperature of 78° C. for a period of 30 days caused no change in the material. Similarly, it withstood immersion in various acids and in a solution of caustic soda without showing any external change or loss of weight. At a temperature of – 18° C. a tube, which had been roved round a cylindrical rod five times its diameter, showed no signs of breakage or splintering. There are many possibilities of usefulness for isyntha tubes in electrical and radio engineering. Wires covered with it are procurable. The material can be stripped off the wires very easily and is puncture-proof for very high voltages.

Cultural and Social Values of Science*

SIR RICHARD GREGORY, BT., F.R.S.

IT is difficult to define 'cultural value'; for there are many different standards by which it is measured. The term is often used to signify acquaintance with classical languages and literature, but a better view is that learning, whether classical or not, is comprised of many parts and that culture is the one indivisible whole made up of them. When science is taught, not as an aid to a vocation, but as part of the training of a modern citizen, it may justly be claimed to have a cultural value. The purpose of scientific study is to discover the truth about all things, including man, his instincts and impulses, his organization in society. The habit of mind developed by this disinterested pursuit may be as effective an ethical agency as that usually associated only with studies of what are called the humanities.

Cultural and social values are, however, rarely implied in the study of science, but with that of literature, history and other subjects believed to be of a more humane type. Even among scientific workers themselves, there are many who are content to regard experimental and observational inquiries as belonging particularly to the natural sciences, and are indifferent to the application of scientific methods to the investigation of social problems or the influence of scientific knowledge upon human thought. Recognition of interrelationships between all departments of learning is, however, becoming more common than it was a generation or so ago: and the forces which were formerly engaged in conflicts between science and religion or science and classics now profess joint interest in the cultivation of all fields of human enlightenment.

Science and literature, or what are called the humanities, are not now regarded by responsible authorities as opposing elements in education. The two terms should be considered as synonymous; for science rightly conceived is modern humanism in the fullest sense. Even if the humanities are understood to mean letters, history and art, there should be no conflict between these studies and natural knowledge.

But though scientific workers know well enough how science touches art and music, how it may enter into literature and how it makes history, there is not like appreciation of science from representatives of those schools of thought and teaching. It cannot be said that the intellectual horizon of men of letters of our own times has been extended by advances in modern science. There is not much evidence in the works of leaders of literature of assimilation of the new knowledge, or even of sympathy with it. Occasionally one finds a reasonable attitude towards the age of science and invention in which we live, but more usually there is an absence of an outlook which will regard science not merely as a storehouse of facts to be used for material purposes, but as one of the great human endowments to be ranked with art and religion and the guide and expression of man's fearless quest for truth.

The influence of science upon material progress and human comfort is understood much more commonly than that of its effect upon the human mind. It is difficult for people of these times to realize the liberation of life and intellect brought about by the works of Copernicus, Galileo, Vesalius and other pioneers of scientific learning. The very foundations of belief were shaken when it was shown that the abode of man was not the centre of the universe but only a minor member of a group of planets revolving around a sun which was itself only one of many thousands of suns in stellar space. When Newton had shown that his law of gravitation was sufficient to account not only for the movements of the planets but also for the paths of the comets, it was no longer reasonable to believe that they were sent as signs or warnings to the human race. Consider the tremendous revolution involved in this substitution of permanent natural law for the conception of a world in which all events were believed to be reflections of the moods of a benign or angry God.

The sense of justice which resulted from the knowledge of the existence and permanence of law in Nature profoundly influenced human thought, and resulted in social changes which had the greatest civilizing effects.

Just as Copernicus deposed the earth from the position it was supposed to occupy in the universe, so Darwin placed man in a new relationship to the rest of living creatures. Science is concerned with the progress of knowledge and the evolution of man not only in the past but also in the present and future. We need not believe that man has degenerated from a state of perfect knowledge to that of being "born in sin and shapen in iniquity", or that the recovery of his lost position must be looked for not in this world but in the next. The adoption of this depressing doctrine is opposed to evolution as a whole and subservient to all progress. Unlike the creatures of the field, man can make his own environment and so promote the development of any type he desires to survive. The social heritage to which he succeeds has an important influence upon his thoughts and conduct, but he himself can exalt or degrade it.

The advance of science in modern times has had supreme social value in the alleviation of human suffering and increase in the capacities and facilities for human happiness. As whatever subjects are defined as cultural or humanistic must be understood as being concerned with the welfare of man, the conquest of disease as the result of scientific research may rightly claim a high place among them.

Progress in physics and chemistry has profoundly altered those social conditions which it is the purpose of social science to study. The immense increase in the productive capacity of mankind is forcing society to consider the human consequences of the unlimited resources now at its disposal.

Scientific methods applied to the fields of politics, human biology, sociology, economics and psychology will enable facts to be ascertained and assembled for consideration by minds free from passion and prejudice, but knowledge of history and insight into human nature will be required to arrive at sound conclusions and construct practicable policies upon them.

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* From contributions, made in the order here printed, to a discussion in Section L (Educational Science) of the British Association at Blackpool on September 10.

In recent years, leading representatives of science have warned the world of the disastrous consequences which must ensue unless the gap is lessened between scientific advance and moral or ethical development in both national and international spheres. Unless science repudiates the methods of cultivated barbarism involved in modern warfare, it must lose whatever right it now possesses to be a spiritual influence and acknowledge with despair that man's ethical evolution has already reached its culminating point. Such an end cannot, however, be contemplated, and it will be avoided by conserving social and spiritual values with scientific teaching and research. With this unity of intention it will be possible to hope for and expect scientific guidance of human growth not only towards individual fitness but also towards a higher human perfection.

PROF. LANCELOT HOGBEN, F.R.S.

We all know what is meant by the vocational aspect of education, and we wrongly assume that there is equally general agreement about the meaning of its cultural side. In theory, the word cultural commonly covers two entirely different functions of an educational system. One is the private problem of helping the individual to discover for himself or herself congenial sources of enjoyment to occupy leisure in after life with the fullest allowance for variety of temperament. The other is the public business of equipping individuals with the knowledge necessary for the discharge of their mutual responsibilities as co-citizens of a democratic society without regard to the personal inclinations of the child. In practice, what is called cultural education is neither the one nor the other. Good taste, which is synonymous with ostentatious refinement appropriate to a leisured class, takes precedence over the cultivation of individual satisfaction of temperamental needs, while political rationalizations of a bygone age exclude the study of resources for welfare which a modern community can use or abuse.

Increasing specialization and expanding outlets of vocational choice for individuals with a native inclination or aptitude for scientific studies must progressively limit the appeal of science as an active hobby. Meanwhile the demand of popular educational movements like the W.E.A. is for information about the social problems of our time. That science should be taught, because it teaches children to be observant and curious, is a dubious proposition. The case for science as an essential part of the education of the average man or woman does not rest on gratuitous assumptions about the transfer values of particular disciplines, or on the individual satisfaction which a small class of individuals may derive from verbal disquisitions on the latest, least digested discoveries at the periphery of theoretical research. The cultural claims of science rest on the social fact that the use and misuse of science intimately affects the everyday life of every citizen in a modern community.

While it is happily true that educationists are ahead of the scientific specialist in so far as the cultural teaching of science demands emphasis on its place in everyday life, the claims of science in the education of the citizen extend far beyond a passing familiarity with the way in which society at present uses the knowledge available for the advancement of human well-being. What is far more important is a recognition of the potential of human welfare inherent in scientific knowledge, which existing social machinery fails to exploit for the common weal. Even this neglected aspect of the problem which confronts us in designing a general course of science to take its place in the curriculum of humanistic studies does not exhaust all the issues which should claim pre-eminence. Others emerge more clearly, if we consider the dangers with which the preservation of democracy is now faced. One is failure to anticipate the dire penalties we may pay for the misuse of science. Complacent acceptance of its prostitution to destructive ends, and ignorance of the constructive alternatives which existing knowledge places at our disposal, will have disastrous consequences for all of us, if the helplessness and horror of modern war is canalized in a revolt against science, a repudiation of the benefits which science can confer and a retreat to a lower level of civilized living.

In contradistinction to purely static emphasis on the place of science in everyday life to-day, education for citizenship demands a knowledge of how science is misused, how we fail to make the fullest use of science for our social well-being, and, in short, a vision of what human life could be, if we planned all our resources intelligently. It calls for understanding of the way in which social agencies foster new discoveries and their useful application. In addition, it must reinforce confidence in rational endeavour by emphasizing the role of advancing scientific knowledge in the growth of social institutions.

A course of general science adapted to the requirements of citizenship should be orientated towards the elucidation of the major constructive achievements of natural knowledge in the evolution of civilization. Among the cardinal themes which thus replace the arbitrary division of science into separate 'ologies', those which claim special attention are the construction of the calendar, the technique of navigation and map making, the extension of deep-shaft mining and exhaustion of fuel supplies, the introduction of inanimate and mobile power, the discovery of chemical fertilizers and the principles of scientific breeding, the control of epidemic diseases and the national dietetic minimum. School science should not be a selection from the competing claims of specialist disciplines. It should be the story of man's conquest of time reckoning and space measurement, of the search for materials and substitutes, the liberation of natural sources of power and the struggle against hunger and disease. When it becomes this, the theoretical principles which have the greatest yield will emerge far more clearly, and there will be less reason for disagreeing about the relative importance of different aspects of scientific knowledge.

The indifference of men of science and educationists in the universities has relinquished one unique opportunity for implementing the cultural claims of science. It was offered shortly after the late European war, when the Civil Service Commission made a paper on *Everyday Science* compulsory for all candidates at examinations for higher grades. Provision of special instruction for such candidates, mainly drawn from the ranks of graduates who specialize in linguistic and historical disciplines, might have become a nucleus for the training of teachers for general science as a cultural subject. The examination proved to be a farce, presumably because no such provision was made until last year, when the Commissioners took the retrograde, if comprehensible, course of omitting *Everyday Science* from the list of compulsory papers. The only official recognition of the need for scientific knowledge in the administration of the nation's affairs was thus withdrawn. Such decisions are not necessarily irrevocable, and it is still possible to bring the pressure of public opinion to bear on the Civil Service Commission. If it can be persuaded to reconsider the matter, the British Association would perform a useful service by appointing a joint committee of educationists and men of science to draw up a syllabus of instruction, and urge the universities to provide it.

Whether science will take its needful place in the instruction of the citizen and statesman depends far less on the attitude of the scientific specialist than on that of the educationist. The scientific specialist is too much immersed in his work and too much imbued with an attitude of social indifference generated by a long period of comparative prosperity and security to take an active part in the educational reformation which the present crisis in democratic societies calls for. The problems of the post-War world demand nothing short of a transvaluation of all educational values. Over-specialization is one of the great obstacles to their solution. If the educationist is to make a constructive contribution to the social problems of the present time, he will have to forfeit the luxury of false modesty in his dealings with the claims of specialists.

SIR A. D. HALL, K.C.B., F.R.S.

The true aim of science is the enrichment of life. Through science man obtains an increasing control over the operations of Nature and the blind forces which limit his activities.

It is commonplace to enumerate the gifts of science to humanity during the last century, such as the speeding-up and extension of communications by steamboat, railway, motor-car and aeroplane. Science gives us new sources of light and heat in our households, unwonted textiles for our clothing, healthier and more attractive food. Science is minimizing the curse of Adam—manual toil. At one time a man required a week to dig an acre; the horse plough enabled him to do it in little more than a day, the modern tractor will make light of it in an hour.

Such gains may be dismissed as material only, but science has equally contributed to our spiritual enrichment. Consider only the enlargement of our knowledge of the world and of the appreciation of history that easy travel has brought, or the contacts with art that photography has made possible. The gramophone has brought the whole range of music within the reach of the ordinary man. Wireless is contributing to the mark of the educated man—that awareness of what is moving in the minds of men.

Yet only a few years ago in a sermon to the British Association, Bishop Burroughs appealed for a ten years' vacation for science. Science is beginning to take on the aspect of an enemy, frustrating the enjoyment of all the advantages it can offer. Science is regarded as dangerous because at the same time as it is conferring the powers of production, people at large are learning of these powers and beginning to ask why they cannot enjoy their fruits.

Science means power, but it has given no consideration to whom that power should be entrusted and to what ends it should be used. The acceleration of productive power has led to over-production and unemployment; the sudden development of a new invention may throw another town into long-continued distress and poverty. The new developments of war methods by science are putting appalling powers of destruction into the hands of Governments.

The greatest of all dangers lies in the temptation that is now offered to the power-mongers. Once having obtained control of the machinery they can wipe out any further exercise of the popular will. Of old, every autocracy ended in revolution; What chance has a rising to-day against guns and gas? Moreover, a subtler technique has been evolved, not merely to control the people by force but also to subdue their minds until they will to be slaves. We are learning how the robot can be created by a Government controlling the Press and all publications, closing the frontiers to all communications, using the wireless and education as instruments of propaganda. The old reformers fought for universal education; Did they ever consider how it would be used to consolidate a tyranny? It is reported that the Germans are moving towards uniformity by the sterilization of the dissidents. The end is the ant community of soldiers and obedient workers.

Putting aside the fundamental question of whether the fruits of science can be enjoyed by the whole community or only by the few, how far can the knowledge of science be shared? It is a common reproach that people are using science without understanding—they press a button or turn a switch. This is no valid reproach; science is for the specialists, but general science should be the basis of education for all, and in this lies the only hope for the future. The specific value of education on a basis of science is that it will encourage if not create a habit of acting on reason rather than emotion. One may recognize that emotion is the spring of action and yet realize that reason can exercise some control.

Party, Country, Religion—these are the kind of emotional issues which constitute the false money wherewith the politicians buy power. They are all forms of the easiest of self-delusions—that of belonging to a chosen race. Step by step the habit of illusion is built up—the old school tie, the club, the regiment, the social class, the nation. In themselves these loyalties are excellent, their dangerous side is that they breed hatreds of the "lesser breeds without the law". The function of an education based on science is to destroy this illusion and to teach people from their earliest formative years that men and women, however diverse as individuals, yet are, collectively and statistically, very much alike. I maintain that this can be effected by a scientific education rather than a purely literary education. The latter is concerned with the past, it pictures the world as governed by the play of emotions, its effect is generally to induce a desire to reproduce the old world and to discourage any confidence in the accelerated tempo science has brought about.

But even education is not enough; men of science will have to organize to make their point of view prevail. This is alien to the temperaments of the leaders in the world of science. They want to remain in their laboratories and secrete knowledge without bothering about its purpose. To do so is to accept slavery.

Association of Special Libraries and Information Bureaux

ANNUAL CONFERENCE AT OXFORD

THE thirteenth Annual Conference of the Association of Special Libraries and Information Bureaux was held at Balliol College, Oxford, on September 18–21. In an address on September 18, Dr. Cyril Norwood, who has succeeded Sir Richard Gregory as president of the Association, dealing with the question of school libraries, asserted that no one can be regarded as educated who has not learnt how to use a library, and directed attention to the difference between text-book knowledge and that which comes from first-hand reading. No man is well educated until he has read real classics and mastered them, has learnt how to consult authorities and collate and use the results.

This point of view formed the keynote of a discussion on the following morning, which was opened by a symposium of papers on "Library Instruction for University and Research Students in America", presented by Miss Granville Meixell, librarian of the Applied Science Library, Columbia University. The first of these papers was by Dr. Peyton Hurt of the University of California, on "Teaching the Use of Libraries", and emphasized the necessity of giving students at least one course in library methods and general bibliography to provide them with a unified outline of the materials and methods involved in using a library for information on a wide variety of miscellaneous substances on which information might be needed during their lives. Dr. Hurt gave a brief account of the course which has been developed at the University of California, and in a subsequent paper Miss E. M. Witmer, Miss E. M. Feagley and Prof. C. Alexander described the consultation services for teachers and for others which have been organized at Teachers College, Columbia University. A special service for doctoral candidates, for example, includes systematic instruction on the location of educational information and data, methods of educational research, and bibliographic research for special areas in education. A further paper by Mr. Louis Shares, of the George Peabody College for Teachers, outlined a programme of library instruction for teachers which provides instruction in the use of libraries and is supplemented by a course of more detailed training for those becoming full-time school librarians, college librarians, etc. The final paper in the symposium, by Mr. Donald Gilchrist, described the instruction in the use of books which is given at St Stephen's College, Columbia.

The symposium stimulated a vigorous discussion which indicated a fairly strong general opinion that systematic instruction in the use of libraries is badly needed in most of the universities of Great Britain, and that many of the municipal and other libraries take very seriously the task of educating the user in the consultation of books and other sources of information.

At a subsequent session, Mr. J. J. Eaton presented a paper on behalf of Mr. W. H. Johnston of the *Yorkshire Post*, describing the methods by which information is collected for the commercial pages of a great daily newspaper. Colonel L. Newcombe, of the National Central Library, described the compilation of a Union Catalogue by the London Public Libraries Union Catalogue Committee. Although expensive to compile, its value in enabling the staff of the National Central Library and the Regional Bureaux to locate books has fully justified the expense, and without it efficient and economical co-operation is impossible. None of the alternatives provides a satisfactory substitute and most of them are also expensive.

The paper presented by Prof. A. M. Carr-Saunders on the "Need for Centralization of Information on Economic and Social Surveys" provoked a lively discussion. Prof. Carr-Saunders dealt mainly with the local social survey, particularly of the type represented by Booth's "Life and Labour of London", repeated by the work of Rowntree and Bowley and the surveys on the Tyneside, Merseyside and elsewhere. Discussing the conditions under which social surveys might be of value to-day, he urged the need for some central authority to guide and co-ordinate local surveys. Research is not everywhere equally worth while, and the areas where surveys are particularly wanted are those with very definite special problems and those typical of a certain kind of area which has not already been surveyed. In the absence of central guidance, there is no certainty that surveys will be initiated where they are most wanted, as the resources are more likely to be found where social problems are least pressing and surveys least necessary.

In addition, Prof. Carr-Saunders is of opinion that central guidance is required to indicate the main objectives which it is now worth while to pursue and also to accumulate and disseminate information as to the best methods to pursue. As an example of objectives for future surveys, he suggested that it would be of value to re-survey some of the places already examined, so as to obtain an adequate measure of changes in poverty. The functioning of the social services also merits attention, and an investigation of local government and the administration of the social services and of their impact upon the population should yield very valuable results. This suggestion is an example of what Sir Josiah Stamp urged in his presidential address to the British Association, and like Sir Josiah, Prof. Carr-Saunders also urged a more equitable distribution of resources between research in the social sciences and the natural sciences. The former is essentially as costly as the latter.

Good discussions characterized most of the remaining sessions of the Conference. Dr. J. E. Holmstrom's account of a system of card indexing of abstracts and research data developed for a small special field to provide instantaneous reference led to some debate on the value of the Universal Decimal Classification. Mr. B. M. Headicar's criticism of the price of Government publications in his rather disjointed paper on the collection, classification and utilization of these works drew a prompt reply from Lieut.-Col. N. C. Scorgie, Deputy-Controller of H.M. Stationery Office, who presided over the session and pointed out that at the present time the price of Government publications is in fact being steadily reduced.

At the final session of the Conference, a paper and demonstration on "The Film in Industry: the Development of the Documentary Film and its Growing Use in Research and Advertising" was given by Mr. John Grierson, of the G.P.O. Film Unit.

The report presented to the annual conference of the Association referred to the publication of the *ASLIB Book List* of quarterly recommendations of scientific and technical books, which has proved a successful development. The work of the inquiry bureau has increased and has been facilitated by the removal to larger premises. The working of the panel of expert translators is being reviewed by a sub-committee with a view to reorganization. The accounts for the year ended June 30 show a small excess of income over expenditure, and the number of members is 305. The report once more refers to the way in which activities are being hampered by lack of financial resources.

Educational Topics and Events

THE Physical Society announces that the eighth annual Craftsmanship and Draughtsmanship Competition will be held as usual in conjunction with its annual exhibition of scientific instruments and apparatus in January next. Competitors must be in the regular employ of a firm or institution which will be exhibiting or has exhibited at least once during the past three years, and which has been invited by the organizing committee to enter its employees for the competition.

THE London County Council's prospectus of lectures and classes for teachers, 1936–37, "designed to bring London teachers into touch with the latest developments in educational methods, to give them opportunities of hearing leading authorities in various branches of learning and on current questions of importance", offers a very wide range of choice to those prepared to give some evenings to the pursuit of these admirable aims and (for the scheme is self-supporting) to pay the moderate fees charged. Last year the entries exceeded 15,000. Among the outstanding attractions are: courses on physical and mental development of children by Prof. H. A. Harris, professor of anatomy in the University of Cambridge; on the development of the child's personality by Prof. Charlotte Bühler of the University of Vienna, director of the Parents' Association Institute; on the psychology of adolescence by Prof. Cyril Burt; on "everyday physics" (the atmosphere, lighting of streets, preservation of food, photoelectric cells, acoustics, modern buildings, etc.) by C. R. Darling; on the Decroly system by Mdlle. Amélie Hamaide of the Ecole Nouvelle, Ixelles, Belgium; on "electricity in the home" by Mr. J. Paley Yorke; recitals by Miss Jean Sterling Mackinlay to demonstrate how to give songs a dramatic and pictorial value; and single lectures by Mr. Frank Dobson on sculpture, Prof. Walter Gropius on modern architecture, Rosita Forbes on "Through Afghanistan to Russian Samarcand", Prof. P. M. S. Blackett on cosmic rays, Dr. F. A. Freeth of Imperial Chemical Industries, Ltd., on modern developments in chemical industry, Prof. J. B. S. Haldane on heredity, and Sir Frank Smith on wireless waves.

Science News a Century Ago

The Entomological Society

AMONG the matters considered by the Entomological Society at a meeting on October 3, 1836, were a notice from H.R.H. the Duke of Sussex, relative to the injury sustained by the pear-tree, arising from the attack of a small subcutaneous larva, evidently one of the Tincidæ; a memoir by W. Sells on the black caterpillar of the *Athalia centifolia*, one of the saw-flies, which during the past season had caused great devastation upon turnips, and a letter from W. Spence containing additional observations upon the natural history and mode of attack adopted by the *Scolytus destructor* upon the elm trees of France; and proving the necessity of an acquaintance with the precise habits of the insect previous to any wholesale felling of the trees, which, although apparently greatly injured, might not contain a single larva; these observations were supported by various facts which have been noticed by Spence and M. Audouin, professor of entomology at the Jardin des Plantes.—(*Athenæum*.)

Buckland's "Bridgewater Treatise" on Geology

IN a letter written on October 4, 1836, to his father, Lyell said they had just called on the Fittons in Portland Place and had had much talk about the presidency of the Geological Society. Fitton, said Lyell, "told us what Gardner the mapseller has since confirmed that Buckland's edition of 5,000 of the 'Bridgewater' is all sold, and 5,000 more printing, each of which editions, Fitton says, will produce the professor £2,000—a piece of news I am truly glad to hear, for what I have read of the book, I think it will do much good in spreading correct notions of the science, and probably popularise it much. Murchison calls it 'Bridge-over-the-water'; and really that part which is to carry us over the abyss of cosmogony is better constructed than I expected, though I should have been sorry to have had to trust myself upon it. Fitton thinks the moral of it to be, that words may mean anything we like, or that science may require a dangerous rule in its general application."

The Steam Department of the Royal Navy

IN the Public Record Office is preserved an interesting report on the organization of the Steam Department of the Royal Navy, dated October 8, 1836, and signed by Captain Robert Oliver, Lieutenant Thomas Baldock and Master Charles Brown. The name of a steam vessel had first appeared in the official Navy List in 1827, and by 1836 some twenty-six steam vessels were included in the list of H.M. ships. The most important steam vessels were then the *Dee*, *Phoenix*, *Salamander*, *Rhadamanthus* and *Medea*, vessels of about 800 tons and 220 nominal horse power, and it was through experience gained with them that the Admiralty laid down in 1836 the first steam frigates, *Gorgon* and *Cyclops*.

At that time there was no properly organized engineering branch of the Navy, engineers possessed no rank and the manning of the engine-rooms and the working of the machinery gave rise to many questions. The three officers mentioned were therefore appointed to report on the machinery of the steam vessels. Of the three, Captain Robert Oliver had commanded the *Dee* during the blockade of the Dutch coast, while

Lieutenant Baldock had commanded the steamer *Firebrand*, one of the vessels used by the Admiralty for carrying the mails between Falmouth and Malta. To Baldock we also owe a memoir of Her Majesty's Steam Ship the *Medea* during a service of nearly four years.

The London Meteorological Society

WRITING on October 9, 1836, from Wycombe to the editor of the *Analyst* (5, 289), J. G. Tatem directed attention to the value of the study of meteorology, and in the course of his letter said: "It must have been matter for surprise that, while there is scarcely a science or art but receives encouragement and support from a society composed of persons professing the one or attracted to the other, Meteorology does not enjoy that patronage. True it is that, in 1823, a society was established in the metropolis under the denomination of 'the London Meteorological Society', admitting persons residing in the country as corresponding members. Of that society Dr. Birkbeck was the president, Dr. Clutterbuck the treasurer and Mr. Wilford the secretary, with a council consisting of eight members; but it never came into active operation, and soon fell into decay. . . ." It was the aim of Mr. Tatem and others to resuscitate the society so that "Meteorology would be able to boast of having a society as extended and active as any of those which are advancing science in every direction, and conferring so much honour upon the country".

Societies and Academies

Paris

Academy of Sciences, August 24 (*C.R.*, 203, 445–472).

PIERRE AUGUSTIN DANGEARD: Necrological notice on Camille Sauvageau.

GEORGES PERRIER: The Martinique Institut de Physique du Globe.

MIÉCISLAS BIERNACKI: The multivalent functions of p order.

PAUL BOURGEOIS and JACQUES F. COX: The origin of comets. The theory of the galactic origin of cometary matter is in accord with known data.

JEAN DUFAY and HENRI GROUILLER: The proportion of polarized light in the solar corona. After correcting for the width of the slit of the spectrograph and the analysing slit of the microphotometer, it was found that the proportion of polarized light was practically independent of the wave-length in the whole of the spectral region studied. The proportion of polarized light reaches a maximum of 0·26 about 10′ from the edge and this maximum is very flat. This result, obtained for the total eclipse of August 31, 1932, was confirmed by J. J. Johnson during the eclipse of February 14, 1934.

JEAN CHAZY: The approximate calculation of the precession of the equinoxes.

JEAN MARIANI: The law of gravitation and parallel displacement.

RENÉ LUCAS: Absorption of elastic waves in fluids.

NY TSI-ZE and FANG SUN-HUNG: The circular transversal vibration of a hollow quartz cylinder.

EDOUARD ROCH: A zone of irregularities, principally with nuclei of eruptive rocks, in the Haut-Atlas, to the east of Marrakech.

PAUL BERTRAND and PAUL CORSIN: The relative independence of the large groups of vascular plants.

HENRI HÉRISSEY and GABRIEL POIROT: The extraction of a crystallized principle, viburnitol, from the leaves of *Viburnum Tinus*. The fresh leaves give a yield of 0·1 per cent of the substance. Its composition is $C_6H_{12}O_5$; it contains no methoxy group and appears to be a polycyclic alcohol.

JACQUES BENOIT: Hypertrophy of the liver in the thyroidectomized duck. The role of the prehypophysis in its enrichment in lipids.

LÉON VELLUZ: The neutralizing action, *in vitro*, of carbon disulphide on the tetanus toxin.

August 31 (*C.R.*, 203, 473–504).

LOUIS DE BROGLIE: The theory of the photon and the relativist wave mechanics of the systems.

LUCIEN CAYEUX: The microplankton of the Tunis and east Algerian phosphates.

VITO VOLTERRA: Vital least action.

JACQUES DE LAPPARENT: Relation of the bodies of the sepiolite-attapulgite series with the phyllitous silicates of the mica type.

JEAN CABANNES and HUBERT GARRIGUE: A photoluminescence phenomenon in the upper atmosphere: stimulation by solar light of the oxygen line 6300 A.

N. A. SLIOSKINE: The theory of the plane movement of a viscous liquid.

JACQUES VALENSI: Aeroplane wings: the influence of the form of the end of the wing on the marginal phenomena.

ROBERT LACAU: The liberation of a yellow oil in mixtures of tar and bitumen.

G. ZBYSZEWSKI: The extension of pre-Devonian strata to the middle of the eruptive series of Beja (Portugal).

RAYMOND FURON: First results of a geological exploration of the great Iranian desert.

MAURICE ROSE and HENRI BERRIER: The topographical distribution of substances functioning as plant auxins in the young tadpole of *Discoglossus pictus*.

LÉON VELLUZ: The neutralizing action, *in vitro*, of the senevols on the tetanus toxin.

GEORGES BOURGUIGNON and MLLE. RENÉE DÉJEAN: The variations of vestibular chronaxy in hemiplegia with or without aphasia.

CHARLES FLANDIN, PIERRE BARANGER and JEAN RAGU: An attempt at the treatment of leprosy with a new complex compound of chaulmoogra and cholesterol, allowing the intravenous injection of large doses of chaulmoogric derivatives. Description of favourable results obtained by this treatment in twelve cases.

Cape Town

Royal Society of South Africa, June 17.

E. NEWBERY: Mercurous perchlorate and the monovalent mercurous ion.

C. VAN RIET LOWE: Rock engravings in the Vaal River basin. A description of rock-engravings recently discovered in the Vaal River basin, giving their relative chronology, and associating certain early phases with implements of the Smithfield *A* and *B* series.

L. N. COHEN: Studies in the inorganic metabolism of the Kelsey and Gaviota plums (1). Potassium.

Rome

Royal National Academy of the Lincei
(*Atti*, 23, 253–276; 1936).

U. Cisotti: Ballast effects due to a doublet.

G. Scorza-Dragoni: Doubly periodic planar translations of Brouwer.

A. Ghizetti: Determination of the limiting curves of a continuous ∞^1 system of homographic plane curves.

G. Bernardini and **O. Bocciarelli**: Valve instrument for registering coincidences between multiplying counters.

G. Dal Piaz: Geological structure of the Austrides (2). The Austrian alpine system south of the tectonic window of the High Taurus.

V. Puntoni: Relations between the anærobic actinomycetes of the Wolff-Israel type and *Bacterium bifidum*.

Washington, D.C.

National Academy of Sciences (*Proc.*, 22, 435–462, July 15).

Aurel Wintner: On the periodic analytic continuations of the circular orbits in the restricted problem of three bodies.

A. E. Mirsky and **Linus Pauling**: On the structure of native, denatured and coagulated proteins. Discussing proteins from the point of view of their physical and chemical behaviour, it is concluded that the molecule consists of one polypeptide chain (sometimes two or more) which continues throughout the molecule. The chain is folded in a uniquely defined configuration, in which it is held by certain side-chain hydrogen bonds. This configuration is the origin of the specific properties of a native protein. Increase in temperature and also certain substances break these side-chain hydrogen bonds, leaving the molecule free to assume new configurations, a process known as denaturation; the denatured protein is thus characterized by absence of a uniquely defined configuration. Dehydration consists primarily in coagulation of molecules without loss of their configuration.

A. H. Sturtevant and **Th. Dobzhansky**: Inversions in the third chromosome of wild races of *Drosophila pseudo-obscura*, and their use in the study of the history of the species. Fourteen sequences of inversions have been found; most geographical regions show several sequences, but no single sequence occurs throughout the whole range of the species. Study of the sequences should give a clue to their historical relationships.

Curt Stern and **Violet Rentschler**: The effect of temperature on the frequency of somatic crossing-over in *Drosophila melanogaster*. The number of mosaic spots is used as a measure of the *somatic* crossing-over. The frequency of crossing-over is not significantly different at 17° and 25°, but is lower at 30° C.

L. H. Kleinholz: Studies in reptilian colour changes. (1) A preliminary report. General darkening of the Florida chameleon (*Anolis carolinensis*) in the dark and on a dark illuminated background is due to a secretion from the pituitary. Certain regions are darkened by adrenalin or a similar substance.

F. Zwicky: An expansion-luminosity relation for novæ. A theoretical discussion of a simplified model of a nova.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Tuesday, October 6

British Association of Refrigeration (at the Royal Society), at 6.30.—Dr. Ezer Griffiths: Presidential Address.

Wednesday, October 7

Pharmaceutical Society, at 3.—Dr. F. L. Pyman, F.R.S.: Inaugural Sessional Address.

Friday, October 9

Association of Applied Biologists (in the Botany and Metallurgical Lecture Theatres, Imperial College of Science, South Kensington, London, S.W.7), at 11.45.—Discussion on "The Problems raised by the Woolly Aphis of the Apple—A Case for Team Research"*.

Official Publications Received

Great Britain and Ireland

Sir John Cass Technical Institute. Calendar, Session 1936–1937. Pp. 138+8 plates. (London: Cass Technical Institute.) [49

Edinburgh and East of Scotland College of Agriculture. Calendar for 1936–1937. Pp. 93. (Edinburgh: Edinburgh and East of Scotland College of Agriculture.) [59

Battersea Polytechnic, Battersea Park Road, London, S.W.11. Technical College for Day Students: Calendar for the Session 1936–1937. Pp 45. 3*d*. Domestic Science Department and Training College: Calendar for the Session 1936–1937. Pp. 32. 3*d*. Department of Hygiene and Public Health: Calendar for the Session 1936–1937. Pp. 18. 3*d*. Evening and Afternoon Courses and Classes: Calendar for the Session 1936–1937. Pp. 29. (London· Battersea Polytechnic.) [59

Other Countries

Bulletin of the American Museum of Natural History. Vol. 72, Art. 1: Further Notes on the Gigantic Extinct Rhinoceros, *Baluchitherium*, from the Oligocene of Mongolia. By Walter Granger and William K. Gregory. Pp. 73+4 plates. Vol. 72, Art. 2: Some Features of the Cranial Morphology of the Tapinocephalid Deinocephalians. By Lieuwe D. Boonstra. Pp. 75–98+plates 5–8. Vol. 72, Art. 3: The Cranial Morphology of some Titanosuchid Deinocephalians. By Lieuwe D. Boonstra. Pp. 99–116+plates 9–17. (New York American Museum of Natural History.) [19

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The Future in Education

SIR RICHARD LIVINGSTONE'S presidential address to Section L (Educational Science) of the British Association at the recent Blackpool meeting is one which should receive attention from all who are interested in educational purposes and scope. His views concerning some of our fundamental ideas on education must either be accepted —in which case far-reaching changes of thought and practice are necessary—or they must be proved to be mistaken. For our part, we believe he has put his fingers upon weaknesses which must be remedied both from the material point of view of value for educational expenditure, and from the philosophical point of view which would have education fit the masses for the tasks—and possible struggles—which lie ahead.

Sir Richard described the three-fold function of man: to make a livelihood, to be a citizen and to be a man; and he asked whether, despite our achievements since the education Acts of 1870 onwards, through which the main lines of our primary, secondary, technical and university organization were laid down, we can now claim to be an educated nation. Does our system make men and citizens? If the majority of an electorate are incapable of benefiting from what are called humanistic studies, "we must either abandon democracy or resign ourselves to be governed by an electorate which can never know what a state should be. Ancient tradition and political instinct may preserve such a democracy from disaster, but not only will its stability be precarious, but its political and spiritual life will be poor. The bad film and the betting news will be its relaxation; the bad press its literature, passion, prejudice, the catchword and the slogan will be its masters".

If the education of children ceased at fourteen years of age in the past, it mattered perhaps less than it does now. Education for leisure would have little purpose if the working man lacked leisure. "Fifty years ago the employment of leisure was no problem for any but the well-to-do who mostly wasted it. To-day it is becoming a commonplace in education." At fourteen years of age a child has made a beginning in many subjects: he has received a training which enables him to use opportunity for learning more: but he knows nothing of the forces affecting his country which, as a voter, he will help to determine. Economic and political theories are outside his range; his knowledge of literature is small, his knowledge of science smaller.

Ordinarily, the answer to such criticisms is that the school-leaving age should be raised. But it is here that Sir Richard Livingstone's first challenge appears. He does not argue *against* raising that age, but he says plainly that it will not, in itself, solve our problems. He makes the telling point that education must be adjusted not only to the natural capacities of the pupil, but also to the stage of development his brain has reached. "At the age of 14 or 15 the mind cannot cope with, if it can conceive, the subjects which compose a liberal education and are vital to the citizen." When, therefore, the Hadow Report spoke of giving a "liberal and humane" education through the schools it proposed, it was using "one of those phrases sounding seductive, but untrue, into which all of us are at times betrayed. The thing is impossible because a humane and liberal education includes subjects which a fifteen-year-old is not sufficiently adult to grasp". In short, maturity of mind is essential to humanistic studies for which full understanding demands experience of life.

What, then, is the solution ? Sir Richard is emphatic that it does not lie in secondary education "about which this age is over-credulous. . . . We must keep our faith in it, but temper it with scepticism", since it is only one part of a great picture from which, to see it as a whole, we must stand back a little.

If the value of raising the school-leaving age is moral and economic rather than intellectual, and if secondary education is insufficient, where must we turn ? One direction must be that of adult education. "In every point except the economic one, adult education has the advantage over secondary education. . . . It is given to students who desire it, who have the mental development to receive it, and have the experience of life to value and interpret it."

In this connexion it is inevitable that we should think of the Workers' Educational Association. Sir Richard Livingstone rightly emphasized the value of its work, but here, too, he rightly challenges complacency and indicates weaknesses. Our population is some 43,000,000. In 1935 there were 59,000 students in W.E.A. classes (at a cup-tie final there are twice that number !). The W.E.A. has therefore left untouched the vast mass of the population, although it has provided for their intelligentsia. Such studies as it has provided must continue, but for the ordinary man a different treatment is needed. Subjects must be brought into connexion with his outlook, his interests and his mind. To do this, Sir Richard sees that new methods must be sought, and he does not hesitate to say that "one of the reasons perhaps why so little progress has been made in adult education is that teachers have mostly been men with honours degrees who have brought to their work the methods and outlook of their own education".

There remain still the problems of post-primary education, and here Sir Richard's suggestions can be said to go back to the ideas adumbrated when the Education Act of 1918 was in preparation. Briefly, "the ideal plan might be for everyone to leave school at 15 and pass into a system where a part of the week was allotted to school, part to earning the living in some practical occupation, the proportions of each varying with the intellectual abilities of the pupil and the demands of the subjects he was studying". For our part we believe that such a system of part-time education would achieve far more than a system which merely raises the school-leaving age with the view of lengthening the period of full-time education. Like Sir Richard, we would not argue against raising the school-leaving age : but, whether that age be fourteen or fifteen or even more, we believe that an education such as Sir Richard has suggested will be best achieved if the pupil has some knowledge of and contact with the practical world. If education is a preparation for life, it cannot neglect the world in which we live. That world rests upon industrial and commercial foundations, and it is only when a pupil has had some contact with the realities found in practical occupations that he will appreciate the value and purpose of education. In Sir Richard's words, "theory will be illuminated by practice and practice by theory. At present the two are nearly always divorced. We lead a life of action without thought ; or we think in a vacuum without contact with the realities and problems of the world. Neither form of isolation is satisfactory". What happens at present is that, on reaching the school-leaving age, the great mass of pupils are expelled abruptly from educational influence : and, without it, the real significance of democratic rights and duties is lost and the possibilities of a wide adult education almost hopelessly diminished.

A scheme of part-time education may, of course, be impossible for all pupils, but even those who follow the usual path to the university might avoid suffering from ignorance of life if a layer of practical experience could be imposed between school and university. The 'sandwich system' followed by engineers is an example.

Wisely, in our view, Sir Richard Livingstone did not attempt full and detailed programmes : that, as he said, would be a fitting task for the Board of Education's Consultative Committee. But, whatever the details may be, we believe he has made out a case for serious change, and his case must either be answered or accepted. His challenge to our present system cannot be denied unless the terrible implication of the following passage can also be disputed : "At present life is so arranged that most of us do our thinking in youth at an age when we are not best fitted for it, and having left the university think, systematically, no more. What wonder that middle life finds so many men unaware of recent progress in their own field, unapt for new experiments and ideas, deeply embedded in their rut, while progress waits impatiently for their death and the arrival of the next generation !"

Natural Selection and Evolutionary Progress*

By Dr. J. S. Huxley

RATE-GENES AND SELECTION

THE results of selection at one period of the life-cycle may have repercussions on other periods and affect the species as a whole in unexpected ways. Perhaps the best example is that of intra-uterine selection in polytocous mammals, where rapidity of growth must be at a premium. This is likely to be transferred in whole or in part to post-natal life; intra-uterine selection may thus help to account for the progressive increase in size seen in so many mammalian lines during their evolution. At any rate, the converse seems to hold. One of the most characteristic features of man is a slowing down of general rate of development. Without it he could not in all probability have become fully human or biologically dominant. This condition could not have occurred until after man's ancestors ceased to have litters and began to bring forth a single young at a birth.

Haldane, in an interesting paper, discusses these and similar phenomena from the point of view of the time of action of the genes controlling them. A more comprehensive view, however, would include as still more important the genes' *rate* of action.

The concept of rate-genes provides a great simplification of the facts of recapitulation and anti-recapitulation. Whenever the rate of a process is correlated with time of onset and final equilibrium-level, a mutation causing an increase in rate will produce recapitulatory phenomena.

Conversely, a mutation causing a decrease in rate will have anti-recapitulatory effects. It will prolong the previous phase longer in ontogeny; it will not only slow the process down but also stop it at a lower level of completion, and it will remove certain previous adult characters and push them off the life-history. Many of the phenomena of so-called 'racial senescence' in ammonites may be due to phenomena of this type.

As de Beer has pointed out, when cænogenetic changes occur in the embryo or larva, the adult remaining unchanged, neither palæontology nor comparative anatomy would register any phylogenetic advance. But if now neoteny or fœtalization occurs, the old adult characters may be swept off the map and be replaced by characters of a quite novel type. This process he calls *clandestine evolution*. Garstang has suggested that it has operated on a large scale in the ancestry of vertebrates and of the gastropods.

A clear-cut small-scale example comes from the snail *Cepea*. Its non-banded varieties are produced not because their genes cause the total absence of pigment, but because they slow down pigment-formation and delay its visible onset relatively to general growth, to such an extent that growth is completed before any pigment can be formed.

This is a comparatively unimportant effect; but when major processes are affected such as metamorphosis, sexual maturity, or general rate of growth or development, the results may be far-reaching. Pædogenesis, neoteny and human fœtalization are examples.

The existence of rate-factors has an important bearing upon the problem presented by apparently useless characters. For alterations in the rate of a process will often automatically produce a number of secondary and apparently irrelevant effects. Numerous examples of such 'correlated characters', as Darwin called them, are now known.

RESULTS OF SELECTION, GOOD AND BAD

It is a common fallacy that natural selection must always be for the good of the species or of life in general. In actual fact we find that intra-specific selection frequently leads to results which are mainly or wholly useless to the species as a whole, including 'hypertelic' characters.

In other cases intra-specific selection may even lead to deleterious results. This is especially true with intra-sexual competition, between members of the same sex of the same species. We may, however, go further and proclaim with Haldane that intra-specific selection is on the whole a biological evil.

This conclusion is of far-reaching importance. It disposes of the notion, so assiduously rationalized by militarists and *laisser-faire* economists, that all man needs to do to achieve further progressive evolution is to adopt the most thoroughgoing competition: the more ruthless the competition, the more efficacious the selection, and accordingly the better the result. But we now realize that the results of selection are by no means necessarily 'good', from the point of view either of the species or of the progressive evolution of life. They may be neutral, they may be a dangerous balance of useful and harmful, or they may be definitely deleterious.

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* *Continued from p.* 573.

EVOLUTIONARY PROGRESS

This question of evolutionary progress remains. It is not true that the use of the word *progress* is a mere anthropocentrism. There *has* been a trend during evolution which can rightly be called progressive and has led to a rise in the level of certain definable properties of organisms. The properties whose rise constitutes biological progress can be defined in the broadest terms as control over the environment and independence of it. More in detail, they consist in size and power, mechanical and chemical efficiency, increased capacity for self-regulation and a more stable internal environment, and more efficient avenues of knowledge and of methods for dealing with knowledge. One-sided progress is better called specialization.

As revealed in the succession of steps that led to new dominant forms, progress has taken diverse forms: at one stage, the combination of cells to form a multicellular individual, at another the evolution of a head; later the development of lungs, still later of warm blood, and finally the enhancement of intelligence by speech.

So much for the fact of progress. What of its mechanism? It will be clear that if natural selection can account for adaptation and for long-range trends of specialization, it can account for biological progress too; for progressive changes have obviously given their owners advantages. There is no more need to postulate an *élan vital* or a guiding purpose to account for evolutionary progress than to account for any other feature of evolution.

One somewhat curious fact emerges from a survey of evolutionary progress. It could apparently have pursued no other course than that which it has historically followed. For example, the final step taken in evolutionary progress to date is that to conceptual thought. We see, however, that this could only have arisen in a monotocous mammal of terrestrial habit, but arboreal for most of its mammalian ancestry. All other known groups of animals are ruled out. Conceptual thought is not merely found exclusively in man: it could not have been evolved on earth except in man. Only along one single line is progress and its future possibility being continued—the line of man.

THE EVOLUTIONARY FUTURE

What of the future? Man is not destined to break up into separate radiating lines. For the first time in evolution, a new major step in biological progress will produce but a single species. We can also set obvious limits to the extension of his range. Thus the main part of any large change in the biologically near future must be sought in the improvement of the brain.

In any case, one important point should be borne in mind. After most of the major progressive steps taken by life in the past, the progressive stock has found itself handicapped by characteristics developed in earlier phases, and has been forced to modify or abandon these to realize the full possibilities of the new phase.

Man's step to conscious thought is perhaps more radical in this respect than any other. By means of this new gift, man has discovered how to grow food instead of hunting it, and to substitute extraneous sources of power for that derived from his own muscles. For the satisfaction of a few instincts he has been able to substitute new and more complex satisfactions, in the realm of morality, pure intellect, æsthetics and creative activity.

The problem immediately poses itself whether man's muscular power and urges to hunting prowess may not often be a handicap to his new mode of control over environment, and whether some of his inherited impulses and his simpler irrational satisfactions may not stand in the way of higher values and fuller enjoyment.

Man seems generally anxious to discover some extraneous purpose to which humanity may conform. Some find such a purpose in evolution. The history of life, they say, manifests guidance on the part of some external power; and the usual deduction is that we can safely trust that same power for further guidance in the future.

I believe this reasoning to be wholly false. Any purpose we find manifested in evolution is only an apparent purpose. If we wish to work towards a purpose for the future of man, we must formulate that purpose ourselves. Purposes in life are made, not found.

The future of man, if it is to be progress and not merely a standstill or a degeneration, must be guided by a deliberate purpose. This human purpose can only be formulated in terms of the new attributes achieved by life in becoming human. Human purpose and the progress based upon it must accordingly be formulated in terms of human values; but it must also take account of human needs and limitations, whether these be of a biological order, such as our mode of reproduction, or of a human order, such as our inevitable subjection to emotional conflict.

Obviously the formulation of an agreed purpose for man as a whole will not be easy. But let us not forget that progress *can* be achieved. After the disillusionment of the early twentieth century it has become as fashionable to deny the existence of progress, as it was fashionable in the optimism of the nineteenth century to proclaim its inevitability. The truth is between the two extremes. Progress is a major fact of past evolution; but it is limited to a few selected stocks. It may continue in the future; but it is not inevitable—man must work and plan if he is to achieve further progress.

Our optimism may well be tempered by reflection on the difficulties to be overcome. None the less, the demonstration of the existence of a general trend which can legitimately be called progress, and the definition of its limitations, is a fundamental contribution to thought; and we zoologists may be proud that it has been made, chiefly from the zoological side, by evolutionary biology.

Production and Technical Application of High Voltages

THE discussion on September 14 in Section A (Mathematical and Physical Sciences) of the British Association, on the production and technical application of high voltages, was one of those selected by the Council of the Association as having a direct bearing on the life of the community. The high-voltage transmission system connecting our major power stations, and the extensive use of X-rays in hospitals, are but two examples of the impact of high-voltage science upon society, and the extent of the applicability of this science is increasing rapidly. In no other science are physics and engineering more interdependent, and it is significant that nuclear physics would have been almost a closed book without the application of high voltages.

High voltages are familiar to us in four forms: low-frequency alternating voltages, unidirectional impulsive voltages, high-frequency alternating voltages and constant voltages. The engineer is for the most part concerned with the first three forms, the normal and the abnormal types of voltage appearing on transmission lines. The lines and the station apparatus of the 132 k.v. 'Grid' in Great Britain are tested up to two or three times normal line voltage with low-frequency alternating voltages, whilst abnormal voltages—such as surges due to lightning or switching operations—up to ten times normal operating voltage may appear on the lines. Thus engineering laboratories equipped to supply 500–1,000 k.v. at power-frequencies, and 1½ million volts from impulse generators, are necessary to test all apparatus for use on high-voltage systems, and to be in the van of immediate requirements. Constant potentials have been mainly used for radiography, X-ray therapy and physical research, and there appears to be an immediate need for voltages of the order of one million for research on nuclear physics and X-ray therapy.

There are many problems confronting the supply authorities of the 'Grid' which arise at the normal transmission voltage of 132 k.v. Among these may be mentioned the effects of corona, atmospheric pollution, gaseous discharge within the voids in so-called solid insulation, and power arc discharges initiated by atmospheric conditions and other causes, as enumerated by Mr. C. W. Marshall of the Central Electricity Board. The manufacturer is equally concerned with these problems and is constantly evolving new designs and new materials for use in high-voltage apparatus better able to withstand these destructive effects. Electrical gradients used in solid dielectrics are far lower than the theoretical permissible gradients referred to by Dr. S. Whitehead, of the British Electrical and Allied Industries Research Association (E.R.A.), on account of the inherent fluctuations in quality of dielectrics, our lack of knowledge of the behaviour of dielectrics over a period of many years when subjected to thermal changes and mechanical forces, and also on account of the dangerously high over-voltages which are known to occur on lines. It has been estimated that these over-voltages are responsible for 75 per cent of all failures of supply systems.

As Mr. R. Davis, of the National Physical Laboratory, pointed out, studies of the behaviour of dielectrics under impulse voltages are still in their infancy, there being so many variables influencing breakdown, such as wave shape and polarity of the applied impulse, electrode shape, and medium of immersion, temperature, and number of applied impulses. Moreover, our knowledge of the nature of surges arriving at terminal stations is all too meagre: information is being obtained by cathode ray oscillographs and lightning current recorders on lines all over the world, but effective measures are not yet available to prevent damage due to lightning. In this connexion it is interesting to note that the E.R.A. has available a 1¼ million volt impulse generator (Fig. 1) with which to study the effects of artificially produced surges on lines and cables, this voltage being adequate to spark over the line insulation of the

'Grid'. The effects of lightning currents of 100,000 amperes have yet to be investigated, and Prof. H. Norinder, of Uppsala, Sweden, gave a brief account of the surge current generator and the effects of large currents on electrodes and earthing materials.

In the realm of atomic physics constant potentials are favoured, as they will produce the most stable source of high-speed ions for nuclear disintegration experiments. The five-million volt generator built by Dr. van de Graaf represents the most outstanding example of high-voltage generation, but is only capable of producing one milliampere at full voltage. Thermionic valve circuits can give greater powers, but so far voltages much in excess of one million have not been produced by such means. For X-ray therapy, now so widely used in the treatment of all forms of tumours, voltages up to 250 k.v. have been used, but higher voltages are essential if the effects of short wave X-rays are to be compared with those of the much feebler γ-rays from 5-gram bombs of radium. A number of such high-voltage X-ray tubes is now in operation at voltages of 500–800 k.v. One of the most original and successful tubes has been made by Mr. Sloan in Berkeley, California, who conceived the idea of generating a continuous high-frequency alternating voltage in the same vacuum chamber as the filament and target of the X-ray tube.

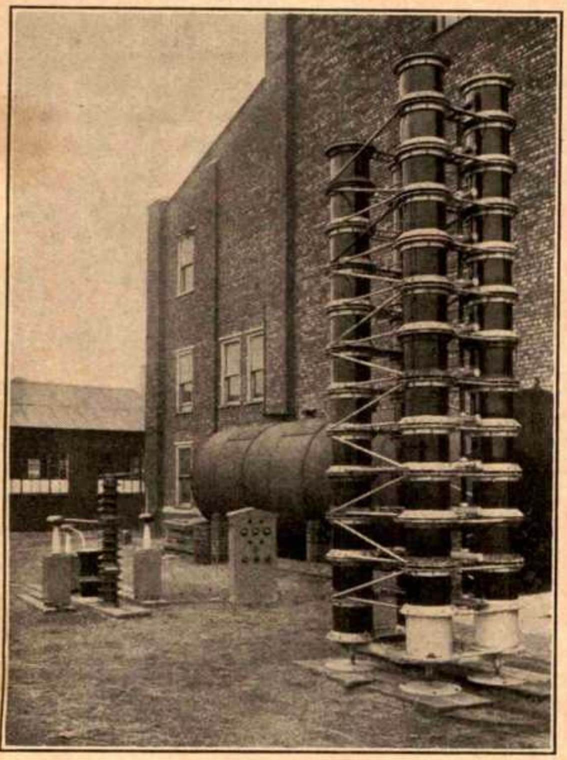

FIG. 1. 1½ million volt outdoor type impulse generator for use by the E.R.A. on the high voltage lines of the 'Grid'.

Dr. G. W. C. Kaye, of the National Physical Laboratory, described his recent researches on the measurement of γ-radiations, and announced that by using an ionization chamber large enough to absorb all the fast electrons liberated in air by the γ-rays, unification of the X-ray and γ-ray dosage measurements has been achieved. Of course, in practice it is not necessary to use a 'free air' chamber for the measurement of γ-rays or very high voltage X-rays; the 'free air' chamber may be replaced by a chamber having walls thick enough to absorb all the fast electrons.

An increasing use for constant voltage generators, widely affecting the community, is for the electrostatic precipitation of dust. Though a very old process of great simplicity, it has only recently been applied on a large scale for the detarring of gas, removal of poisonous fumes such as arsenic, and the elimination of dust from power-station flues. In one of the large municipal power-stations an electrostatic precipitator removes no less than 1,000 tons of dust per week which otherwise would be emitted from the chimney.

The measurement of high voltages presents a diversity of problems. Low-frequency alternating voltages may be measured by sphere spark-gap (a secondary standard) or by a crest voltmeter (a primary standard involving the measurement of the charging current of a standard condenser). The design of the condenser for one or more million volts presents the major difficulty as the condenser must be isolated from all sources of corona current. For lower voltages the condenser may be placed in a compressed gas chamber, or the new precision spark gap devised by Prof. W. M. Thornton may be used. This gap consists of parallel plates with rolled edges across which the field strength is uniform, so that sparking occurs with greater uniformity than occurs between spheres. For impulse voltages, however, this gap is not much superior to the sphere gap: an accuracy of one or two per cent is obtainable, provided that the spacing between spheres does not exceed the radius of the sphere and provided that the impulse wave front is at least one microsecond in duration. In shorter times than this, the gap measurement may be seriously in error, and the only reliable standard is the capacitance potentiometer and cathode ray oscillograph: the accuracy of measurement is then not greater than a few per cent. Constant potentials may be measured by the resistance voltmeter if sufficient power is available: for the electrostatic belt-type generator an electrostatic alternator voltmeter has been evolved which gives fair accuracy.

T. E. A.

The Architecture of Life

SECTION I (Physiology) of the British Association arranged a discussion at Blackpool under this title, in which Sections A (Mathematical and Physical Sciences) and B (Chemistry) took part. This discussion was concerned with some of the evidence bearing on the problem of the fundamental structure of the cells of animal organisms. In a wide and imperfectly explored field such as this, papers dealing with experimental data tend to appear rather unrelated and miscellaneous. What follows is not so much a summary of the papers as an impression of the main features of general interest.

Introducing the subject, Mr. A. D. Ritchie said that the advance of knowledge in the biological sciences depends upon an understanding of structure. In the history of science, the first stage was the development of anatomy, which revealed the relations and functions of those parts and organs of the body that are visible to the naked eye. The second stage was the development of microscopical technique which revealed the cellular structure of tissues, the functional relations of cells to one another, and, to some extent at least, the structure of the cells themselves. These methods have now accomplished most of their work. The third and the last advance will be the elucidation of the molecular architecture of the living cell. No possible improvement in microscopic technique can make structures so small as 10^{-5} cm. directly visible. The range of molecular magnitudes lies below this, say 10^{-6} cm.–10^{-8} cm. No one method of attack is going to reveal structures of this order, but only the co-operation of many different methods making use of all the resources of physics and chemistry.

Dr. D. M. Wrinch dealt with what is perhaps the central problem, that of the structure of proteins. The foundations of our knowledge have been laid by the labours of the organic chemists using the classical conception of Fischer, that proteins are built up of α-amino acids joined by the peptide linkage. Their results can now be extended by means of two new physical methods. By Svedberg's centrifuge method the size and shape of molecules of proteins in solution can be determined. By the X-ray method Astbury has obtained information about the molecular structures of keratin fibres and the protein of muscle, and Bernal about soluble crystalline proteins. The chief difficulty has been to understand the transition in structure from the globular form of the soluble crystalline state to the long chain structure of the denatured state and the fibres. The 'cyclol' scheme put forward by Dr. Wrinch gives promise of a solution. According to this conception the amino acids are linked in patterns of condensed six-atom rings. The possible patterns of this type are limited in number and their configurations can be worked out geometrically. The tautomeric change from the cyclol arrangement to the fully extended straight chain through the intermediary of folded chains becomes intelligible. There can be little doubt that all the ordinary proteins have the same kind of skeleton holding them together, so that a general solution of the structural problem is possible.

There is, however, a very different kind of protein-like material, the nucleo-proteins, the main structural constituents of the chromosomes of the cell nucleus. Geneticists have shown that the carriers of the hereditary characters are to be found here, and that they are specific and definitely localized. Fortunately, some chromosomes are so large that details of their structure are visible under the microscope. The molecular basis of the chromosome, Dr. Wrinch suggested, consists of bundles of straight chains of mainly basic amino acids bound together by combination with transverse bands of nucleic acid molecules—a suggestion that the most recent work tends to confirm.

Attached to the central structural skeleton shared by proteins in common are the side chains of the amino acids, which confer on each one its peculiar and specific properties. The importance of these specific properties comes to light in investigations of quite a different type. Dr. J. H. Quastel pointed out that for the catalysis of the chemical reactions brought about by living organisms, it is necessary to assume definite spatial arrangements of the enzyme systems concerned. Destruction of the normal cell structure stops some of the chemical reactions but not others. Experiments with bacteria have shown that while one chemical reaction can be blocked by the presence of an inactive substance on the active surface, another can proceed normally, so that the two must occur in different places and each place is specific for catalyzing one type of reaction. In the active cell there are simultaneous and successive reactions linked together in a way that implies not only definite patterns of reactive groups in the cell structure, but also some means for separating and restricting the diffusion of the soluble substances that undergo chemical change.

Dr. P. Eggleton's paper dealt with some aspects of this very difficult subject.

If a dead muscle is suspended in Ringer's solution, dissolved substances can diffuse freely into the whole of the water of the tissue. When the muscle is alive, most electrolytes can diffuse into one third only of the water it contains; the remaining two thirds are inaccessible to them. Glucose also has access to one third only, but urea can diffuse freely throughout. Histidine can diffuse throughout, but not its derivative carnosine. It is impossible at present to understand the partitioning mechanism underlying these facts, but some mechanism there must be.

The electrical potentials that are developed at cell surfaces are generally believed to be due to unequal concentrations of electrolytes on the two sides. The frog's skin develops such a potential between its two surfaces, but only so long as oxidative chemical reactions are going on, presumably to provide energy for maintaining a concentration gradient. Mr. O. Gatty has found that specific types of chemical reaction are necessary for this purpose, and is endeavouring to work out their course in detail.

Mr. J. S. Mitchell's experiments have been concerned with a rather special problem, the chemical changes in proteins brought about by ultra-violet light; but the method used is one of very general interest and great importance. It is to study the process in monomolecular films spread on a water surface. In such films the molecules can be definitely orientated and molecular structures and transformations may be studied directly. Many important cell constituents and other substances of biological interest can form monomolecular films, so that this very powerful method can be applied to them.

A. D. R.

Obituary

Dr. J. B. Charcot

THE wreck of the polar yacht *Pourquoi Pas?* in a furious gale on the coast of Iceland on September 16, with the loss of all on board but one, was a tragic but not an inglorious end to a famous ship and to the life of the brilliant explorer whose career was so closely bound up with her for nearly thirty years.

Jean Baptiste Charcot was born in 1867, the son of a famous physician and neurologist, Prof. J. M. Charcot. He studied medicine in Paris and was for a time an assistant in the Pasteur Institute. Although he published several papers on medical subjects which were not without merit, circumstances determined that his reputation was to rest not on his professional achievements but on the outcome of his devotion to the sport of yachting.

Charcot's love of the sea brought him under the influence of the revival of polar exploration at the beginning of the present century and fired him to take a part. He raised funds for the purchase and equipment of a small ship, renamed the *Français*, for an arctic voyage, but changed the scene of his exploration to the Antarctic and sailed in 1903 with the intention of searching for the missing expedition of Otto Nordenskjöld in the Weddell Sea. When in South America he heard of Nordenskjöld's relief, and took the *Français* to the west side of Graham Land, there to continue the work begun by Gerlache in the *Belgica*. He reported the existence of Loubet Land south of Graham Land, and pushed on within sight of Alexander I Land; but the main value of the expedition lay in the physical observations and natural history collections made with the aid of his efficient scientific staff during two years.

On his return, Charcot secured Government support for a second expedition, and after a close study of the British, German and Norwegian polar ships, he had the *Pourquoi Pas?* designed to unite the best features of them all. In her he cruised for two years, 1908–10, to the west and south of Graham Land, giving precision to the somewhat nebulous lands seen from the *Français*. He explored the coast of a large island south of the Antarctic Circle to which he gave the name of Adelaide Island, believing it to be an extension of the small island so named by Biscoe in 1832. South of Adelaide Island he discovered a large inlet which he named Marguerite Bay and a new land south of Alexander I Land to which he gave the name of his father. These lands he could not approach, and he believed them to be islands lying off the Antarctic continent. As on the previous expedition, the main value of the researches on the *Pourquoi Pas?* came from the very extensive series of magnetic, meteorological and oceanographical observations and the collections of geological and zoological specimens.

After completing the publication of his results, Charcot continued to make oceanographical summer cruises in the *Pourquoi Pas?*, especially in the Greenland Sea and along the west of Scotland. He was one of the very small number of sailors to effect a landing on the remote islet of Rockall, 185 miles west of St. Kilda, and he acquired an intimate knowledge of the complex coasts of the Outer Hebrides. At the beginning of the Great War his Government insisted on placing him in the Army medical service, but he succeeded in proving that he was a better sailor than a surgeon, and received a commission in the French Navy. Later he was given command of a British vessel with a combined French and British crew, and in her he rendered valuable service by preventing the establishment of enemy submarine bases in the desolate harbours of the west of Scotland which he knew so well.

After the War, Charcot continued to visit East Greenland on summer training cruises with young French sailors. He made a trip to Scoresby Sound in 1931 to select a site for the French station for the Polar Year observations of 1932–33, and afterwards transported the party of French physicists to and from the Sound. He rendered willing and efficient help to many of the recent Greenland expeditions. To young explorers Charcot was always a generous friend and a wise counsellor, and he gave the full benefit of his experience to Mr. Rymill of the British Graham Land expedition which is now in the field.

Charcot was a man of great personal charm and high culture. His literary style was clear and graceful, and his speeches on his many visits to England were always bright and to the point, for he had a perfect command of the English language and a gift for making enduring friendships. Apart from his scientific writings and his polar narratives, he was the author of a very attractive book on Christopher Columbus in which historical critics recognized the value of the interpretation of Columbus's voyages by a scientific man with a practical knowledge of seafaring.

Charcot's genius won for him full recognition as a leading man of science both at home and abroad. He was a member of the Institut de France and of the Academies of Sciences and Marine, received the gold medals and honorary membership of all the chief geographical societies of the world, and at the time of his death was president of the Paris Geographical Society.

Hugh Robert Mill.

Dr. A. Anderson

Dr. Alexander Anderson, whose death at the age of seventy-eight years occurred on September 5, was a physicist and mathematician of note. He was professor of experimental and mathematical physics at University College, Galway, for almost fifty years. He was one of the last holders of the joint chairs of experimental and mathematical physics, a distinction shared with Prof. Morton of Belfast, who paid a graceful tribute to him in *The Times* of September 10.

Dr. Anderson was born in 1858. He studied in Queen's College, Galway (as it was then called), and graduated in 1880. He won an entrance scholarship to Sidney Sussex College, Cambridge, in 1881. He was sixth wrangler in 1884. After a short period in the Cavendish Laboratory under Sir J. J. Thomson, he was appointed professor at Galway in 1885. He became president there in 1899 and held both offices until his resignation in 1934.

Anderson is perhaps best known for his method of measuring self-inductance, which is in general use in laboratories of physics and electrical engineering. Two other of his methods have become standard practice, namely, his method of measuring surface tension and his method of measuring the viscosity of a gas. From 1890 onwards he published many papers in experimental and mathematical physics on optics, electrostatics, electromagnetics and relativity. Of his researches in experimental physics, possibly the most important is his contribution to the theory of contact differences of potential. In mathematical physics his papers mainly deal with new methods of approach to older theory.

The remarkable thing about Anderson was his really wide knowledge of experimental and mathematical physics and his continuous keenness as a teacher, especially of advanced students. I remember hearing the late Prof. McClelland, his most distinguished student, state many years ago that it was usual for his advanced lectures on mathematical physics to go on continuously for three hours, and this was his practice almost up to his retirement. He simply revelled in physical and mathematical problems. Personally Dr. Anderson was a most kindly man with a marked sense of humour. M. P.

Prof. Antoine Meillet

We regret to record the death of M. Antoine Meillet, professor of philology at the Collège de France, and president of the Historical and Philological Faculties at the École des Hautes Études, Paris, which took place at Châteaumeillant (Cher) on September 22, at the age of seventy years. Prof. Meillet was born at Moulins (Allier) on November 11, 1866. He became a lecturer in the École des Hautes Études in 1891. From 1904 until 1906 he was a professor of the École des Langues Orientales Vivantes and in the latter year was appointed to the chair of comparative philology in the École de France. M. Meillet was regarded as one of the most eminent philologists of the day, his researches extending over the whole field of the Indo-European and Iranian languages. His "Introduction à l'Étude Comparative des Langues Européennes", first published in 1897, has been through many editions, the last appearing in 1934.

We regret to announce the following deaths:

Prof. Henry Le Chatelier, For. Mem. R.S., and honorary fellow of the Chemical Society, on September 17, aged eighty-five years.

Brig.-General Sir Brodie Haldane Henderson, K.C.M.G., C.B., president in 1928–29 of the Institution of Civil Engineers, who designed the Lower Zambezi Bridge, on September 28, aged sixty-seven years.

Lieut-Colonel R. Knowles, C.I.E., acting director of the Calcutta School of Tropical Medicine, known for his work on medical protozoology, on August 3, aged fifty-two years.

Dr. A. H. Mackenzie, C.S.I., C.I.E., pro-Vice-Chancellor of the Osmania University, Hyderabad, who was a member of the recent Quinquennial Reviewing Committee of the Indian Institute of Science, Bangalore, on September 26, aged fifty-six years.

News and Views

The University of Sheffield

THE University of Sheffield, although only a little more than thirty years old, has taken an established place among the universities of Great Britain, and is attracting an increasing number of students. Recent years have witnessed some important developments and additions to the buildings, including a new department of mining, a school of dentistry, hostels for men and women and a new students' union. These additions have been largely due to specific gifts to the University. But in nearly all departments the present buildings are overcrowded. Teaching and research are carried on under conditions discouraging and hampering to both students and staff. Moreover, the limited resources of the University, imperilled by recent falls in rates of interest, limit the possibilities in securing the best men to fill vacancies on the staff and keep salaries below the usual level of other universities. To meet the urgent requirements for buildings, equipment and endowment, the University has issued an appeal for £250,000. Not less than £450,000 is required for complete fulfilment of requirements, but the lesser sum represents the minimum for outlay that is long overdue.

THE departments suffering most are medicine, geography, architecture, engineering and metallurgy. It is proposed to begin with the building of a new wing as part of a more comprehensive scheme. This wing will accommodate botany, zoology and geography, thus liberating other rooms occupied by these subjects. Engineering and metallurgy will find further accommodation by the acquisition of new land adjoining the applied science department of the University. The completion of these buildings would for a few years relieve a congestion that has become intolerable. But equally urgent is the provision of further space for the growing library. The present library, with space for only one year's normal addition of books and periodicals, and reading space for only a small number of students, must be extended. The proposal is to add to the library the present assembly hall, known as the Firth Hall, which is much too small for its present purpose and has very bad acoustic properties. This will entail the building of a new assembly hall of adequate size. For the main extensions the University already has the land, but the houses that occupy it will have to be demolished. Some of them at present accommodate in small and unsuitable rooms departments in the faculties of arts and law. Further land, however, is urgently required for the extension of playing fields for the growing number of students. Plans for the completed university have been prepared by Mr. T. Lodge and are published in the pamphlet which the University has issued. The gift of large sums to the universities of other large industrial towns has set an example which it is hoped may be followed in Sheffield now that the economic depression seems to be passing. Contributions to the extent of £54,000 have already been promised, including a sum of £10,000 from Sir Robert Hadfield, to whom the University is already indebted for generous gifts in the past.

New Laboratory for Research in Aeroplane Materials

ON October 3, Mr. D. R. Pye, deputy director of technical development at the Air Ministry, formally declared open the laboratories of Aero Research Ltd., Duxford, Cambridgeshire, by setting in motion a press of 1,300 tons capacity. The ceremony was to have been performed by Mr. H. T. Tizard, chairman of the Aeronautical Research Committee, but he was unfortunately prevented at the last moment from doing so by illness. Aero Research Ltd. is a private research organization working in co-operation with Messrs. the de Havilland Aircraft Co. Ltd. and with the Department of Scientific and Industrial Research, chiefly on synthetic resin materials. A number of demonstrations was given of the properties of the materials developed, and it was shown that the apparent brittleness in static fracture is counterbalanced by a high energy absorption which results in a remarkable freedom from 'notch sensitivity'; at the same time the amorphous structure of the material gives exceptionally good fatigue properties. Controllable pitch airscrew blades were shown, designed and manufactured by the de Havilland Aircraft Co. Ltd. from material supplied by Messrs. Bakelite Ltd., which had withstood successfully severe tests in addition to sixteen and three quarter hours actual test flying (involving continual changes of pitch) and fifty engine backfires. Other demonstrations were given of X-ray apparatus, photoelastic apparatus, special testing machines and of the utility of mass balancing in preventing wing flutter.

Records of Bird-Song

ON October 6 a private hearing was given by Messrs. H. F. and G. Witherby of some wonderfully successful gramophone records of British birds singing in their natural haunts. These are to be issued next week with a book on "Songs of Wild Birds" by Mr. E. M. Nicholson, said to be the first work to be published in Great Britain with auditory as well as visual illustrations. The records themselves were made by Mr. Ludwig Koch, with the assistance of Mr. C. Horton-Smith and the technical co-operation of the Parlophone Company. The material given on two double-sided disks, running for twelve minutes in all, has been selected from a large number of recordings. The practical difficulties to be overcome were obviously great, but the results obtained are well worth much labour. The songs of such musicians as the nightingale and blackbird are beautifully reproduced; the characteristic strains of lesser songsters like the chaffinch and willow-wren are faithfully recorded; and the calls of cuckoo and dove—even the non-vocal drumming of the spotted woodpecker —lend pleasing variety. The quality is incomparably superior to that of previous records obtained from captive birds of a few species. These records will certainly give much pleasure and useful instruction: they may also provide valuable opportunities for analytical study of bird music. No doubt more will be made, for different kinds of birds, now that the example has been set. It is clear, too, that there are other subjects to which this interesting innovation of the 'sound book' may in future be applied.

Advances in Radium Therapy Technique

TELERADIUM therapy progresses in Great Britain, and more than one big unit is now established, for, apart from those centralized under the control of the Radium Beam Therapy Research, there is a 4 gm. unit at Westminster Hospital's Radium Annexe, where physicists and engineers have combined in devising an efficient form of distant electrical control. The radium container is suspended from a rotating beam bolted to a steel girder. This container weighs about 70 lb., and the transfer of the radium in it after application to the patients, to a massive safe for purposes of custody, is carried out electrically. There is no actual handling of the radium by any of the staff, the operator being 14 ft. from the patient's couch. Another interesting feature of the container used is that it carries a collar of platinum in order to reduce scattering of emergent rays to a minimum. These technical developments in the construction of big units of radium are very welcome, because the ordinary methods of protection for the personnel which are quite efficacious in the case of X-rays are inapplicable with penetrating gamma radiation.

The New Fulham Electrical Power Station

THE new power station at Fulham on the banks of the Thames was opened formally on September 26. It occupies an area of 15 acres and has a river frontage of 1,300 feet. It is an extension of the existing plant of the Metropolitan Borough of Fulham, but the disparity between its size and the demand required for the borough shows that the new station is an undertaking to serve the Grid. Two sets of 60,000 kilowatts each were installed this year and a third set is now being added. The boiler house is at right angles to the river and the turbine room is parallel to the river. Two white reinforced concrete chimneys three hundred feet high are already built, and when the station is completed there will be four of them. Three colliers have been ordered, each of them capable of carrying 2,300 tons of coal, and the jetty has three travelling cranes each capable of handling 175 tons an hour. The cranes pass the coal to weighing machines, whence it is fed to the furnaces on two belt conveyors which run at 300 feet per minute. Using only two cranes enables a collier to be unloaded in 6½ hours. When complete and working at approximately half its maximum power, the station will consume roughly 2,000 tons of coal per day. The final fleet of colliers will consist of six boats capable of sea voyages and of passing under the seventeen bridges up the River Thames to Fulham. The new station has a dignified appearance and in conjunction with the Battersea power station on the opposite bank of the Thames will enable the Central Electricity Board to balance the London load.

THERE has been considerable opposition to the location of 'super' stations in urban areas, mainly on the ground that their chimneys emit grit and noxious vapours. But the gas washing plants at Fulham are so efficient that this objection has little weight. Each boiler is provided with sulphur extraction plant in the form of two separate units each provided with a separate induced draught fan. The sulphur extraction plant employs grid packing irrigated by a liquor containing suitable alkali so as to maintain intimate contact between the boiler gas and the washing liquor. The liquor system is known as the Howden non-effluent system. The washing medium is constantly recirculated and purged in order to keep the concentration of solid at the best value. The solids extracted are dealt with by a separate and external settlement plant. The amount of liquor recirculated through a complete washer for one boiler unit is 13,000 gallons per minute. Each complete plant is capable of handling 105,000 cubic feet of gas per minute, and the extraction efficiency for sulphur and grit is 98 per cent if the coal have a maximum sulphur content of 1·7 per cent.

The Electricity Grid

MR. H. HOBSON, in a paper read to the recent World Power Conference at Washington, pointed out some of the advantages that have accrued to Great Britain from the electricity grid. The present trend of the national output of electric supply makes it clear that, before the end of the first ten years of its operation, the system will have effected great economies without cost to the country. In the last three years alone, fuel costs per unit have been reduced 15 per cent and thermal efficiencies have risen more than 12 per cent. In 1925 the reserve generating plant was about 2 million kilowatts, against an aggregate maximum demand of less than 3 million. Last year the reserve showed no increase although the aggregate maximum demand was greater than 6 million. There is one point that is being seriously considered by the Air Raid Precautions Department of the Home Office. There is no doubt that the grid with all its associated superstations will be much more vulnerable to aircraft action in war than the old regime with its independent power stations and few overhead lines. Anti-aircraft forces would doubtless be a help, but permanent protection by camouflage or otherwise would be very difficult. Unless a super-power station were taken absolutely by surprise, palliative measures could be devised to prevent damage to the stations linked with it.

Estimates of Future U.S. Power Supplies

SOME conclusions from the reports given at the third World Power Conference as to how long petroleum, coal, natural gas and water power will last in the United States, have been issued by Science Service, Washington, D.C. There is a possibility of a shortage of domestic petroleum so early as 1940, and by 1945 the shortage may be serious. There is no cause for alarm in the figures reported, but wasteful methods of drilling and using are deplored. The question of coal conservation is considered immediate and urgent. The life of the coal resources at the recent maximum demand is about 2,000 years. With the probable increased demand of the future, the life may be measured in hundreds of years only. For natural gas the known domestic reserves are seventeen to twenty times the annual consumption. For water power, only a small percentage of the total potential hydro-electric power has yet been developed; but in making estimates, many other factors have to be considered in connexion with navigation, recreation, wild life, soil conservation, etc. One of the reports suggests the possibility of replacing all the 'manufactured gas', usually made from coal, with the by-product gas of petroleum refineries. The second most important gas resource of America is the nearly 200,000 million cubic feet of gas which has been stripped of all the condensable constituents that can be used in motor fuel. In the generation and distribution of electric power, engineers have effected notable economies in fuel consumption and the use of materials. This is a conservation step in the right direction, but many engineers think that more careful engineering is required in the mining of coal to reduce waste. Power is also used for purposes that constitute only a waste of what the engineers have so economically produced.

Enzymologia

It is with mixed feelings that we extend a welcome to yet another scientific journal. *Enzymologia* is edited by Dr. Carl Oppenheimer, assisted by an international group of distinguished collaborators, and bears the imprint of Dr. W. Junk, of The Hague, on its cover as publisher. It is to be an international monthly journal for the publication of researches relating to the enzymes. Two parts appeared, in July and August, containing twenty papers in English, French and German, and it is stated that two further parts are in the press. The subscription price for the volume of about 400 pages in six parts is 15 Dutch florins. We write "mixed feelings" because all of us, including the libraries which are the chief subscribers to the periodical literature nowadays, agree there are already too many journals both to read and to purchase. The advantages to the specialist in having his reading mainly provided for him in one journal are considerable, but against this must be set the inevitable curtailment of his general reading, tending to produce a narrow outlook. Notwithstanding these remarks, it is clear that a welcome awaits a journal devoted to progress in enzyme chemistry, the more especially since this is a field which is due for intense cultivation, leading to marked progress during the next few years. *Enzymologia* in no way conflicts with the now popular "Ergebnisse der Enzym-Forschung", which is an annual summary. The issue of the new journal from The Hague is one more example, if such indeed were needed, of the progress of biological chemistry in Holland; the first issue begins appropriately with a contribution from a distinguished Dutchman, Prof. A. J. Kluyver of Delft.

Conversazione of the Quekett Microscopical Club

By kind permission of the Royal Society, the Quekett Microscopical Club is holding its annual conversazione in the rooms of the Royal Society at Burlington House at 7 p.m. on Tuesday, October 13. Not only will there be a large number of exhibits staged by members of the Club, but also the Committee responsible for the organization of the conversazione has been fortunate in enlisting the sympathy and co-operation of other well-known scientific workers and microscopical clubs. The Royal Society is exhibiting original communications from Van Leeuwenhoek and drawings by Hooke. In addition, exhibits have been received from the Natural History Society of Cape Town, from the Microscopical Society of Victoria, Australia, from microscopists in France, the United States and various microscopical societies in Great Britain. A series of cinematographic exhibits on microscopical, pond and other life, also of the development of the bird ovum, will be given at intervals during the evening by Messrs. Kodak, Ltd. Cards of admission can be obtained on application to Mr. W. S. Warton, 35 Doneraile Street, London, S.W.6.

The Osborne Reynolds Ridge

Since the letters on the subject appeared in Nature, the Reynolds line has been seen by readers both on fresh-water and sea-water. Some of those who have seen it, however, missed the note in the News and Views columns of the July 4 issue (p. 20), giving references extending back to a paper by Prof. Osborne Reynolds. Mr. K. G. Denbigh, of Draidland, Norton Road, Norton-on-Tees, Durham, has sent an account of his observations. He saw the line at the fort of Carrawburgh, where a spring rises in a circular pool about five feet deep and eight feet in diameter. It formed a loop, roughly circular and about twelve inches across, surrounding the spot where the water rising from the bottom broke the surface. Apart from this small area where the water was perfectly clear, the pool was, no doubt, covered with a film; he refers to pollen grains and other small vegetable matter floating on it. As Reynolds explains in his paper, the line is only stationary if the rate of spreading of the film over the clean surface of the water is balanced by the outward motion of the water. Mr. Denbigh found that the loop was sensitive to wind, contracting to a point when disturbed and expanding again when the wind died down. He also noticed and sketched the distortion of reflections of reeds where they appeared to cross the line. He watched the line for nearly an hour, until a few soap shavings thrown into the water proved to be an overdose for this sensitive phenomenon.

Progress in Seismology

THE forty-first report of the British Association Committee on Seismological Investigations includes many points of interest. A brass sphere, 18 inches in diameter, has been made by Messrs. Casella for use in the determination of epicentral distances. The positions of observatories are marked by holes and the sphere has been chromium-plated. The Committee is indebted to Mrs. H. H. Turner for providing most of the accessories that will be used in ascertaining the distances and azimuths of the epicentres. Four small earthquakes were felt in the British Isles since the last report was presented, in the Channel Islands and at Leigh, Comrie and Kinlochewe. The earthquakes in the island of Montserrat continue, though they were less frequent during the first half of 1936 than in the two preceding years. A Wiechert horizontal seismograph has been installed, in addition to a number of Jaggar shock-recorders that were made at Kew Observatory for the use of the expedition sent out by the Royal Society. The preparation of the International Seismological Summary for 1931 has been completed, and the sections for the first half of the year have been printed and distributed. The number of earthquakes included is 297. References are also made to Dr. H. Jeffreys' revised table of transmission times recently published by the Bureau Central de Séismologie, to the unusually long seismic waves associated with the South Pacific earthquake of June 26, 1924, and to the Baffin's Bay earthquake of November 20, 1933.

Megalithic Monuments of South Wales

THE latest addition to the Megalithic Survey of England and Wales ("Map of South Wales showing the Distribution of Long Barrows and Megaliths". Compiled by F. W. Grimes. Southampton: Ordnance Survey. Pp. 56 and Map: Scale 4 miles to 1 inch. *5s.*, *5s. 6d.* and *6s. 6d.* net) incorporates the results of a survey of the area covered by Sheet 7 of the Quarter-inch Ordnance Map. It is now possible for the first time, as the Director-General points out in an introductory note, to assess the distribution of the megalithic monuments of an area which has been recognized as an important centre of the culture. This region, predominantly upland, and, therefore, differing essentially from others already covered by the series, falls into two parts, a narrow coastal plain of undulating country, seldom more than 400 ft. above sea-level, in which the monuments are mainly found, and an upland, which attains its greatest heights in Brecknock Beacons, and of which a large part is above the 1,000 ft. contour line. Mr. Grimes discusses a number of questions arising out of the distribution of the monuments, not the least interesting being those relating to his omissions, a matter with which he proposes to deal at greater length elsewhere. He also raises a question of wide general interest in connexion with Stonehenge. One of the most noteworthy contributions to British archæology of the post-War years was the conclusion, at which the late Mr. H. H. Thomas of the Geological Survey arrived in 1923, that the blue stones of the inner circle at Stonehenge were igneous rock derived from the Presely Mountains and the altar stone micaceous sandstone of either the Cosheston Beds around the estuary of Milford Haven, or the Senni Beds of Carmarthen and Brecknock; but up to the present no satisfactory hypothesis as to the method of transport and route has been offered. Mr. Grimes discusses the question in the light of his survey and gives his reasons for suggesting a route by both land and water in which transport from the Presely Mountains to the sea was effected by one of three possible ancient roads which he shows.

Aleutian Islands' Skull of Abnormal Size

DR. ALEŠ HRDLIČKA, it is reported by the Smithsonian Institution, Washington, D.C., in the course of excavations on the Aleutian Islands, has brought to light a skull of remarkable size. Its cubic capacity is said to be no less than 2,005 c.c. This is the second highest skull capacity recorded, the largest being that of Turgenev, the Russian novelist, whose skull has a capacity of 2,030 c.c. Skulls of known capacity ranking next are those of Daniel Webster, 2,000 c.c., Bismarck, 1,965 c.c., La Fontaine, 1,950 c.c., Beethoven, 1,750 c.c. and Kant, 1, 740 c.c. The enormous, but imperfect, South African Boskop skull, according to one estimate, has been rated at 1,950 c.c.; but a more conservative figure places it round about 1,700 c.c. Dr. Hrdlička's excavations on the Aleutian Islands, in the course of which the present find was made, are in continuation of a series of investigations of the archæology and physical anthropology of the present and former inhabitants of Alaska and the adjacent islands, upon which he has been engaged on behalf of the Smithsonian Institution for successive seasons during a number of years. His object is to elucidate the racial affinities and chronological succession of the early peoples who migrated from north-eastern Asia to populate America. On this problem, unfortunately, his latest discovery, apart from the probability that it is no more than an individual instance of abnormal development, would appear to throw no certain light, owing to the absence of the facial skeleton.

Human History and Geographical Discovery

IN his presidential address to the British Academy in July last (London: Oxford University Press. *1s.* net) Mr. J. W. Mackail said that we are at the beginning of a new era of discovery and interpretation which is revolutionizing the whole aspect of human history. Civilizations of the past in every continent are yielding up more of their secrets. Byzantine history, art and institutions have emerged from comparative neglect to an important place in humane studies. The past ages of India, China and Japan and even Central Asia are revealing their significance. The greatnesses of Central and South America are taking their place in the panorama of the past, and undiscovered Africa and impenetrable Arabia no longer exist. But important as are the acquisition and tabulation of knowledge, the primary function of humanism is the appreciation, in the largest sense of the word, of the classics of art, music, philosophy, history and creative invention over the whole range of life as throughout the whole range of literature. The danger which menaces learning is not that of conflict of sectional interests but of a general relapse into barbarism. It is not needless to reaffirm once more our emphatic and uncompromising support of all efforts to maintain the free development of the human intellect, unhampered by autocratic interference.

Avon Biological Research

THE third Annual Report, 1934–35, describing the continuation of work on the lines approved by the Avon Co-ordinating Committee, has recently been published (University College, Southampton. Avon Biological Research. Annual Report, 1934–35. Pp. 126+3 plates. Southampton: University College, 1936. 2*s*. 6*d*.). The work is conducted at University College, Southampton, where there are special laboratories set aside for the purpose, and on various parts of the river; the main purpose being salmon research and its branches, although trout research is also included. The salmon research is approved by the Development Commissioners, who since October 1934 have kept it under their official supervision, the Treasury having granted a sum towards the expenses enabling, among other things, a junior research officer to be appointed. Much help is acknowledged. Colonel Bennet-Stanford has erected a hatchery and provided facilities for the freshwater rearing of salmon in his lakes at the head waters of the Nadder, a tributary of the Avon, more than fifty miles from the sea, and many others have assisted substantially, both financially or by individual work and advice. A rotating fish screen (described in the appended papers) has been set up on Major Napier's land at Fordingbridge, where also are experimental spawning beds. East Mill still remains the headquarters of the river. The general report deals with the importance of vermin, artificial propagation and smolt migration. Appended papers include "British Mammals and Birds as Enemies of the Atlantic Salmon" (a most interesting and important summary), and "Importance of Iodine in Relation to Fish", besides accounts of hatching and stocking experiments and of scales from the Avon trout and grayling.

Useful Birds

THREE new Advisory Leaflets dealing with some British birds of prey have been issued by the Ministry of Agriculture and Fisheries. One describes the appearance and activities of the buzzard, another those of the long-eared and short-eared owls; and in the case of each of these birds the decision is that it is beneficial and worthy of careful protection. The third leaflet discusses the tawny or brown owl and the little owl; while the former is regarded on the whole as doing more good than harm, the little owl, although it also destroys pests, has become too plentiful in many districts on account of the loss it causes to poultry-keepers and others, and is therefore in no need of protection. These leaflets with their excellent illustrations by G. E. Lodge should be widely distributed in schools; they form the best sort of propaganda for bird protection.

Destruction of 'Vermin' in Bedfordshire

LUTON MUSEUM has performed a useful service in publishing a summary of "Bedfordshire Vermin Payments", extracted by J. Steele Elliot from the records of parish officials during the sixteenth to nineteenth centuries. A recent note in these columns referred to the exceedingly limited distribution of the pine-marten and polecat in Britain at the present day; but up to 1808 the pine-marten was being killed, at 2*d*. a head, in Bedfordshire, and in forty-two parishes payment was claimed on a total of more than 6,000 polecats, the most recent record in these accounts being in 1835. It is a sorry tale of extermination.

Indian Wild Life: a New Magazine

IN an effort to encourage wider sympathy with wild life in India, a group of enthusiasts has published *Indian Wild Life*, the official organ of the All India Conference for the Preservation of Wild Life. The objects of the Conference are ambitious: to give effect in all parts of India to the provisions of the All India Convention of 1935, to encourage the preservation of fauna and flora, popularize natural history in schools, establish a natural history library, and an exchange system of literature, to establish a National Park and to publish books and pamphlets on Indian natural history, and to disseminate literature in different languages. It is a big programme, but it is worth aiming at, and well worth encouraging. To the mind of a Western reader, too great a part of the new magazine is given up to personal paragraphs, but it is encouraging to find that already one of its objects has been fulfilled, and that a United Provinces National Park is an accomplished fact—the only Park of its kind in India.

British School of Archæology at Rome

IT is announced that Mr. C. A. Ralegh Radford has been appointed director of the British School of Archæology at Rome in succession to Mr. Colin Hardie, recently appointed fellow and classical tutor of Magdalen College, Oxford. Mr. Radford is a former student of the British Schools of Archæology at both Athens and Rome; and by his excavations on prehistoric Roman and medieval sites in Britain and abroad has taken a prominent part in recent advances in archæological studies. He was appointed Inspector of Ancient Monuments for Wales and Monmouthshire in 1929, and is also a member of the Royal Commission on Ancient Monuments of that area. As general secretary with Prof. V. Gordon Childe of the First International Congress of Pre- and Protohistoric Sciences he was jointly responsible with him for much of the success of the session held in London in 1932. Mr. Radford's training and experience have been such as should enable him to preserve the necessary balance between the studies of the School in prehistoric, protohistoric and classical archæology, to which the special circumstances of Rome are perhaps less conducive than those of Athens.

Television Demonstrations in London

EXPERIMENTAL television programmes are being transmitted by the B.B.C. until further notice between 11 a.m. and 12 noon and 3.0–4.0 p.m. daily. A demonstration television receiver has been installed at the Science Museum, South Kensington, upon which the B.B.C. transmissions from the Alexandra Palace are received. The receiver has been lent by Messrs. A. C. Cossor, Ltd., and is of the type which is now available to the public for home reception. A special aerial has been erected on the roof of the Museum, and the receiver has been installed in one of the basement galleries where provision has been made for visitors to see the demonstrations. The Southern Railway has also provided television receivers at Waterloo Station for the use of ticket-holders.

Announcements

THE Thomas Hawksley Lecture of the Institution of Mechanical Engineers will be delivered on November 6 by Prof. A. Fowler, who will take as his subject "The Spectroscope and the Atom".

THE council of the Illuminating Engineering Society has awarded the Gaster Memorial Premium to Mr. Ralph G. Hopkinson, for his paper on "The Photographic Representation of Street Lighting Installations", read before the joint meeting of the Illuminating Engineering Society and the Royal Photographic Society last December; and the Silver Jubilee Commemoration Award to Mr. W. R. Stevens, for his experimental work on "Thermal Endurance of Illuminating Glassware".

THE Masters Memorial Lectures of the Royal Horticultural Society will be given in the lecture room of the Society's New Hall in Greycoat Street, Westminster, on October 27 and November 10, at 3.30 p.m., by Dr. Redcliffe N. Salaman, on "The Potato in its Early Home and its Introduction into Europe".

DR. PASTEUR VALLERY-RADOT, a distinguished Paris physician and grandson of Pasteur, who is well known for his work on anaphylaxis and asthma, has been elected a member of the Paris Academy of Medicine.

DR. ETIENNE BURNET, formerly assistant director of the Pasteur Institute of Tunis and expert in the public health organization of the League of Nations, has been nominated director of the Pasteur Institute at Tunis in succession to the late Dr. Charles Nicolle.

THE Riberi prize, founded by an Italian surgeon, for the best contribution to the progress of medicine within the last five years, has recently been awarded to Dr. Francesco Pentinalli, professor of general pathology at Florence, for his work on experimental tumours and cancer. The articles submitted for the prize numbered 273 and emanated from 38 contributors from nine different countries.

THE Indian Science Congress, which will be held at Hyderabad on January 2–8, 1937, will consist of sections of mathematics and physics, chemistry, geology and geography, botany, zoology, anthropology, agriculture, medical and veterinary science and physiology and psychology. Further information can be obtained from Dr. H. Hyder Ali Khan, Medical College, Osmania University, Hyderabad.

THE Central Office of the World Power Conference, 36 Kingsway, London, W.C.2, announces that it will publish on October 28 the first number of the "Statistical Year Book of the World Power Conference" (price £1). This volume will contain an inventory of the power resources of the world, and annual statistics, relating to 1933 and 1934, of the production, stocks, imports, exports, and consumption of solid and liquid fuels, natural gas, water power, and electricity.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A technical officer for experimental work with ground and aircraft radio direction-finders at the Royal Aircraft Establishment, South Farnborough, Hants—Chief Superintendent, quoting No. A. 243 (October 12).

A lecturer in mining subjects in the Municipal College, Burnley—Director of Education, Educational Office, Burnley (October 12).

A lecturer in the Department of Architecture, Building and Structural Engineering, Rutherford Technical College—Director of Education, City Education Office, Northumberland Road, Newcastle-upon-Tyne, 2 (October 14).

Chemists (male) and a junior assistant chemist (male) at H.M. Factory, Irvine—Under-Secretary of State (C. 5), War Office, London, S.W.1 (October 17).

An assistant lecturer in the Aeronautics Department, Imperial College of Science and Technology, S.W.7—Secretary of the College (October 17).

An assistant biochemical engineer in Saorstát Alcohol Factories, Irish Free State—Managing Director of the Factories, Department of Industry and Commerce, 14/15 St. Andrews Street, Dublin (October 17).

An assistant lecturer in engineering at the School of Mines, Treforest—Director of Education, County Hall, Cardiff (October 19).

A civilian technical officer in the Department of Scientific Research and Experiment, Admiralty—Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1, quoting C.E. 6024/36 (October 24).

A library assistant at the Research Department, Institution of Automobile Engineers, Great West Road, Brentford, Middlesex.

Engineers for the Public Works Department (temporary staff) of the Government of Nigeria—Crown Agents for the Colonies, 4 Millbank, London, S.W.1, quoting M/4500.

A lecture assistant and laboratory steward for the Chemistry Department, Sir John Cass Technical Institute, Jewry Street, London, E.C.3—The Principal.

A lecturer in theory of structures and structural design, and a lecturer in electrical engineering at the Medway Technical College, Gardiner Street, Gillingham—Mr. C. Colles.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 646.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Diffraction of Light by Ultra-Sonic Waves

F. H. SANDERS[1], in a recent note in these columns, has reported excellent agreement between our theory and his experimental results. His note, however, calls for a statement from us clarifying the theoretical position. As is well known, Debye and Sears in America and Lucas and Biquard in France discovered, in 1932, that a beam of light after passing through a supersonic field breaks up into a fan of diffraction spectra. Following this discovery, Prof. R. Bär, of Zurich, carried out extensive investigations regarding the nature of the phenomenon; he obtained numerous beautiful results concerning the manner in which the relative intensities of the various diffraction spectra depend on the wave-length of light, the supersonic intensity and the thickness of the cell. He also discovered that the frequencies of light in the diffracted spectra are modulated by the sound field in a very peculiar manner depending on the order of the spectrum.

As has been remarked by many investigators, these results of Bar, and even the appearance of a large number of diffraction spectra, found no explanation in terms of the theory of Brillouin. Indeed, the existence of higher orders had been erroneously ascribed to the existence of overtones in the supersonic field. In the theory of Lucas and Biquard, which was mentioned by Sanders in his note, the laws of geometrical optics were applied to the problem, and it was assumed that the individual rays of the incident light follow paths independent of one another. This theory ignores the interference effects which are fundamental to the problem, and does not succeed in explaining the characteristic features observed in experiment.

The theory of the phenomenon initiated by us is set out in a series of papers[2]. At the outset, our purpose was to develop a theory of the simplest possible character which would satisfactorily account for Bär's experimental results. A simplification was effected by assuming that the wave-length of the sound is not too small and the thickness of the cell is not too large; in which circumstances, it can be shown theoretically from Fermat's principle that only the phase changes occurring in the passage of light through the cell need be considered. Indeed, Bar[3] reported later that the results in our papers I, II and III agreed qualitatively with most of the observed features of the phenomenon even in the general case, and in a perfectly quantitative manner when the experimental restrictions postulated by us were actually satisfied. In our papers IV and V, the restrictions mentioned above were dispensed with and the theory of the phenomenon was developed quite rigorously on the basis of the electromagnetic wave-equations. This general theory has been fully worked out by one of us (N. S. N.) and leads to a satisfactory explanation of some remarkable experimental results obtained by Dr. S. Parthasarathy[4] at this Institute. It is found that, when the light is incident obliquely to the sound waves and the latter are of sufficiently high frequency, the intensity of the diffraction spectra shows very marked asymmetry and that particular orders attain maximum intensity at characteristic angles of incidence given by a formula of the Bragg type. This is in agreement with the deductions from the theory.

Another aspect of the problem has been worked out by one of us (N. S. N.) in a paper now under publication. It has been explained why the supersonic waves can be seen directly through a microscope focused on a plane to the rear of the sound-wave cell. The theory predicts the interesting result that the grating-like pattern observed through the microscope repeats itself periodically as the focal plane of the microscope is moved away from the cell by integral multiples of a definite distance. This prediction has been confirmed quantitatively in a very recent (as yet unpublished) investigation made at this Institute by Dr. Parthasarathy. Other peculiar features of the sound field as optically observed—for example, a doubling of the number of fringes in certain positions of the microscope, and a disappearance of the fringes at certain other positions—are also indicated by the theory and are beautifully confirmed by the experiments.

C. V. RAMAN.
N. S. NAGENDRA NATH.

Department of Physics,
Indian Institute of Science,
Bangalore.
Sept. 9.

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[1] F. H. Sanders, NATURE, **138**, 285 (1936).

[2] C. V. Raman and N. S. Nagendra Nath, *Proc. Ind. Acad. Sci.*, **2**, 406 and 413 (1935); **3**, 75, 119 and 459 (1936). N. S. Nagendra Nath, *Proc. Ind. Acad. Sci.*, **4**, 222 (1936).

[3] R. Bar, *Helv. Phy. Acta*, **9**, 265 (1936).

[4] S. Parthasarathy, *Proc. Ind. Acad. Sci.*, **3**, 549 (1936).

Surface Markings on a Diamond

ACCORDING to the mosaic hypothesis, it is postulated that the uniform lattice structure of an ideal crystal is interrupted over narrow regions distributed periodically throughout the crystal at distances large compared with the size of the unit cell. Various forms of the hypothesis have been devised to explain anomalies in the intensity of reflection of X-rays, breaking strength and other 'structure-sensitive' properties of crystals, but the subject is at present highly controversial. Whilst many facts undoubtedly fit the hypothesis, several workers claim that some half dozen other types of fact do not fit[1]. All forms of the hypothesis including the 'lineage structure' proposed by Buerger[2] would predict non-uniformity

(*Continued on p.* 641.)

NATURE

SUPPLEMENT

No. 3493 SATURDAY, OCTOBER 10, 1936 Vol. 138

William Stukeley on Newton

Memoirs of Sir Isaac Newton's Life by William Stukeley, M.D., F.R.S., 1752: being some Account of his Family and chiefly of the Junior Part of his Life. Edited by A. Hastings White. Pp. xvi+86+3 plates. (London: Taylor and Francis, 1936.) 5*s.* net.

WE have reached a position when biography is taken seriously. Imagination is wanted; but in the case of great men, it is not enough to be imaginative; one requires to scrutinize the sources themselves in readable form.

William Stukeley owes his fame to Newton. He was an antiquary. According to the "Dictionary of National Biography" he is chiefly known to the public by one of his errors in reading a coin, which is the wrong thing for an antiquary to be known by. He was a friend of Newton; a Lincolnshire man like Newton. He was also at Cambridge. Though considerably Newton's junior, he afterwards saw much of Newton in London, and acquired an almost oppressive admiration for him. He afterwards went to Grantham, where he was in a favourable position to learn the truth of various stories. Hence when Conduitt, who married Newton's niece, wrote to several friends for their recollections, Stukeley was among the number, and responded.

We owe the present publication to Mr. A. Hastings White, consulting librarian of the Royal Society, to whom, as the superintendent of the British Museum Reading Room says in the foreword, "the thanks of students in so many branches of learning are due for his scholarship and never-failing readiness to help".

Mr. L. T. More regards Stukeley as "the principal source of our knowledge of Newton's personal life"; he also speaks later of Stukeley as "trustworthy"—one would add, if you take a grain of salt with his stories. He seems to have been a pre-scientific antiquary. Of Woolsthorpe, he writes, "This Mannor of Wulsthorp probably belong'd to Ulfus and took its name from him", and embarks on a page and a half about Ulf, decorated by an "in all probability" and an "I suppose". From the frontispiece to this volume, Stukeley looks a pleasant, good-humoured man. He had great opportunities, but I do not think he made the best use of them. He does not seem to have taken himself too seriously. He gives a sketch of Woolsthorpe as it was in his day, and says the house was rebuilt "not so large a form as the old house", from which we infer that the cut given in Brewster does not represent the house in which Newton was born. One would suppose that Brewster's well-known talent for inaccuracy lay in wait for him on an unnecessary occasion. But other people's boots are on the wrong feet too. Stukeley himself was not meticulously accurate. Mr. White gives an allegorical portrait of Newton by Stukeley, supported by a nude and dubious Urania (if it *is* Urania), with as many breasts as Stukeley can find room for, irrespective of the possibilities of anatomy, though Stukeley was, among other things, a medical graduate and a practising doctor.

One requires to be pretty clear as to *which* of Stukeley's writings the present volume is. Stukeley went to Grantham in 1726, the year before Newton died, and began collecting traditions. When Newton died, Conduitt wrote and asked him to contribute his collections, and Stukeley mostly sent these to Dr. Mead, who had attended Newton in his last illness. These apparently figure among the "Catalogue of Portsmouth Papers" (p. 44, No. 109), and they were auctioned with the rest by Messrs. Sotheby when the Portsmouth Papers were sold on July 13–14 of this year. Brewster consulted them, and also L. T. More. But Stukeley also made, apparently, two drafts of his letter to Mead in 1727, and kept these by him until 1752, perhaps completing them and perhaps allowing ample time for second thoughts. He drew these up twice over, under three heads. The heads should make for clearness; but they do not. They are rather conflicting, and one does not discover in the contents much trace of them. He put in the dedication, but he never seems to have taken any steps as to publishing them. One learns from the foreword to the volume under notice that Stukeley's own papers were auctioned in 1931, that is, before the Portsmouth Papers were dispersed. Afterwards, the chief MS. found its way to the Royal Society, where Mr. White copied it out and published it in the volume before us. Hence there are at least two documents by Stukeley, and one must compare, as well as one can, the present volume with what has passed through the sieve of Brewster and L. T. More, to find out whether they agree, Stukeley's papers in the Portsmouth collection not being now available elsewhere.

The result of this comparison is that the two are remarkably alike, though not quite verbatim. On the whole, we learn very little new from them, and what they do say, we would like to see confirmed from other sources. One would gather from the account of Newton's rich relations that he was always in opulent circumstances, which does not tally with his going to Trinity College in the capacity of a sizar. Among the major things we learn are that Newton was of a cheerful disposition; that he was very much attached to Grantham; that he was talkative among his own countrymen; that he was very much interested in plants and was in the habit of going "simpling"; that he used to be a good draughtsman when young; that when he had a cold, he stayed in bed until it was over;—all things that might be told of anybody. "Give me of Nelson only a touch, And I keep it, be it little or much." It is none the less a book to be read, as giving a picture of Newton and his personal habits, as he seemed to one who had seen him in the flesh. We are indebted to Mr. White for its publication.

One thing we get is a clue to the origin of the verses which Newton's former love, Mrs. Vincent, used to repeat when eighty-two years of age, which Brewster and also L. T. More attribute to young Newton, namely, they were copied out of *Eikon Basilike*, along with the drawing of King Charles I which is their subject. R. A. S.

The Naturalist Outlook in Psychology

The Natural History of Mind
By A. D. Ritchie. (Tarner Lectures delivered in Trinity College, Cambridge, 1935.) Pp. viii+286. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 15*s*. net.

THE title of this book is significant, indicating, as it does, that the author proposes a return from all the sterile systems of psychology that derive from the Cartesian separation of mind and body to the naturalistic outlook of Aristotle. He is in good company, and one of an increasing band of students of the biological sciences who, whether philosophically minded or not, are already upon the same road.

Mr. Ritchie, however, is philosophically minded, and makes use of his science to lead up to problems, vital for all philosophy, that emerge most clearly, though not exclusively, in psychology. Indeed, these are the very problems from which psychology originally arose, when men first began to speculate about the value of any kind of knowledge and the binding force of any kind of law. So far, however, as psychology is concerned, they remain problems to the end; for though this science still investigates the origin and growth of knowledge, and the belief that some actions are right and some wrong, it is left to philosophy to discuss the ultimate validity of the one and the ethical status of the others.

Because of this common sharing of subject-matter, Mr. Ritchie maintains that psychology must always remain "intimately connected with philosophy, as in the past". This is open to criticism; for, if a distinction is drawn between subject-matter and formal subject-matter, and between proximate and ultimate problems and principles of solution, the science of psychology could be differentiated from philosophy in exactly the same way as the other sciences are differentiated from it. Philosophy is not exclusively occupied with epistemology and ethics; and psychology, though it may provide the data, does not professedly deal with those topics.

Such criticism aside—and Mr. Ritchie anticipates it by remarking that his opinion is advanced "at the risk of misunderstanding and unpopularity"—"The Natural History of Mind" is intentionally a suggestive rather than a constructively conclusive book. Nearly half of it is taken up by preliminary chapters dealing, among other matters, with causation, the distinction between the living and the lifeless, the nervous system, and the functions of the brain. These preliminaries are necessary, for in the event much will turn upon the way they are treated. For example, the question of freedom (which, for Mr. Ritchie, rather than consciousness, is "the most central and illuminating fact of mental life") can only be profitably discussed in the light of an adequate theory of causality. Again, teleology (which "is not an explanation in the ordinary sense but a statement of fact, or a description") is one of those facts of which account must be taken when dealing with specific biological problems that are only generically covered by solutions of the more comprehensive problems of physics. Man, as a physical object in a physical world, is subject to physical laws ; as a living organism, he is subject to biological laws as well ; and, as a being capable of perceiving, thinking, feeling and willing humanly, it is surely arguable that even more specific laws apply also in his case. As Mr. Ritchie points out, you can prove once for all that all triangles have certain common properties ; but this does not absolve you from considering the peculiar properties of the different kinds of triangles.

Very interesting chapters are those on the brain and nervous system. They show how modern work has overthrown the reflex theory of Descartes that for so long handicapped physiology and psychology alike, and also indicate incidentally the influence of the *Gestalt* way of thinking. Their results for psychology are, however, in the main negative. The answer to the question "What does psychology study ?" which stands as title to Chapter vi, is disappointing. The science has no source of information of its own not shared by other sciences ; and it differs from these chiefly if not only by reason of the explanatory concepts of which it makes use. Mr. Ritchie writes paradoxically : "Self consciousness is a fact but not a fact that leads to knowledge about the self or the consciousness". Yet, if psychology is "the study of the embodied mind", surely this peculiar fact must lead to knowledge of some sort, that the self at least knows itself capable of feeling, thinking, willing and the like, because it has experienced itself doing so. This is no knowledge of abstract 'activities', but of an active concrete entity, from which the anthropomorphic conceptions used in physiology and the biological sciences are derived. It is noteworthy that Mr. Ritchie admits in parenthesis : "We need not enquire at present whether the categories of cause and substance even are safe from this accusation" (of anthropomorphism).

The final chapters deal with sensation, perception and cognition, and with emotion and thought, the latter containing a sympathetic criticism of Spearman's Two-Factor Theory and Principles of Cognition mainly from the point of view of linguistic defects in verbal *g* tests.

It has been said that this book is suggestive. It gives evidence of very wide reading in very many subjects ; and, while necessarily dealing with profound problems, is written with an admirable lightness of touch.

Clinical Research

Vascular Disorders of the Limbs :
described for Practitioners and Students. By Sir Thomas Lewis. (Department of Clinical Research : University College Hospital, London.) Pp. xi + 111. (London : Macmillan and Co., Ltd., 1936.) 6*s*. 6*d*. net.

THE active department of clinical research, under the direction of Sir Thomas Lewis at University College Hospital, London, has been engaged for the last eight or nine years in the study of disturbances of the circulation in the limbs. Because of their much greater surface relative to that of the head and trunk, the limbs suffer more from alterations in blood supply, and the circulation in the limbs is of greater importance. This book is not, however, an account of the scientific discoveries which have been made, but is written as a guide to the practitioner to direct his treatment of different conditions.

Many interesting observations are made. It has been customary to treat deficient circulation in one limb by keeping it warm ; Sir Thomas Lewis points out that a greater increase in circulation is obtained in the limb by warming the rest of the body. Heat applied to the body as a whole has the effect of lessening the vasoconstrictor tone in all arteries ; the arteries, therefore, dilate and admit more blood to the extremities.

A valuable analysis of the conditions grouped under the heading of Raynaud's disease is given ; Sir Thomas Lewis states that the term has been applied to a number of distinct conditions ; he applies the term Raynaud's *phenomenon* "to any state in which loss of circulation to digits occurs spasmodically, displaying itself in transient attacks of discoloration"; he uses Raynaud's *disease* to comprise cases of intermittent spasm of digital arteries. The cause of the disease is that the arteries are incapable of full expansion, being narrowed by thickening of the intima. In treatment, vasodilator substances have little or no value, though if the basal metabolism is low, the administration of thyroid is often beneficial. The section and degeneration of the sympathetic nerve supply improves the circulation to the limbs in these cases.

During the period in which the research on which this book is based has been done, Sir Thomas Lewis has been an influential advocate of the importance of clinical as opposed to laboratory investigation in the fight against disease; his book is, therefore, to be regarded as an example of what clinical research can do for the patient. That the results embody a large amount of industrious and expert observation is obvious, but they are rarely surprising, and it may be asked whether the most valuable and inspired research does not always give surprising results.

Clinical research is of course of the highest importance, for only by contact with it does the clinician learn the importance of physiology; the neglect of clinical research is responsible for the inefficient therapeutics seen everywhere to-day. But clinical methods are too limited to allow fundamental discoveries to be made; these demand the freedom which is only possible in the laboratory. If the laboratories have not been sufficiently fruitful in the past, it is the fault of the men in them, and their lack of training, rather than of the possibilities of laboratory methods.

The Biological Action of Radiation

Biological Effects of Radiation:
Mechanism and Measurement of Radiation, Applications in Biology, Photochemical Reactions, Effects of Radiant Energy on Organisms and Organic Products. (Prepared under the auspices of the Committee on Radiation, Division of Biology and Agriculture, National Research Council, Washington.) Edited by Prof. Benjamin M. Duggar, with the co-operation of Janet Howell Clark, Kenneth S. Cole, Farrington Daniels, Gioacchino Failla, Charles Packard, Henry W. Popp. Vol. 1. Pp. x+676. Vol. 2. Pp. vii+677–1343. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 70*s*.

TO write a comprehensive work upon the "Biological Effects of Radiation" has now become an impossible task for any single person, and we are, therefore, especially grateful to Prof. Duggar and his collaborators for the preparation of the two volumes before us. These volumes contain forty-three essays on various aspects of the question, and give about four thousand references to original papers; while their scope ranges from pure physics and chemistry to the chromosomal aberrations which may be produced by irradiation. Two subjects are, however, specifically excluded, namely, practical considerations relating to plant production, and those special applications of rays which are concerned with radiotherapy. It is as obviously impossible for one person to write an adequate review of such a work as this, as it is for him to compile it; and all that can be attempted is to give a general idea of the vast field that has been covered.

The great difficulty encountered by all serious workers upon experimental radiology is the highly varied branches of science with which it is necessary for them to have some acquaintance. As a consequence of this, we think that the writers of these volumes have done well in their introductory chapters to lay stress upon recent developments in physics, physical measurements, and some of the general chemical effects of radiations. To the pure physicist, the introductory chapters on photons, electrons and measurements might seem elementary or even superfluous; to the biological worker we are certain that they will prove invaluable. A further complication is introduced by the fact that rays of various kinds have now become not only an object, but also a means of research.

Mutations in plants and animals have been effected by exposure to X-rays and to the rays from radium; these subjects are dealt with in a series of papers which are at once clear, succinct and comprehensive; and although any special reference to the therapeutic use of radiation is excluded, the practical bearing of this experimental work must be obvious. The science of genetics is indeed largely indebted to the use of radiations for the attainment of some of its most interesting results.

To make definite selections from the large amount of information which has been presented to us is difficult, but there are a few topics, apart from those that have already been collectively mentioned, which it may be interesting to name, so that workers in special fields may have a guide as to where an epitome of the latest information is available.

The first of these is an excellent paper on the statistical treatment of biological problems in irradiation. The need for adequate statistical presentation of the experimental data obtained from large numbers of animal experiments is obvious, and more especially is this the case when a large number of experiments have been made on, for example, the question of heredity and susceptibility to implanted tumours. Too often conclusions on these and similar subjects have been based, not only on inadequate data, but even have been reached by methods which no statistician would regard as admissible. The essay on this subject should therefore fulfil a requirement which has long been unsatisfied. Of other aspects which may fittingly be made the subject of special mention are the biological effects of 'short' electric waves, which are of particular interest at the present time owing to the extensive use that is being made of them in medicine, and the much discussed problems of mitogenetic radiation. The radiations considered range from the 'short' electric waves to the γ-rays of radioactive substances; while the biological field extends from bacteria to phanerogams and from protozoa to mammalia.

The two volumes must undoubtedly find a place in every laboratory and institution where the biological effects of radiation are the subject of instruction or investigation.

India and Mineral Development

India's Mineral Wealth:
a Guide to the Occurrences and Economics of the Useful Minerals of the Indian Empire. By Dr. J. Coggin Brown. Pp. x+335+14 plates. (London: Oxford University Press, 1936.) 15*s*. net.

THE predominant impression produced by a perusal of this handy little book is one of astonishment at the amount of information packed within so small a compass. Dr. Coggin Brown possesses the happy facility of condensing facts and preserving at the same time, even in a work of this kind, an easy style and a connected narrative. The bird's-eye view of the situation, occupying no more than a single page of the introduction, is a snapshot as complete as it is harmonious of the position of mineral development in the Indian Empire, in which is included Burma.

The introduction serves as a signpost to anyone desirous of following the progress of the country from the point of view of minerals. It reminds readers where they can consult reviews of mineral production, including brief accounts of the geology pertaining to each mineral and full bibliographical lists. The mineral and geological literature concerning India is probably the best indexed in the world, thanks to the publications of her Geological Survey and more especially to the unselfish labours of Mr. T. D. LaTouche. The construction of a work of reference is a monotonous and glory-lacking occupation, too apt to be received, like food and drink, as a matter of course, and sharply criticized for any omission or defect rather than lauded for its incontrovertible value. Those who have occasion to use such works as the indexes of LaTouche and the compendium now under review will feel inclined to follow the example of the Cambridge divine who made a point of thanking God for the men who make dictionaries, catalogues and indexes.

Within a space of 300 pages of text, the useful minerals of India are considered individually by Dr. Brown as regards occurrence, history of development, uses (in the case of some of the less common minerals), outputs and their values from early times to the present day, and comparison with imported rivals, with brief notes on their origin.

India and Burma are associated in the average lay mind with gold and precious stones, but it is with the fuels that the author very rightly commences. Apart from the pivotal importance of fuel for most industrial purposes, India's output of coal and oil greatly exceeds that of any other mineral. As the figures published in this book show, during the quinquennium ending in 1933, the value of the output of the Indian goldfields, which supply the world with about 1·34 per cent of its needs in gold, was about three tenths of the value of her coal, and less than two fifths that of her petroleum; as for precious stones, the coal production was worth nearly 450 times as much as the diamonds, rubies, sapphires and spinels together! The book is full of little suggestive side-issues and remarks on subjects such as the simultaneous import and export of paraffin wax; the recovery of gasolene from petroleum gas, and the potential uses of what remains in the manufacture of dyestuffs, solvents and anæsthetics, in the preparation of helium for aeronautics, and as a fuel for domestic and power purposes; the amount of silver leaving the country in the copper matte and the zinc concentrates; the failure of corundum mining in contrast to its success in South Africa;

the import of coal for consumption on the Giridih coalfield and the analogous importation of Persian oil for fuel purposes in the Yenangyaung oilfield of Burma.

To check every statement and figure would be to rewrite the book, but those who know Dr. Coggin Brown's reputation for accuracy will have complete confidence in accepting his statistics. As Superintendent of the Burma Party of the Geological Survey of India for many years, as Mineral Advisor to the Indian Trade Commissioner, as an officer closely associated with the Imperial Mineral Resources Bureau, and as a man with an undoubted *flair* for collecting and presenting statistical information, Dr. Brown is peculiarly qualified for the task he has so ably completed. The work closes with a bibliography which with business-like brevity includes only the latest and most comprehensive publications dealing with each mineral.

It would take an ultra-cynical mind to discover any positive defect in Dr. Coggin Brown's excellent little book, and one closes it with one regret only, and that is that its pages are so few. To increase them to any large extent would, admittedly, defeat the main purpose of the volume, but one suggestion is perhaps worthy of consideration with respect to a second edition. It is the addition of a few pages describing and commenting on the special problems which confront the adequate development of India's minerals. As examples, the following will serve: the vital necessity of persuading the Indian peasant not to cook his food with cow-dung, the selling price of which as a fuel is half its value as a manure, but to substitute coke or coal, and to increase in this way and for this worthy purpose the ridiculously low coal-consumption figure of two million tons annually by a population of more than 352 millions; the reduction thereby of the considerable imports of artificial manure; the conservation of indigenous coking coal for metallurgical requirements; the possibility of eliminating the high sulphur content from the Assam coal, which would then furnish a rich source of hard, metallurgical coke; the substitution of some other reducing agent in the place of metallurgical coke; the question of winning oil by mining in place of boring; the prospects of oil shale and artificial substitutes as rivals to the free mineral; the adequate utilization of the large gas supplies available in the country; the question of India's smelting her own zinc concentrates, copper matte, tin ore, chromite, nickel and cobalt, speiss, etc., instead of exporting them in the raw state; the problem of utilizing more of her pig iron in the manufacture of her own steel; the discovery of additional uses for the almost inexhaustible supplies of magnesite, and for the large quantities of monazite; the establishment of a sulphuric acid industry; the employment of water-power for the manufacture of aluminium from the large reserves of bauxite; the encouragement of glass manufacture to replace the enormous imports from Japan; the remedy for the rock-bursts which at depths of 1½ miles are becoming a serious impediment to further development of the gold mines.

Many of these and other problems are alluded to directly or indirectly in the text but, having in mind the number of Indian statesmen, legislators, administrators and industrialists who will find a use for the book, a definite tabulation and presentation of the problems might stimulate and direct research, and even legislature. The book purports to be a collection of facts, but the problems are also facts though their several solutions have unfortunately not yet attained that status. The suggestion is no criticism of what is in the book; what is already there is so excellent that it is excusable to want more, even if only another ten or a dozen pages.

The book will be invaluable to industrialists, Government officials, economists, statisticians, members of legislative assemblies, and all interested in a great country which, with a mineral output valued in 1928 at £24 million, is slowly taking her place in the mineral world but still has much further to go.

EDWIN H. PASCOE.

Malayan Zoogeography

Die Geschichte des Sundabogens:
eine tiergeographische Untersuchung. Von Bernhard Rensch. Pp. viii+318. (Berlin: Gebrüder Borntraeger, 1936.) 18 gold marks.

IN the present volume Dr. Rensch presents a masterly summary of the zoogeography of the Malayan Archipelago. A general account of the expedition he and his colleagues made to the Sunda region (islands east of Java) was published in 1930, and the author has now collected together not only the results of his own expedition but also of some three hundred titles dealing with the region as a whole.

The bulk of the book consists of a detailed analysis of the fauna of each island in turn. Generally speaking, only the mammals, birds, reptiles, amphibia, butterflies and land snails are dealt with, but these are probably sufficiently representative of the various types of dispersal-power in the animal kingdom. His method has been to make a list of the fauna of the whole region and to divide the species, genera, etc., into four groups: those with a predominantly western (Asiatic) distribution, those with an intermediate type of distribution, those with an eastern one, and those with a distribution of an 'indifferent' type. The frequency of the types on each island is then examined and other resemblances between the fauna of different islands or groups of islands are investigated.

A preliminary conclusion is to maintain the significance of 'Wallace's Line', running between the islands of Bali and Lombok. This line is not, as indeed Wallace admitted, a boundary between two distinct faunal regions. It is rather the western limit of many animals with an eastern type of distribution. Thus in Bali, amongst the 255 genera, the four types of distribution are in the proportions 128 : 3 : 5 : 115, while in Lombok the proportions are 70 : 5 : 10 : 117 (out of 202 genera). From Lombok eastwards, there is a gradual but regular increase in the number of eastern forms. A more general conclusion is that the islands west of Lombok form part of the Asiatic continental shelf, while New Guinea, etc., belong to the Australian shelf; between these areas lies a *labile* area where the relations of land and sea have long been unstable. The fauna of this unstable area is fundamentally Asiatic in origin, but in relatively recent times it has been invaded from the east. Forms with better developed powers of dispersal (birds and butterflies) tend to penetrate westwards more than less mobile forms (reptiles). Dr. Rensch considers (p. 298) that the facts in general support Wegener's application of his theory of continental drift to this region, though he would modify such details as the dates of separation very considerably.

Apart from the special study of the Malayan region, several points of the widest zoogeographical interest are raised. Thus the author considers what is known of the repopulation of Krakatau after the earthquake of 1883. This is used to show that birds, small snails, and small reptiles have a considerable advantage in dispersal over mammals, amphibia and larger snails and reptiles. Mere lack of power of flight is not necessarily a barrier. Again, he notes the frequency with which a few miles of sea appears to act as a barrier to bird species. He suggests that in these tropical conditions there is never a yearly shortage of food and that no species has any urge to leave its normal habitat.

In all zoogeographical speculation, one feels strongly the need for some independent line of evidence to support the theories. A sufficiently complex series of hypothetical land-bridges and inundations could explain all the known facts of distribution without being true. Supplementary evidence derived from fossils is probably by far the best type of support, but unfortunately such evidence is at present lacking in the Malayan region. In some cases, however, Dr. Rensch's suggested bridges and dates have been independently postulated by geographers.

The fauna of many of the islands is still, of course, imperfectly known, and Dr. Rensch indicates (p. 301) which are especially deserving of exploration. It may be suggested that one larger map on which all the islands mentioned were clearly marked would have been a very useful addition to the book.

O. W. R.

Plant Cytology

Die Pflanzenzelle

Vorlesungen über normale und pathologische Zytomorphologie und Zytogenese. Von Ernst Küster. Pp. xii + 672. (Jena: Gustav Fischer, 1935.) 34 gold marks.

THIS book embodies the main features in Prof. Küster's courses of instruction in plant cytology at Giessen as they have developed during the last fifteen years or so. It is therefore particularly interesting as reflecting the point of view of a school of botany from which a very definite individual contribution has been forthcoming during the period in question; at the same time, the book shows that the author has been at pains to keep abreast of modern views in a field where output of publications, of new terminology and of new theories has been at a maximum, though the progress of time may show that the actual addition of new facts has been proceeding rather more slowly.

Prof. Küster has himself been a pioneer in the study of pathological plant anatomy, and this experience gives a definite character to the book, in which anomalous behaviour of cells and both degeneration and regeneration phenomena are treated with unusual thoroughness, though at the same time with a welcome breadth of outlook.

The book is also a notable departure from most recent cytological texts in that almost equal space is given to the four sections upon protoplasma, the nucleus, the wall and cell development, whilst three rather less extensive sections deal respectively with plastids, with starch grains, crystals and other dead inclusions, and with vacuoles. Thus much less space is given to nuclear division phenomena than usual, whilst the chondriome and vacuome receive subordinate, if sympathetic treatment, in the sections that deal with plastids and the vacuole. The treatment throughout is balanced and critical, and when an extensive section of modern literature is dealt with rather summarily, as is the case with the mitogenetic hypotheses of Gurwitsch, the author briefly indicates the ground for his position.

Altogether, whilst probably no other plant cytologist would write a book with the same emphasis, that is obviously one of the reasons why the book should be welcomed by botanists generally, who will probably read it with profit, and notably such sections as the extensive one dealing with the contribution to our knowledge made by plasmolytic studies, where the author's own investigations give additional weight to the critical presentation of results. The full bibliographies to each section, including citations of papers published in 1935, add very considerably to the value of the work.

Nature and Functions of Soil Humus

Humus:
Origin, Chemical Composition, and Importance in Nature. By Prof. Selman W. Waksman. Pp. xi+494. (London: Baillière, Tindall and Cox, 1936.) 30*s*.

NO problems of soil science have proved more difficult than those concerning the nature and functions of soil humus. The early work of Sprengel and Berzelius yielded a long list of humic and other acids which are still discussed in textbooks and some scientific papers, even though it has long been shown that they are indefinite complexes greatly modified by the processes of extraction. Physical chemistry and microbiology have cleared up some of the problems involved in the acidity of peats and soils and in the decomposition of plant residues, but methods are still lacking for characterizing adequately the forms of humus in different types of soil.

The fundamental paradox is that, in the soil, cellulose is rapidly decomposed and humus is comparatively stable, whereas in the laboratory humus is readily oxidized under conditions in which cellulose is inert. It is now obvious that most of the steps in the decomposition of plant residues are effected by micro-organisms, and that the more stable products are colloidal complexes formed by the condensation of modified lignins from plants with protein degradation products from micro-organisms. Little progress has yet been made in unravelling the constitution of these complexes. In the past, loose analogies were too often drawn between the humus extracts from soils and the black messes so readily produced in a variety of organic syntheses.

Agricultural investigations have brought out a bewildering array of special circumstances in which soil fertility appears to be related to the amount and form of soil organic matter or in which farmyard manure remedies some defect. Thus, the steady decline in yield in fifty years of continuous cereals at Woburn (not at Rothamsted as given by Waksman on p. 199) was associated with a loss of one third of the carbon and nitrogen originally present in the surface soil. Soil drift in the Canadian prairies and erosion in many parts of the tropics are the results of systems of land management which destroy soil organic matter by cutting off the normal additions and intensifying through cultivation the losses by oxidation. Farmyard manure and crop residues return to the soil the major plant foods, a variety of 'minor nutrient elements', and decomposible organic matter which forms colloidal complexes with high absorptive power.

The processes of soil formation are so intimately linked with the growth of plants and the decomposition of their residues that the main subject matter of pedology might well be regarded as the ecology of humus. Already in forestry it is recognized that the natural humus type should determine the system of management, and it is almost certainly true that the proper husbanding of soil organic matter is the essential requirement for any stable system of agriculture.

The literature on soil humus is immense in volume and widely scattered, but much of it is poor in quality. A critical review to replace Wollny's book of 1897 was long overdue, and Prof. Waksman's monograph will be warmly welcomed by workers in agriculture and forestry and in the many pure sciences which bear on soil problems. It contains a bibliography of well over

1,300 papers, and a particularly useful historical summary which shows how confusion has arisen through the uncritical use of ideas, nomenclature and methods long after they had lost their scientific basis. The statement of recent work on the decomposition of plant products under experimental conditions should prepare the way for a much more cautious and systematic approach to the more difficult problems presented by the behaviour of plant residues in natural and cultivated soils. It is to be hoped that the book will reach such a wide audience that there will soon be an opportunity for a second edition at a greatly reduced price.

Dairy Science

The Chemistry of Milk

By Dr. W. L. Davies. (Monographs on Applied Chemistry, Vol. 10.) Pp. xii+522. (London: Chapman and Hall, Ltd., 1936.). 25*s*. net.

THIS book has been awaited with considerable interest by chemists and others working in a field much wider than that of milk production only. The extent of the interest is, indeed, a measure of the economic importance to-day of milk, not only as a substance for consumption more or less unmodified, but also as a raw material both for food products and in industrial processes.

It is perhaps not surprising that the literature of milk is vast. One would think it was the most important fluid in the world, to man as well as to the cow. It is a matter for some reflection that the literature of human blood, obviously the most important fluid to the human species, though wide and varied, is far less extensive than that of cow's milk.

Dr. Davies has wisely restricted the scope of his volume, which touches on bacteriological questions only quite incidentally. The book is what its title denotes, but it is more than a re-hash or a reconstruction of any previously existing book on dairy chemistry. The late H. Droop Richmond's invaluable volume may not be replaced by the newcomer, for it will always have great historical interest and a peculiar value owing to the fact that it was primarily the work of an analytical chemist, but the passage of time must necessarily give such a book more and more of a documentary and less and less of a practical value. Dr. Davies has taken the opportunity of bringing up to date all the literature surveyed in Droop Richmond's book, a process of deletion as well as of addition, and in so doing has entirely re-arranged the subject.

Part 1 of the book under notice discusses the composition of milk with particular relation to variations in composition and the causes thereof. Part 2 discusses each of the individual constituents of milk, from the type substances, butter-fat, lactose and casein, down to the 'minor' constituents, minerals, enzymes, vitamins and so on. Part 3 is devoted to the physical chemistry of milk, with a chapter on its coagulation, and Part 4 to the chemistry of milk processing, including particularly the technology of condensing and drying milk. Part 5 is, perhaps, not strictly speaking covered by the title of Dr. Davies's book, for it discusses the nutritive value of milk, both of its separate constituents and of milk as a whole. One can dismiss the possible irrelevancy of this inclusion in a book on chemistry, because of the importance of the subject and the interest of the survey.

Some minor criticisms may be permitted, such as the overlooking in Chapter viii of Bleyer and Kallman's work on the residual nitrogen of milk, although their work on lactochrome is mentioned. On the other hand, there is no reference to lactoflavin, the composition and synthesis of which have now been worked out, though they possibly had not been when Dr. Davies's manuscript was completed. Nevertheless, the position of flavin as an essential part of the vitamin B_2 complex was surely known at that time, and whey was its chief source.

One could, of course, make minor criticisms on many other points, especially on those where matters of opinion are involved. But surely Dr. Davies cannot maintain that commercial caseins should have a moisture below eight per cent; by far the greater portion of them have moistures between ten and twelve per cent, and generally nearer the higher figure. Dr. Davies does not, in my opinion, sufficiently stress the different properties of acid casein and rennet casein from the industrial point of view, and it is not made clear that they are quite uninterchangeable between the plastics industry and the adhesives industry (using this term in the widest sense). His figures for the moisture content of milk, whether spray dried or roller dried, are a long way out. Reasonable maximum figures for a good grade commercial full cream dried milk are 2·5 and 3·5 per cent respectively for the two types. Again, why does Dr. Davies state that "the conception of the analyst is that milk of low quality should not be offered for sale, such milk as an article of food being equivalent to adulterated milk" ? The view of the analyst—presumably Dr. Davies means the 'public' analyst—is that milk must conform to legal requirements, and Dr. Davies himself points out that legal requirements do not prevent the sale of milk of low quality, provided it is 'genuine', that is, comes uncontaminated from the cow.

The range of subjects mentioned in the course of the book is far larger than might be expected by those who only casually come into contact with the chemistry of milk and its constituents. Taking a few isolated random pieces of information, one may record the distinction between 'casein' and 'para-casein'; the analysis of the milk of the zebra, the llama and the porpoise, among other mammals ; the methods of estimating citric acid ; the nature of autoxidative changes in fats, and so on. Indeed, one of the weaknesses of Dr. Davies's book is that he has crowded into it so much recorded information that he has left himself no time or space to evaluate it critically, and much of it badly needs this evaluation. The many detailed bibliographies at the end of each chapter, however, enable the reader to turn to the original sources and make this evaluation for himself. The book is made still more useful by an alphabetical author index before the subject index at the end.

This book is so important, and must so soon go into another edition, that the reviewer feels, in all friendliness, obliged to urge upon Dr. Davies and the publishers to make a new edition the occasion for careful revision. There is evidence of inefficient proof reading. Some of the undetected errors are trivial, but one can scarcely pass over the description, on p. 96, of β-lactose as "β-glucose-β-glucoside". Again, on the next page, it is stated that Hockett and Hudson's new compound constituted "the first instance for lactose to crystallise out in the anhydrous form". The statement should have been made to apply, of course, to α-lactose only, since β-lactose always crystallizes without water of crystallization.

It has, moreover, to be admitted that Dr. Davies possesses an unfortunate and rather inelegant style. This is shown in, for example, his definition of iodine value as "the percentage of iodine with which the unsaturated acids of the fat can combine". One sees what Dr. Davies means, but he has not said it. There is a sentence towards the end of p. 80 that is, at any rate to the reviewer, almost meaningless, and this is not the only example.

The fact remains that Dr. Davies's compilation is very valuable, and would be invaluable were it readable, which in places it is not, owing to his curious handling of the English language. In a sincere wish to increase the value of this book to workers in many branches of science and technology, and in the desire to assist Dr. Davies in maintaining the high reputation that is already rightly his in the research field, I would urge upon him to enlist the assistance of some of his colleagues at Reading for a thorough revision of this book on the literary side.

A. L. BACHARACH.

The Field of Inorganic Chemistry

Inorganic Chemistry

By Niels Bjerrum. Translated from the third Danish edition (1932) and brought up to date and adapted to English conditions in collaboration with the author by R. P. Bell. Pp. x+317. (London : William Heinemann, Ltd., 1936.) 7*s.* 6*d.*

It is seldom that any real enthusiasm can be aroused by an introductory chemical textbook. After the novelty of the 'ultra-humanized' book, introduced a decade or more ago, had worn off, there appeared imitations with varying degrees of merit, and differing mainly in the order of presentation of conventional matter, just as previous to them a line of monotonous uninspired productions had challenged the keenness of generations of beginners. Prof. Bjerrum's volume does not essay to initiate a further revolution ; it strives after no sensational effects, but unostentatiously and by a masterly treatment of its subject matter embodies all the qualities of a really first-class text-book. For its modest size, its special strength is in its handling of physical and theoretical aspects and developments. There are few who would fail to endorse the opinions expressed in the foreword by Prof. Donnan, who states that it is the finest introduction to modern chemical science that he has read, that there is no fundamental aspect of that vast field as it exists to-day that the book does not explain and illustrate in a clear and logical manner, and that its adoption in every English-speaking seat of learning would result in a marked improvement in the average standard of chemical knowledge.

After a short introductory chapter, the atomic theory with its practical aspects and ramifications is treated in the widest sense, embracing solutions, crystals, kinetics and valency. The non-metals are then dealt with in natural groups; a special feature, however, is that each group is followed by an adequate section on chemical change, each section being the one most suitably illustrated from the element-group preceding it. Thus hydrogen is followed by velocity and equilibrium in the formation of water, the halogens by velocity of chemical reaction, the sulphur group by a comprehensive survey of the modern theory of acids, bases, ionization and reactions in solution, the nitrogen group by the laws of chemical equilibrium, and the carbon group by thermochemistry and fuels. Then come the light metals with radium and radioactivity, the periodic system, atomic structure and electrochemical series; lastly, we have the commoner heavy metals in their appropriate groups. With copper and silver are considered the complex compounds and the general theory of complex ions, electrovalency and the nature of chemical linkage.

Practical aspects and applications of chemistry are interwoven throughout the whole text. It would perhaps be hypercritical to complain that there are no photographs and only seventeen line diagrams, including graphical plottings, and that deuterium is no more than mentioned and nothing is said about heavy water.

As a result of the inclusion of far more detailed physical chemistry than is found except in a large treatise or special text-book, we have a most up-to-date and useful survey of that branch of the science; the section on the modern theory of electrolytes is particularly worthy of note, covering as it does about forty-five pages and being work with which the author and his collaborators of the Danish school of physical chemistry are so closely associated. The book should be a source of inspiration to the post-novitiate student and one of interest and instruction to the more hardened scientific veteran. Binding, printing and production are in keeping with the high standard of the text.

N. M. B.

Structure Factor and Electron Density Formulæ

Simplified Structure Factor and Electron Density Formulæ for the 230 Space Groups of Mathematical Crystallography

By Dr. Kathleen Lonsdale. (Published for the Royal Institution.) Pp. vii+181. (London: G. Bell and Sons, Ltd., 1936.) 10*s*. net.

THE intensity of an X-ray crystal reflection is governed by many factors, such as the state of perfection of the specimen and the electronic structure of the component atoms, but chiefly by the relative arrangement of the atoms in the unit cell. The resultant amplitude obtained by combining simple sine waves emanating from each atom in the structure is known as the geometrical structure amplitude. Dr. K. Lonsdale has carried this summation over the co-ordinates of the general positions in which the atoms lie ("equivalent points") for each of the 230 space groups of mathematical crystallography. The general formulæ she has already given in the "International Tables for the Determination of Crystal Structures" (see NATURE, 137, 927; 1936), but in the present work these equations are reduced to forms in which they can be applied directly for any given combination of indices. In addition, the converse formulæ, in which the electron density at any point is expressed as a Fourier series, are given in convenient form, the summation here being taken over the eight quadrants of the reciprocal lattice, so that only positive values of the indices *hkl* need be considered, if the axes are orthogonal. For non-centrosymmetrical structures, the way in which the phase constants vary in the different quadrants is also given in every case.

We must congratulate the author on the completion of this intricate and beautiful piece of work. It will prove of inestimable value to all those engaged in quantitative X-ray analysis of the solid state, and its necessity will become more and more apparent as the methods of investigation improve and it becomes possible to make more rapid comparisons between one structure and another often belonging to an entirely different space group. The task of deriving these complicated relations from first principles each time soon becomes a serious handicap. Attention should be paid, however, to the warning given by the author as to the necessity of understanding the basis of the calculations before attempting to apply the tables in special cases.

The photographic method of reproduction from the original manuscript ensures freedom from misprints, and has the further welcome result of making the price very moderate for a work of this nature. We envy Mrs. Lonsdale her ability to produce such a manuscript, that all can read!

J. M. ROBERTSON.

A Programme for Astrophysics

Theoretical Astrophysics:
Atomic Theory and the Analysis of Stellar Atmospheres and Envelopes. By S. Rosseland. (International Series of Monographs on Physics.) Pp. xix+355. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 25*s*. net.

THE author of this book is well known as the professor of astronomy in the University of Oslo. It is evident that the same broad outlook upon the future of his science that led him to found the Institute of Theoretical Astrophysics at Oslo, with its associated publication *Astrophysica Norvegica*, has inspired him also in planning this volume.

The first few chapters give a logically developed account of atomic theory, treated by wave mechanics approached from classical dynamics via statistical mechanics. It is taken as far as the theory of atomic multiplets, and followed by a short account of the quantum theory of radiation. So it provides in outline a necessary and sufficient basis in general physics for almost all the astrophysical theory which follows.

The central part of the book is naturally devoted to the theory of stellar atmospheres. Starting from the theory of propagation of radiation in an atmosphere, and the formation of the continuous spectrum, it passes on to the treatment of line-widths and total intensities. A special feature is the account taken from the outset of the possibility of cyclical atomic transitions between more than two quantum states. Prof. Rosseland was himself the first to realize their significance in his well-known theory of bright lines in stellar spectra, and they have lately gained new importance in regard to the troublesome question of the central intensities of absorption lines. This theory is then linked on to that of thermal excitation and ionization in stellar atmospheres, which is specially associated with the names of Saha, Fowler, and Milne. By giving a simple unified rational interpretation of the whole sequence of stellar spectra, it probably still ranks as the most remarkable success in the application of atomic physics to astronomical observations. The effects of rotation, and of electric and magnetic fields, on the form of stellar lines are next considered. The occurrence of molecular bands in the spectra is also thoroughly discussed.

The last part of the book deals with the theory of stellar material lying outside the normal atmospheres. It proceeds from a consideration of the solar chromosphere and corona to the extended envelopes of some giant stars, then to gaseous nebulæ, and finally to the cosmic cloud. These all present new problems of mechanical and radiative equilibrium, amongst the latter being various intensely interesting questions connected with the occurrence of 'forbidden' lines.

The author's method in tackling any problem is first to describe clearly the *general* physical theory and the *general* mathematical methods that are required. In dealing with applications, he is, in this book, more concerned with key ideas, and with a careful statement of the assumptions and restrictions that have been made, than with details of results. This treatment will make the book particularly valuable to anyone beginning research in astrophysics. In the first place, it will put him in a position to refer intelligently to works of reference on physical subjects of the type of Fowler's "Statistical Mechanics" or the "Handbuch der Physik". In the second place, it will enable him to read the most recent work on the branches of theoretical astrophysics here treated, with a clear understanding of what has led up to it, and of the technique employed. Also the book will be welcomed by mathematical physicists wishing to gain an adequate idea of this field of application of their work.

The book has one characteristic which some readers may judge to be a deficiency. The astrophysical applications are in many cases left off at a seemingly unsatisfactory stage, and not completed by working out detailed theoretical results suitable for crucial observational tests. But this is apparently done by design. For, in spite of the almost startling successes of the subject, surveyed in the masterly introduction to the present volume, there is probably no part of it that will not repay fresh investigation using more powerful mathematical methods or more general physical models. The hope that this will be done, no less than that fresh problems will be attacked, is evidently behind the prefatory remark: "The aim of this work is to formulate a programme of theoretical astrophysics. . . . A second volume is planned to give a similar view of the internal structure of the stars". Prof. Rosseland's attractive presentation of his programme should draw many recruits to the promising task of attempting it.

W. H. McC.

The Theory of Differential Equations

Introduction to the Theory of Linear Differential Equations
By E. G. C. Poole. Pp. viii+202. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 17*s.* 6*d.* net.

SINCE Newton and Leibniz began to study differential equations in the seventeenth century, mathematics has made great strides. Though the creative mathematicians have mainly been inspired by the art of their subject rather than by the prospect of its useful applications, yet the demands made by the rapid progress of science have been responsible for a considerable amount of research. Much of this has been devoted to differential equations, for herein lies primarily the mathematical basis of applied science, notably physics and engineering. Unfortunately, however, most practical equations cannot be solved in finite terms, so that resort has to be made to approximations. Even Newton himself realized this difficulty and tentatively applied power-series, but before such a method could be reliably applied, it was necessary to show, not only that the power-series was valid within specified boundary conditions, but also that a solution to the given equation actually existed. It was not, therefore, until Cauchy discriminated between analytic and non-analytic systems and gave rigorous existence theorems for each type that any material progress was made.

Of the many types of equation, that which occurs most frequently is the linear form and, as a consequence, much has been written on separate branches of the relevant theory. Dr. Poole's "Introduction", the preface of which forms the basis of the above sketch, deals with this type and incorporates a considerable amount of noteworthy research in a single volume. The text, running into ten chapters, may be divided roughly into two parts. The first part, consisting of the first five chapters, deals mainly with the properties common to most linear equations; the second part—Chapters vi–x—is devoted to detailed discussions of the well-known equations of Gauss, Laplace, Lamé and Mathieu.

Among the general properties may be specially mentioned the powerful operational calculus of Heaviside, with its important application to equations with constant coefficients, and also, the principle of invariant factors, so essential to the Fuchsian theory. In the chapter on equations with uniform analytic coefficients, the interchange of solutions around a circuit is well illustrated by Euler's homogeneous equation and the equivalent system of linearly independent solutions—the Hamburger set—derived from Jordan's canonical transformation. Thomé's inductive proof of Fuchs's condition for a regular singularity is also given, together with Birkhoff's direct proof of the sufficiency of the conditions. The final chapter of the section on general properties is concerned with regular singularities, and includes a rigorous treatment of formal solutions in power-series.

Chapters vi and vii begin the detailed examination of some particular equations and are devoted to the theory of Gauss's, or the hypergeometric, equation. The relation between this and Riemann's P-equation is clearly exhibited and the existence of Kummer's 24 series-solutions proved. The discussion then passes to Schwarz's problem and conformal representation. The special cases of the dihedral, the octahedral, the tetrahedral and the icosahedral equations are of particular interest. Chapter viii deals with Laplace's transformation of the generalized equation with constant coefficients. This includes the theory of Kummer's first and second confluent hypergeometric equations with integral representations of their solutions. Then follows, in Chapter ix, the derivation of Lamé's equation and the relevant theory introducing Weierstrassian elliptic functions, with Halphen's transformation and Brioschi's solutions. The chapter ends with a brief discussion of Picard's type of equation in which the coefficients are uniform doubly-periodic functions.

The final chapter gives an account of Mathieu's famous equation which arose in a problem on a vibrating elliptical membrane. The particular solutions, known as Mathieu functions, are soon introduced, but, owing to the difficulty of finding a solution to the general form, only the equation which arises in celestial mechanics is considered. The theory concludes with an account of the solution of Lindemann and Stieltjes, which is modelled on the Hermite-Broschi treatment of Lamé's equation.

The equations of Bessel and Legendre have not been discussed in detail, for, as the author points out, "there are so many admirable accounts of them in English suitable for students of every grade".

Each chapter contains a number of important and useful examples, many of which are additional theorems taken from original papers. A valuable bibliography is also provided for further reading.

The book is designed for senior undergraduates at Oxford, but it may be confidently recommended to every mathematician interested in the very important study of differential equations.

F. G. W. B.

The Growth of Ancient Science

Histoire des sciences : Antiquité
Par Pierre Brunet and Aldo Mieli. (Bibliothèque scientifique.) Pp. 1224. (Paris : Payot et Cie., 1935.) 200 francs.

THE history of science claims a legitimate place in the organization of research and learning on the ground that it gives a faithful account of the development of positive knowledge with reference to the intellectual atmosphere of the various periods of civilization. It is not merely as an outline of the progress of thought and technology, but rather as a critical exposition of the chequered career of scientific thought, that the history of science has now secured recognition as an important and useful branch of knowledge and study. Of this conception of the history of science, an excellent illustration is given by the present work, which covers the origin and growth of ancient science.

In spite of its comprehensive title, this work deals almost exclusively with classical antiquity, though three of the opening chapters (pp. 38–112) are devoted to those civilizations which are claimed to have a direct influence on Greek and Roman thought and technology. It may be said, however, that a mere juxtaposition of the Eastern civilizations with that of the Greeks does not illustrate sufficiently the influence of the former on the latter. It is true that we possess little direct evidence of the possible filiation of this influence. But there is no reason why a discrimination should be made in favour of the Egyptian and Assyro-Babylonian civilizations.

There have been numerous and sometimes prolonged contacts between Greece, on one hand, and Persia and India on the other ; consequently, it is only fair to discuss, on the evidence we possess, the probable influence on Greece of all those races and civilizations with which Hellenism came into contact. As a matter of fact, this should be one of the most important tasks of modern research in this field of study. The authors of this work recognize the importance of this task, and they propose to deal with it more fully in another volume. In a lengthy note on p. 330 they indicate that the influence of Persia and India on Greece is not so great as is sometimes thought ; and they believe that if much of what is said of the antiquity of Indian science is discounted, it will be found that Greece may have influenced Hindu thinkers much more than is commonly admitted. The importance of this question is such that what they have to say on the matter in their forthcoming volume will be awaited with keen interest.

Faithful to their method of adhering strictly to original documents, the authors give a rather short account of the Pythagorean School. Similar reasons led Prof. Loria to dismiss summarily, in his "Storia delle Mathematiche", the claims put forward in favour of the importance of Pythagorean mathematics. But Sir Thomas Heath felt himself justified in giving, in his "History of Greek Mathematics", nearly one hundred pages to Pythagorean theories, for the evaluation of which he also uses later writers such as Nicomachus, Iamblichus and Theon of Smyrna. The truth may lie somewhere between these two positions. Nevertheless, the natural philosophy at least of the Pythagoreans (p. 428) could have been treated more fully in the present work, by making a judicious use of the testimonies of Plato and Aristotle and of other writers.

Of the controversial questions about which a straightforward opinion of the authors is given, we may quote Aldo Mieli's view of the personality of Socrates, whom he considers to be the last of the Sophists, or rather, as he puts it, a "Sophiste manqué", afterwards idealized by his disciples (p. 200). Contrary to the general belief, Aldo Mieli thinks that the influence of Socrates on science is more destructive than anything else, because he diverted the attention of the mind from the study of external phenomena to introspective or moral considerations. Again, the authors maintain that the study of Plato belongs to literature and philosophy rather than to science, his views on various scientific subjects being more speculative than positive.

A more generous attitude is taken towards Aristotle, because of his empirical attitude of mind ; and though the physical doctrines of the Stagyrite have been long ago discarded by science, the spirit of his inquiries still remains a fundamental characteristic of scientific research. Moreover, the results obtained by Aristotle in the field of biology are of the greatest importance in themselves as well as for the history of science. All these points are adequately developed by the authors, who do not seem to share the opinion expressed by Prof. F. Enriques in his work "Il Mondo Antico", where he accuses Aristotle of having suffered from an inferiority complex and from an exaggerated 'professorial' attitude of mind.

An important part of the present volume deals with the Golden Age of Greek science in the Alexandrine period. In the field of pure mathematics, Euclid, Archimedes and Apollonius are treated with the prominence they deserve. The study of the works of Archimedes is far from being complete, and the authors believe that much could be done by using the available Arab manuscripts. In a lengthy note on p. 387, they explain the meaning of the famous "Method" of Archimedes as involving the notion of "integral" and of "static moments" considered as proportions and not as products of a distance by a force. It is thus suggested that this Method, which was known in the Middle Ages, has influenced the conceptions of Cavalieri and the genesis of the calculus.

The astronomical views of Heraclides and Aristarchus, and their bearing on the heliocentric view of the universe, are summarized and contrasted with the doctrine of the homocentric spheres developed by Eudoxus. So also are the remarkable labours of Hipparchus, who improved the theory of the Epicycles and used trigonometrical methods in astronomy, and of Eratosthenes, the founder of scientific geography. A good account is given of Ctesibius, Philo and Heron, the most representative engineers of classical antiquity. Of the later astronomers, Ptolemy is given fifty pages, in which a summary of his works is followed by helpful appreciations and criticisms from the authors. Interesting additions to the traditional exposition of Ptolemy are the two chapters on optics and acoustics, in which an adequate account is given of the methods and views of the ancients concerning these important subjects. The exposition of Greek mathematics closes with an analysis of the writings of Nicomachus, Diophantus, Pappus and Proclus.

The development of ancient medicine is outlined with great skill and understanding in Chapters viii, xxix, xxxvi, xliv, xlv and liii. The Hippocratic writings, the Alexandrine physicians, the controversies about Celsus, the various schools of medical theory, the remarkable works of Galen and the decline of medicine during the Byzantine period, are considered in turn and illustrated with long extracts from the original texts. The pharmacological views of Dioscorides are treated in a separate chapter. Chemistry is given only one chapter, near the end of the present work ; in this connexion, an interesting passage is quoted from a "Lesson of Comarios to Cleopatra" about the fabrication of gold.

If the Romans made negligible contributions to pure science, their practical mind asserted itself in their interest for applied science. Agriculture and husbandry, engineering and public works, navigation and military science, geography and meteorology, biology and medicine, owe a great deal to the genius of the Romans. This debt is very ably outlined in the present work in the several chapters dealing with the development of these subjects during the Greco-Roman period. The architectural theories of Vitruvius, the encyclopædic work of Pliny, are thus discussed side by side with the geographical writings of Strabo, and the tidal hypotheses of Posidonius. After a brief mention of the encyclopædists of the beginnings of the Christian era, the authors bring us to the threshold of the Middle Ages.

The volume contains a mass of material of scientific, historical and controversial interest—so much, indeed, that there is a risk that the reader may have difficulty in following the thread of the story. The authors are at great pains, however, to explain carefully the various problems raised in the light of the available texts, and to discuss conflicting opinions about them in a wealth of footnotes. The views expressed are illustrated and supported by nearly three hundred textual quotations from more than eighty original sources ; and a number of passages have been translated by the authors themselves. A comprehensive index, two synchronical tables and a critical bibliography of twenty-five pages add to the practical and scholarly value of this important work.

THOMAS GREENWOOD.

Short Notices

Archæology and Anthropology

The Law and the Prophets

By H. Peake and H. J. Fleure. (The Corridors of Time, Vol. 9.) Pp. viii+188. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 5*s*. net.

In each succeeding volume of "The Corridors of Time", the authors have sought to epitomize the salient characters of a period, as well as mark the cultural advance recorded. In electing to close the series with "The Law and the Prophets", they indicate that they see the transition from archæology to history, not so much as a matter of written record, as the dawn of abstract thought and the initiation of a concept of godhead, which transcends the tribalized or local deity. This is a logical scheme, but in practice it is apt to leave ragged edges.

Broadly speaking, this volume covers the last millennium B.C., coinciding, however, more or less with the Iron Age, rather than with any absolute span in term of years. It opens with the rise of the Scyths, passes then to Assyria, China of the Chou Dynasty and the philosophers, India, where the racial problem is further discussed in the light of the last census report, the rise and fall of the Jewish kingdom, Persia, Greece and the rise of Greek philosophy, and the Iron Age of Italy, of Central Europe and finally of the British Isles. As the authors have been constrained by their plan to deal very briefly with a vast body of material, which in large part is historical, their method of treatment has been cramped, and they have been able to devote too little space to the archæological argument, in which, as is shown in the admirable, if brief, summary of the results of latest research in the British Isles, their power of acute and suggestive reasoning most frequently illuminates the evidence.

A welcome announcement states that a supplementary volume will deal with the processes of racial and social evolution of man in general terms.

Bitumen and Petroleum in Antiquity

By R. J. Forbes. Pp. vi+109. (Leiden: E. J. Brill, 1936.) 2 f.; 5*s*.

Knowledge of the technology of bitumen in antiquity has been considerably extended by the recent excavations at Ur and elsewhere in Mesopotamia. Mr. R. J. Forbes, though a technical expert and not an archæologist, has made a comprehensive survey of the archæological and literary sources for the use of bitumen in ancient times, and discusses fully the information relating to the character, sources and uses of the material to be derived from this evidence.

Although known and used from very early times, the importance of bitumen and oil in industry and commerce is a modern development, their place having been taken by pitch produced from wood from Roman times onward, except in the manufacture of 'Greek fire', of which the use, it was agreed among the nations in medieval times, was "too barbarous" for war. This oblivion, which became more or less complete in the Middle Ages, Mr. Forbes attributes to the fact that not only were the ancients impressed by the dangers of handling the material, but also the principal sources of supply lay outside the bounds of the Roman Empire in the eastern sector of the Fertile Crescent, and more especially on the eastern side of the Dead Sea and in Mesopotamia.

Mr. Forbes, on the whole, agrees with the view that the use of bitumen by the Egyptians in embalming is late and not so extensive as was once thought. At the same time, he points out that the importance attached by the Egyptians in Ptolemaic times to control of the area in Palestine in which it occurred, must be regarded as significant. His examination of the uses of bitumen in building construction in early Mesopotamia and at Mohenjo-daro will afford valuable guidance to field archæologists.

Biology

Rhododendrons and Azaleas:

their Origins, Cultivation and Development. By Clement Gray Bowers. Pp. xiv+549+40 plates. (New York: The Macmillan Co., 1936.) 42*s*. net.

As announced in the preface, this book is concerned with the practical use of rhododendrons and azaleas in North America and elsewhere. In England much valuable experience has already been gained with the genus, and made public by the Rhododendron Society and Rhododendron Association. Full use of this information has been made by Mr. Bowers and he is to be congratulated on having provided a very useful compendium on the genus, especially for American readers. His chapter on the behaviour of new introductions in America should be of special interest to growers in Great Britain, where diversities of climate are not nearly so great.

Inside the covers of the book are two highly decorative maps of that part of the Old World and of North America wherein rhododendrons are found, the numbers in red referring to the geographical regions mentioned in the text. It is a pity, however, that the distribution of the outlying species, *R. Lochæ*, in Queensland should have been omitted, the presence of this species on a remote mountain being of considerable phytogeographical interest.

The coloured illustrations are very poor and not worthy of the book. Indeed, they seem more suitable as designs for wallpaper-panels. The black-and-white figures, however, though crude, often give quite a good impression of the species, which may sometimes be recognized by anyone who already knows them well. The few photographs are mainly of general views in gardens and are very well reproduced.

The large bibliography will be useful to most readers and is divided into (1) general references, (2) historical, (3) culture and propagation, (4) physiology, etc., (5) hybridization, etc., (6) pathology and insect pests. J. H.

Les conceptions modernes de l'hérédité

Par Prof. Maurice Caullery. (Bibliothèque de Philosophie scientifique.) Pp. 312. (Paris: Ernest Flammarion, 1935.) 15 francs.

THIS book gives a fairly adequate account of the physical basis of heredity and of the more conventional aspects of genetics. The general treatment is on the whole satisfactory, but scarcely original. Unfortunately, many of the more important modern advances are omitted. There is no discussion of auto- or allo-polyploidy, of the evolution of dominance, or of the gene-complex. The physiology of sex-determination, and the whole subject of genetic physiology, is also omitted. The treatment of cell-division is entirely out of date: no attempt is made to modify the older views of it in accord with the work of Bělař, Darlington and the modern school of cytologists. On the other hand, Stern's cytological proof of genetic crossing-over is explained in a helpful manner.

There is a somewhat inadequate index, from which all names of authors are omitted. The references are scattered throughout the book, at the foot of the pages on which they are quoted. This is an extremely inconvenient system; they should be collected at the end, when they ought to form a useful bibliography. E. B. F.

Chemistry

A Text-Book of Organic Chemistry

By the late Dr. Julius Schmidt. English Edition by Dr. H. Gordon Rule. Third Edition, revised and extended. Pp. xxiv+865. (London and Edinburgh: Gurney and Jackson, 1936.) 25s. net.

THE appearance of a third English edition of Julius Schmidt's text-book bears witness to a steady demand for this work by advanced students of chemistry and biochemistry. This is not surprising, as the choice of comprehensive text-books of advanced organic chemistry in the English language is strictly limited. The work under notice deserves commendation as providing a coherent and well-documented background to the numerous monographs and series of lecture-notes with which the present-day student reading for honours in this expansive subject is hedged about. Although it has grown from 798 to 865 pages since 1926, this text still remains between two covers. This is a distinct merit; for, as a modern Dean Swift might write, whoever can reduce two volumes of an advanced organic chemical text-book into one deserves better of the honours student than the whole race of Beilsteins and Richters put together.

The new edition is considerably in advance of the last German edition of 1929, as on account of the death of Prof. Schmidt in 1933 no later German issue has been made. Dr. Rule has added materially to the value of his English text by including accounts of recent advances in the biochemical zone of organic chemistry (polysaccharides, sterols, bile acids, vitamins, hormones, natural colouring matters, etc.); the physical zone, also, has received its share of attention through the treatment of such topics as recent work on the Beckmann transformation, dipole moments, and dissymmetric allene derivatives.

It may be suggested that a fuller reference to the subject of strainless rings would be of use. J. R.

Recent Advances in Organic Chemistry

By Prof. Alfred W. Stewart. Vol. 2. With the addition of Part 2, by Dr. Hugh Graham. Pp. xiv+519+2 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 21s. net.

THE reissue of the sixth (1931) edition of Prof. Stewart's well-known work contains a new supplement of four chapters by Dr. Graham, dealing with the bile acids and sterols (28 pp.), the cardiac aglucones (vegetable heart poisons) (7 pp.), the hormones (23 pp.), and the vitamins (19 pp.). Separate name and subject indexes are provided for the supplement. Dr. Graham has given a judiciously selective account of the important advances in these fields of work, so that in its extended form the book will continue to render valuable service to advanced students and research workers in organic chemistry and biochemistry. That progress during the past few years in the common domain of these two regions of chemical science has outstripped the most sanguine anticipations of the last decade is a reflection which must occur forcibly to readers of this supplement, with its review of so many spectacular achievements.

Engineering

Dielectric Phenomena in High Voltage Cables

By Dr. D. M. Robinson. (Monographs on Electrical Engineering, Vol. 3.) Pp. xii+173. (London: Chapman and Hall, Ltd., 1936.) 15s. net.

THE economies effected by the use of very high voltages when transmitting electric power have led to its rapidly increasing adoption, but the higher the voltage the greater the number of breakdowns of the transmission cable. In electric supply an interruption of this nature is most serious; so expensive and elaborate tests in specially constructed laboratories are being carried out by cable manufacturers on the wrappings which surround the cables (the sheath).

In some cases the breakdown leaves a clean radial hole between conductor and sheath. In others, scorched and brittle papers are found particularly in the inner portions of the dielectric. Often they leave tree-like or fern-like patterns accompanied by dry patches where scarcely any free impregnating oil remains. The early investigators were baffled by the complexity of these breakdowns and concentrated their attention on the losses which occurred during a life test of the cable. Mathematical methods which assume that the sheath is homogeneous and that there are no 'voids' in it are only of limited use. In the book under notice, Dr. Robinson shows that visual examination has succeeded where external electrical measurements have failed. The work was carried out in the Research Laboratories of Callender's Cable Co.

The Design of Reinforced Concrete Structures

By Prof. Dean Peabody, Jr. Pp. ix+457. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 20*s.* net.

THE wider aspects of design are dealt with in detail by Dean Peabody in his book "The Design of Reinforced Concrete Structures". Theory is introduced so far as is necessary to develop the methods of calculation employed and to elucidate the force systems dealt with in the course of his subject, which includes the practical design of slabs, rectangular and tee beams, columns, footings and retaining walls, statically indeterminate structures and concrete arches. The numerous illustrative problems which have been fully worked out will be of especial value to the student. J. A. C.

Miscellany

The Paradise of Fools:

being an Account, by a Member of the Party, of the Expedition which covered 6,300 Miles of the Libyan Desert by Motor-Car in 1935. By Michael H. Mason. Pp. 282+23 plates. (London: Hodder and Stoughton, Ltd., 1936.) 15*s.* net.

ALTHOUGH this expedition into the Libyan desert, with Mr. Kennedy Shaw as leader, undertook scientific investigations, its primary function was exploration; and to the author of "The Paradise of Fools", in which it is described, it was mainly "a joyous adventure". The expedition, of which Mr. Shaw gave accounts in *The Times* during August 1935, and later before the Royal Geographical Society, covered by motor-car altogether six thousand three hundred miles, of which some three thousand were in country previously unexplored. Starting from Cairo, the cars travelled along the Nile to Assiut, then south-west to the Gilf Kebir plateau and then by devious ways from oasis to oasis to El Fashir, about four hundred miles west of Khartoum. They returned, mainly westward of their outward route, by way of the Selima oasis, through the Great Sand Sea between Gilf Kebir and Siwa northward to the Mediterranean.

The author's keenest interest lies in the desert, with all its attractions, less apparent perhaps to other travellers, as well as its dangers. The latter have by no means vanished with the coming of the motor-car, although they have changed their nature, and hardships have diminished. As hunter, Mr. Mason, when not engagingly concerned with the desert and incidents by the way, gives his attention mainly to the observation of animal life, more especially in its relation to water supply. Scientific results, however, are recorded in appendixes and a large-scape map. Of these results, the most noteworthy were archæological. The expedition secured some remarkable evidence of the activities of early man in the form of rock-drawings, pottery and the like, as well as skeletons of early man himself, of which some details have already appeared in NATURE (137, 159; 1936).

American Martyrs to Science through the Roentgen Rays

By Dr. Percy Brown. Pp. xv+276. (Springfield, Ill., and Baltimore, Md.: Charles C. Thomas; London: Baillière, Tindall and Cox, 1936.) 16*s.*

THIS work contains short and vivid accounts of the life and work of twenty-seven men and one woman—Mrs. Elizabeth Fleischman Ascheim—aged from thirty-five to seventy-seven years at the times of their deaths, who as doctors or technicians in the United States contracted severe X-ray dermatitis and cancer, and died after many years of suffering and operations in the form of skin grafting or amputation.

Among the most eminent of these martyrs were Clarence Madison Dally, who with his brother Charles did valuable work in the development of the various types of X-ray focus tube; Louis Weigel, who introduced an adaptation of the Wheatstone stereoscope, and invented a tube holder; Wolfram Conrad Fuchs, inventor of an electrolytic interrupter; Rome Vernon Wagner, inventor of the mica plate static machine; and his brother Thurman Lester Wagner; Charles Lester Leonard, a pioneer in urinary rontgenology and a prolific writer; Walter James Dodd, who occupies the same place in early American radiology as does Rontgen in the annals of German science; Eugene Wilson Caldwell, inventor of the liquid interrupter and of a stereo-fluoroscopic apparatus as well as of a practical method for examining the accessory sinuses of the nose; Frederick Henry Baetjer, author of important papers on the X-ray diagnosis of aortic aneurism and bone tumours; Francis Le Roy Satterlee, who made valuable contributions to dental radiology; and William Krauss, a pioneer in the therapeutic use of X-rays.

The text is freely interspersed with portraits and illustrations of röntgenological apparatus and accompanied by bibliographical references. A glossary for lay readers is appended.

A Parson in Revolt

By Joseph McCulloch. Pp. 174. (London: Nisbet and Co., Ltd., 1936.) 3*s.* 6*d.* net.

MR. MCCULLOCH is a young clergyman who delivered a broadcast talk in the "Youth Looks Ahead" series about a year ago. One of the thousand letters received by him as a result of his broadcast is printed in the author's preface to the volume before us. It sheds a clear light on the attitude of many who have a strong desire to satisfy their religious instincts, but do not find the Church of much use to them. "The real difficulty of our time," says Mr. McCulloch, "is in the approach to religion. The modern reaction is first an intellectual quarrel, then an attack on the institution, and third an expression of a genuine desire for God." But Mr. McCulloch pleads that it is "fundamentally topsy-turvy to attempt to build up a religion by starting with a search for one which is intellectually watertight". This is doubtless the case in so far as the religious need is not *primarily* an intellectual, but an emotional one. At the same time, a religion that is not "intellectually watertight", or at least reasonably so, is not of much use to anybody. Such a religion can only be a more or less deceptive fantasy, and cannot be relied on in a crisis.

The trouble with institutional religion as it exists to-day is that it does not take the claim for "intellectual watertightness" nearly seriously enough. Merely to bring the technique of worship up to date, and to scrap the parochial system (as Mr. McCulloch suggests), is just to scratch the surface of the problem. Beautiful and inspiring worship, and efficient organization, avail nothing if the religion stresses as important beliefs which are not historically or scientifically true. Yet Mr. McCulloch has written an honest, stimulating book. J. C. H.

Physics

Electrical Measurements in Principle and Practice

By H. Cobden Turner and E. H. W. Banner. Pp. xiv + 354. (London: Chapman and Hall, Ltd., 1935.) 15*s*. net.

THE always inadequate literature of electrical measuring instruments is notably strengthened by this addition. The frontispiece in itself is worth having, though it merits printing on three separate pages normally oriented in place of the single much folded sheet, which demands some proficiency in acrobatics for its full enjoyment. The treatment of the measuring instruments of power-engineering and of audio-frequency work is in general satisfactory; that of the more fundamental work, and of oscillographic work, is not so good; while the treatment of radio-frequency measurements is definitely amateurish.

Local patriotism and the camera have combined to weaken the balance and usefulness of the work as a whole. The predominance of Lancashire does not extend so far into the instrument field as the proportion of "Salford" illustrations suggests. Photographs, without the inclusion of the invaluable foot-rule, are much less useful to the reader than are line diagrams. The authors have allowed the sales and publicity men to unload on them an undue share of their facile material, as, for example, on p. 241, a "Valve Oscillator. Mains All-Metal Type". The learned judge might, with more reason than usual, ask "What is an all-metal oscillator?" Whether he might advantageously be invited to turn his attention to p. 143, "experience in the supply of testing instruments to the Government Services has produced robust instruments able to withstand the maximum of rough handling", is a high-politico-legal problem.

The definition of a galvanometer (p. 109) is not good; the reference to oscillographs on the same page is worse. A galvanometer is not necessarily sensitive; it is of its very essence that it does not, directly, "measure" D.C. or A.C.; oscillographs are not merely "a form of galvanometer" and are not of two types—moving coil and cathode ray. The moving iron oscillograph deserves mention, the moving coil oscillograph is not sensitive (as a member of the authors' class of galvanometer must be) and the cathode ray oscillograph would still be a laboratory toy were it only a galvanometer.

The power engineer will probably find the book more valuable than these critical comments suggest. A good book, first edition, would be a very good book, second edition, if attention be given to the points mentioned.

Tables of Physical and Chemical Constants and some Mathematical Functions

By Dr. G. W. C. Kaye and Prof. T. H. Laby. Eighth edition. Pp. vii + 162. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 14*s*. net.

IT is difficult to imagine a modern physical laboratory which does not possess its well-thumbed copy of "Kaye and Laby"; and it is a special pleasure to see that our old friend, clad in gayer harness than has been his wont, has now reached his eighth edition.

Kaye and Laby's Tables is a work the utility of which is quite out of proportion to its modest dimensions. In a small and handy volume of tables, the editors have to pick and choose, and they have two main duties to perform: to see to it that they let down the users of the tables as infrequently as possible, and to arrange their matter so that the searcher for a number may find it with ease. How well the editors have accomplished their task is obvious—an eighth edition speaks for itself.

This edition preserves all the old features, and a number of recent data have been added. If a very mild criticism may be ventured, it is that the editors, in their anxiety to introduce new data under the appropriate heading, have had to cut short the amount of new information which they could have given us. In all instances of physical properties which vary with pressure and temperature, it is advisable to list these properties over as wide a range as possible—preferably by means of equations, when dealing, say, with homologous organic compounds. For heavy water, some preliminary investigations have been made, and density, viscosity and surface tension, for example, have been investigated at different temperatures. Exigencies of space have made it impossible for the editors to do more than quote one or two figures—it were impossible otherwise to squeeze them in under their appropriate heads. It is much to be hoped that the editors will, in the ninth edition which is surely contemplated, give the latest information which may be needed in any detail by way of a separate sheet or two at the end of the book. A detailed index, which already exists, would serve as guide, and much more additional information would be easily made accessible to the reader.

The new edition may be heartily commended, both to users of the old editions, and to those unfortunates who know not how Kaye and Laby's Tables *delectant domi, non impediunt foris.* A. F.

Light

By A. E. E. McKenzie. Pp. x+178+10 plates. (Cambridge: At the University Press, 1936.) 2*s*. 6*d*.

THIS unassuming little volume presents the elementary facts of optics to pupils of School Certificate standard in most attractive fashion. The author has evidently written the book *con amore*, and his enthusiasm for his subject should be infectious.

He has accepted the recommendations in the report of the Physical Society on "The Teaching of Geometrical Optics" with respect to sign convention, and of the conventions recommended has adopted that in which distances actually travelled by a ray of light are taken as positive, and distances measured along a virtual ray as negative.

The subject is developed in its usual order, and the book is illustrated by an excellent series of photographs, including a most remarkable photograph of a desert mirage as seen in Persia. An ample number of numerical examples are appended to the chapters.

The book can be unreservedly commended.

A. F.

Philosophy and Psychology

The Way to Happiness for Humanity:
a Modern Philosophy for Everyone. By "Amator". Pp. 324. (London: The Good Hope Publishing House, n.d.) 4*s*. net.

IF it is true that anyone who thinks is a philosopher, it is equally true that anyone who has thoughts to put forward after careful consideration is entitled to do so, provided he satisfies himself of their appropriateness as to form and content. Moreover, if it is true that happiness is the goal of any mortal man, we are all of us entitled, whatever our particular interests, to think of the best means of attaining happiness; and when we consider that our way may be of some use to others, then it is almost our duty to communicate to the world at large the results of our thought. It is probably such and similar thoughts that prompted the anonymous author of this work to write it. In expressing his opinion he shows great courage and a thorough understanding of the issues involved. As an attempt to solve one of the major problems of philosophy, "The Way to Happiness" deserves praise and careful consideration.

Personality Maladjustments and Mental Hygiene:
a Textbook for Psychologists, Educators, Counselors and Mental-Hygiene Workers. By Dr. J. E. Wallace Wallin. (McGraw-Hill Publications in Psychology.) Pp. xii+511. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 18*s*.

MENTAL hygiene has become so much a matter of everyday politics that well-balanced books on the subject are welcome. This is a sane and readable account of personality difficulties and how to deal with them. How we wish the dictators and other psychopaths in the world could apply mental hygiene principles to themselves and their henchmen. The author very wisely says: "A large proportion of our social and political distempers can, doubtless, be traced to the disfigured, discordant, dissatisfied personalities that inhabit the earth. . . . Mental health and mental hygiene in international as in personal relations means facing facts and issues candidly and dispassionately, without bias, duplicity, hypocritical diplomacy and subservience to insensate emotional urges."

Twentieth Century Psychiatry:
its Contribution to Man's Knowledge of Himself. By Dr. William A. White. (Thomas W. Salmon Memorial Lectures.) Pp. 198. (London: Chapman and Hall, Ltd., 1936.) 10*s*. 6*d*. net.

THIS series of lectures presented by Dr. White to the New York Academy of Medicine in 1935 makes most interesting reading both to the psychiatrist and to the layman. Psychiatry is an ugly word but has a wide meaning, and it is a pity that the average layman has little idea of its meaning. To-day it covers not only the work of the old-time alienist but also that of the modern workers in mental hygiene, criminology, sociology and wide ramifications in sundry ancillary subjects.

We commend these lectures to those who are sympathetic to what is one of the most technical, most difficult and most exhausting branches of modern specialized medicine.

Technology

Practical Photo-Micrography

By J. E. Barnard and Frank V. Welch. Third edition. Pp. xii+352+23 plates. (London: Edward Arnold and Co., 1936.) 21*s*. net.

THE appearance of the third edition of "Barnard and Welch" is a very welcome event. Broadly speaking, it follows the plan of its predecessors, except for a number of recent developments which add materially to its value. These are concerned with the application of infra-red radiation to microscopy, and an extended technique suitable for opaque objects. In this latter connexion one would have been glad to see some specific reference to recent work on the photomicrography of polished minerals and ores by polarized light, such as has achieved considerable success both at Cambridge and on the Continent. In metallurgical practice, the tendency to forget that magnification exerts little influence upon exposure times (due to the self-condensing action of the objective) is specially mentioned—a most valuable reminder. Again, the photo-micrography of mercury droplets as a method of perfect centration is a very elegant device, beautifully illustrated for both ordinary and dark-ground illumination. As the authors remark, skill and long experience are more important than complex equipment. That is the conclusion which many workers in this field have reached, encouraged maybe by the guidance of "Practical Photo-Micrography".

F. I. G. R.

The Gramophone Record

By H. Courtney Bryson. Pp. xix + 286. (London: Ernest Benn, Ltd., 1935.) 21*s.* net.

THE gramophone record industry is so specialized, particularly in the manufacture of disk records, that although the industry is half a century old and substantial developments have taken place in the last decade, there have been hitherto no books or 'inside' information published which give a comprehensive account of the extremely delicate processes involved in making multiplications of a master record perhaps a million times. The author gives an amusing, but intelligent, historical account of the pioneers and their early efforts in recording natural sounds, and then carefully states the nature of the problem and how it is solved at the present time.

The text is profusely illustrated with photographs of technical operations, so that the reader is not left in the air with theoretical notions. The author is a specialist in plastics, and hence the valuable part of the book is concerned with the materials, which are necessarily the limiting factors in making records of technical excellence, their properties and technique of handling. The final chapter deals with possibilities of departing from the prevalent black shiny disk, but the author is not hopeful. We are also pessimistic, since the shellac disk is the cheapest method of obtaining an artistic record which is tolerable, and on account of the rapid decline in the sales of records, the large record firms, which have substantial monopolies, will be loath to change to an improved system. These aspects tend to make the present text the more valuable. L. E. C. H.

Stereoscopic Photography:

its Application to Science, Industry and Education. By Arthur W. Judge. Second edition, revised and enlarged. Pp. xi + 340 + 22 plates. (London: Chapman and Hall, Ltd., 1935.) 21*s.* net.

IN Great Britain the amateur photographer, unlike his colleague on the Continent, is not as a rule interested in stereoscopic photography: its developments therefore have been mainly scientific and industrial. The additional matter contained in this new edition of Mr. Judge's book reflects this condition. The most important advances perhaps are in connexion with medical work, ophthalmic appliances and the recording of X-ray 'screening' experiments under improved conditions. Nevertheless, the classical part of the subject permits of wide extension, such as the application of geometrical optics to the more refined problems of binocular vision. The book is thoroughly practical and provided with an abundance of illustrations.

In the past, it has been difficult to obtain up-to-date information of the kind in English: this volume therefore should appeal to a wide circle of inquirers. F. I. G. R.

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on such a section of a crystal as a crystal face. Hence all observations of small-scale regular markings such as etch figures and slip bands at the crystal surface and especially their minimum dimensions are highly relevant to the subject.

The dimensions of the sharply defined triangular markings shown in numerous photomicrographs[3] of natural (111) faces of diamond are all large compared with the hypothetical dimensions, about 1 μ, of mosaic irregularities. Whilst examining the surface irregularities on some unusually good specimens kindly lent by Prof. W. T. Gordon for X-ray study, it was noticed that a number of regions on one specimen which at ordinary powers of magnification appeared to be free from triangular markings, at magnifications of about 750 diameters showed many minute triangles (Fig. 1). Their orientation was normal, with the angles pointing towards octahedron edges, and the edge of the smallest clearly resolved triangle measured 1·3 μ.

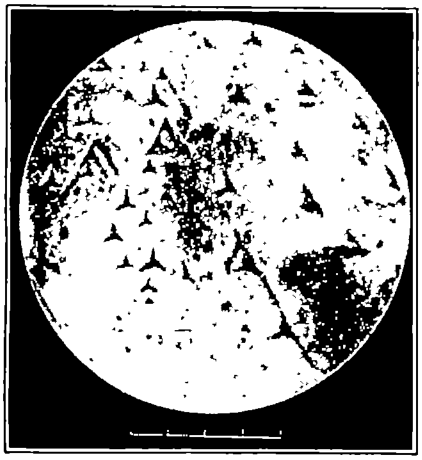

FIG 1. Photomicrograph of (111) face of a diamond showing some triangular markings of 'mosaic' dimensions. Each scale division represents 0 01 mm.

These abnormally small regular markings were found only in groups and only at the edges of the crystal face. They were not detected on any of the other specimens examined similarly. The specimen measuring about 6 mm. × 4 mm. was the only one from the new diamond field at Sierra Leone. No trace of striations of this 'mosaic' order of magnitude was detected optically, but even the triangular markings themselves were difficult to observe because of their minuteness and the high transparency of the diamond. The optical difficulties were too great to justify an attempt to find the unit size of the largest equilateral triangular network fitting *all* the observed triangles[4]. For the (111) face of bismuth this derived quantity, claimed to be of the order 1·4 μ, is about the same as the observed dimensions of the edge of the smallest triangle on the diamond. Sufficient contrast to see or to photograph the markings was got by defocusing, and I am indebted to Mr. G. A. de Belin for the trouble taken to get the photomicrograph reproduced.

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[1] See Ann. Report Chem. Soc, 189 (1935).

[2] Buerger, *Z. Krist.*, 89, 195 (1934)

[3] A. F. Williams, "The Genesis of the Diamond", vol. 2 (1932), and J. R. Sutton, "Diamond" (1928).

[4] Goetz, *Proc. Nat. Acad. Sci*, **16**, 99 (1930).

Optical Experiments on Liquid Helium II

THE anomaly in the specific heat of liquid helium at 2·19° K. has the same shape as that of the λ-point anomaly in crystalline substances. In crystalline bodies the λ-point anomaly, similar to that shown by ferromagnetic bodies at the Curie point, is due to some process connected with a change of order in the crystal.

It is natural to suppose that in the case of liquid helium II we also have to do with some form of order. As this type of transition is observed in liquids when liquid crystals are formed, it is not impossible that liquid helium at temperatures below 2·19° K. also forms liquid crystals.

Liquid crystals are anisotropic, and it is therefore interesting to study the optical properties of liquid helium II. If liquid helium II does in fact form liquid crystals, polarized light, on passing through a layer of helium, must be depolarized, as on its way it traverses a large number of optically anisotropic regions of different orientation.

In our experiments a layer of helium, 10 cm. in length, was placed between crossed nicols. The accuracy was such that a change in the intensity of light corresponding to a rotation of the prisms of ± 1·5° could easily be registered. On cooling the helium from 4·22° to 1·72° K. no change in the intensity of the light could be detected. It is possible that the effect could not be observed owing to the small dimensions of the liquid crystals. We therefore studied the Kerr effect in liquid helium II at 1·72° K. in a constant field of 63,000 volts per cm. No change in the light intensity could be observed with crossed nicols, the planes of polarization of which formed an angle of 45° with the direction of the electric field.

Assuming that the field was sufficiently strong completely to orient the optical axes of the crystals, we have computed that the anisotropy of the refractive index for helium II is less than 7×10^{-8}. If the optical axes were oriented perpendicularly to the direction of the field, this ratio would be 1×10^{-7}.

As the optical anisotropy which might have been expected in helium II lies within the accuracy of measurement, it must be assumed that the anomaly in liquid helium cannot be explained by a transition into the liquid crystal state.

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Kharkov. Sept. 10.

Infra-red Absorption Spectrum of Heavy Phosphine (PD_3)

THE infra-red absorption spectrum of PD_3 has been investigated with the view of testing the applicability of the 'valence force field' in correlating the fundamental vibration frequencies of a pyramidal molecule of the type YX_3. If it is assumed that the valence force field applies to PH_3, then one can deduce the values of the force constants of this molecule from its known vibration frequencies. This has been done by Howard[1], who gives $3 \cdot 09 \times 10^5$ dynes/cm. for the force required to alter the PH distance, and $0 \cdot 34 \times 10^5$ dynes/cm. for that required to alter the HPH angle. From these data one may compute the frequencies of the PD_3 molecule (since it is permissible to assume that these force constants are not appreciably altered by the substitution of a deuterium for a hydrogen atom). The frequencies of PD_3 are thus predicted as $\nu_1 = 1{,}630$ cm.$^{-1}$, $\nu_2 = 1{,}639$ cm.$^{-1}$, $\nu_3 = 775$ cm.$^{-1}$, and $\nu_4 = 871$ cm.$^{-1}$, all of which should be observable in the infra-red.

Strong absorption bands have been observed in gaseous PD_3 at approximately 1,670 cm.$^{-1}$, 790 cm.$^{-1}$ and 730 cm.$^{-1}$. These may reasonably be identified as ν_1, ν_4 and ν_3 respectively. The frequency ν_2 which is not observed in PH_3 is also apparently too weak to be observed in PD_3. Weaker bands have also been observed at 2,325 cm.$^{-1}$ and 3,280 cm.$^{-1}$ which may readily be interpreted as the combination bands $\nu_1 + \nu_3$ and $2\nu_1$ respectively. Three Raman lines have been observed for liquid PD_3 by Hemptinne and Delfosse[2] at 1,664 cm.$^{-1}$, 805 cm.$^{-1}$ and 748 cm.$^{-1}$. These obviously correspond to our three main absorption bands and have, in fact, been given the same interpretation by those authors. The results are tabulated below.

Fundamental Frequencies of PD

	ν_1	ν_2	ν_3	ν_4
Calculated on valence force field	1,630	1,639	775	871
Observed in infra-red (gas)	1,670	—	730	790
Observed in Raman effect (liquid)	1,664	—	748	805

It is immediately obvious that the discrepancy between observed and calculated values is a fairly serious one. It is much larger, for example, than in the corresponding comparison[1] for ND_3. One must conclude that the simple valence force field is a rather incomplete representation of the force field in this type of molecule, and that considerable allowance must be made for interaction and anharmonic terms in the potential function. The determination of those necessitates a very accurate knowledge of the spectrum of PD_3, which is therefore now being investigated under high dispersion.

We are very much indebted to Mr. I. L. Bolland, of the University of Edinburgh, for his kindness in supplying us with the sample of PD_3 used in this investigation.

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Sept. 14.

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[1] J. B. Howard, *J. Chem. Phys.*, **3**, 207 (1935).

[2] M. de Hemptinne and J. M. Delfosse, *Bull. Sci. Acad. Royal de Belgique*, **21**, 793 (1935).

Atmospheric Oscillations

As is well known, the semidiurnal barometric oscillations indicate that the atmosphere has a free oscillation of a period of 12 hours[1]. On the other hand, G. I. Taylor's evidence[2] from the propagation of waves of explosion points to a free period of 10½ hours. Moreover, the diurnal variation of the earth's magnetic field, when interpreted by the 'dynamo' theory, shows[3] that at the upper conducting layer the pressure oscillations are nearly 180° out of phase with the observed pressure oscillations at the ground. Also, the required conductivity of the layer is larger than the value that can be inferred from radio soundings.

It appears that all the above mentioned facts can be reconciled if we assume a temperature distribution in the atmosphere such as is shown by the curve T in the accompanying figure (Fig. 1). The rise of temperature between 37 km. and 60 km. has been inferred by F. J. W. Whipple[4] from the abnormal propagation of waves from gun-fire, and is in general agreement with the results of similar experiments carried out in Germany. This atmosphere has one mode of free oscillation (1), with a period of about 10½ hours and a corresponding velocity of long waves agreeing exactly with the velocity of the Krakatau wave. It also has another mode of free oscillation (2), with a period very nearly 12 hours. The ratio of the horizontal velocities at any level to the value at the ground is shown by the curves $U^{(1)}$ and $U^{(2)}$. The pressure oscillations are proportional to U. It is seen that, while $U^{(1)}$ is of the same sign throughout, $U^{(2)}$ vanishes at about 30 km., and is of opposite sign at higher levels. The atmospheres above and below this level swing mainly horizontally in opposite directions, and there is a high pressure in one part whenever there is a low pressure in the other. The velocities at the level of 100 km. are, especially in (2), about 100 times greater than at the ground, so that a correspondingly smaller conductivity is required for the conducting layer of the dynamo theory. It will be noticed, however, that the energy densities, which are proportional to the density and the square of the velocities, ultimately vanish exponentially with height, as is shown by the curves $E^{(1)}$ and $E^{(2)}$. From the run of these curves one might expect that a disturbance like the Krakatau eruption which was concentrated at the ground would excite mode (1) and would therefore be propagated with a corresponding speed. That the Krakatau wave was shallow can be inferred from the fact that the wave front was considerably modified by the trade winds, as was shown by Taylor.

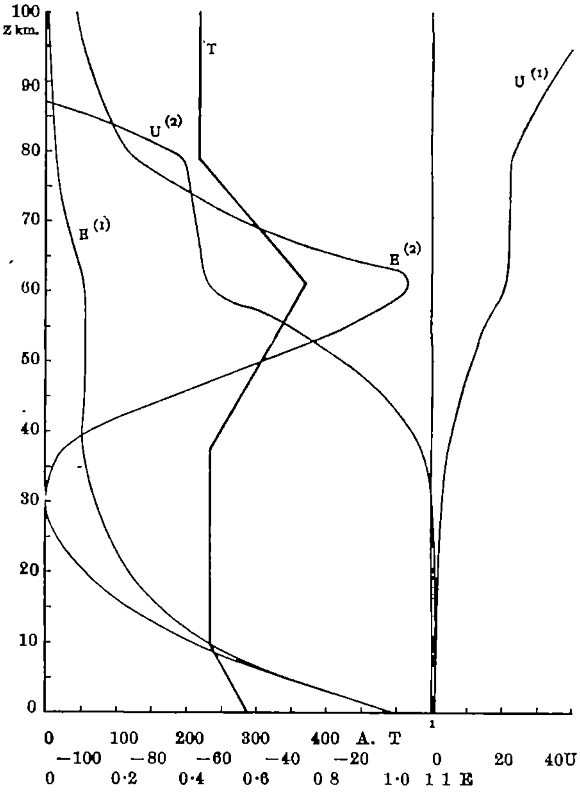

FIG. 1. Assumed vertical distribution of temperature T and computed velocity U and energy density E for the two modes of free oscillation (1) and (2).

Although the motion is mainly horizontal, the large amplitudes of the oscillation at high altitudes are accompanied by considerable vertical displacements of the atmospheric layers. These are of the order of a km. at the 100 km. level, but increase exponentially with height until they begin eventually to be damped by the increasing kinematic viscosity and thermal conduction. It is thus possible that the anomalous variation of height and ionization of the F_2 layer, as reported by Appleton and Naismith[5] and Martin and Pulley[6], might be associated with the semidiurnal oscillation of the atmosphere. Were it not for the retardation by viscosity and conduction, the upper layers would be expected to reach their maximum height at about 9.30 a.m. and 9.30 p.m.

A detailed report of this investigation will appear elsewhere.

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40 Grantchester Road,
Cambridge.
August 22.

[1] S. Chapman, S. K. Pramanik and J. Topping, *Beiträge zur Geophysik*, **33**, 246 (1931).

[2] *Proc. Roy. Soc.*, A, **126**, 169, 728 (1929); *Mem. Roy. Met. Soc.*, 4, No. 35 (1932); *Proc. Roy. Soc.*, A, **156**, 378 (1936).

[3] S. Chapman, *Phil. Trans.*, A, **218**, 1 (1919).

[4] *Quart. J. Roy. Met. Soc.*, **61**, 285 (1935).

[5] *Proc. Roy. Soc.*, A, **150**, 697 (1935).

[6] *Proc. Roy. Soc.*, A, **154**, 455 (1936).

Fossil Human Remains from Kanam and Kanjera, Kenya Colony

IN NATURE of March 9, 1935 a letter appeared from Prof. P. G. H. Boswell upon this subject, and I should like to comment upon certain issues raised. Prof. Boswell wrote: "Unfortunately, it has not proved possible to find the exact site of either discovery, since the earlier expedition (of 1931–32) neither marked the localities on the ground nor recorded the sites on a map". This sentence gives the impression that no adequate measures were taken to record the position of the discoveries. Actually, steps were taken which would have proved adequate had not all the photographs, taken especially for the purpose, failed owing to an unsuspected hole in the bellows of the camera. I did not record the sites on a map because there was no map of sufficient accuracy available, and I had not the means of making one at that time. I might have tried to obtain the services of a surveyor, but that would have been costly and I was saving all the money I could for a second visit to Oldoway, which I, at the time, believed was more important.

When we went to Kanam and Kanjera, we had only recently returned from Oldoway, where the geologists had decided that the evidence for the great age of the Oldoway skull was geologically sound. I had accepted their verdict[1] (which was proved to be wrong after my return to England[2]) and I had consequently withdrawn my earlier attack[3]. When I was at Kanam the evidence of Oldoway was once more being questioned[4], and so I was arranging to revisit Oldoway with Mr. Wayland, the director of the Geological Survey of Uganda, in order to re-examine the evidence.

Later events have proved that this was an error of judgment, and that it would have been better to get a surveyor for Kanam and abandon the idea of revisiting Oldoway, but it is easy to be wise after the event. I believed at the time that the sites were adequately marked.

In spite of everything, I maintain that I showed Prof. Boswell the actual stratum from which the Kanam mandible was obtained, as well as the position within circumscribed limits. At Kanjera I showed him the exact spot where the residual mound of deposits had stood which yielded the Kanjera No. 3 skull *in situ*. We ourselves dug away most of the mound in 1932, and the small remaining portion had been eroded away. But the fact that I did show Prof. Boswell the site is proved by a small fragment of bone picked up there in 1935 which fits one of the 1932 pieces.

Another issue raised by Prof. Boswell is connected with the accidental use of a wrong photograph. He wrote: "Moreover, the photograph of the site where the mandible was found, exhibited with the jaw fragment at the Royal College of Surgeons, was, through some error, that of a different locality; and the deposits (said to be clays) are in fact of entirely different rock (volcanic agglomerate)." This sentence is even more misleading than the previous one, and there are two points which I must discuss.

First of all, the accidental use of a wrong photograph. As already mentioned, my own photographs of the site all failed, and I consequently had to make use of photographs taken by other members of the expedition. In view of this, I carefully refrained from using any photographs *as evidence* in connexion with my claim for the antiquity of the Kanam mandible, and only used them to show the general nature of the sites. I had among others a photograph taken by Miss Kendrick and marked on the back "Kanam West, site of Deinotherium tooth". Owing to a mistake on my part, which I freely admit and deeply regret, this was taken to be a picture of the site where the deinotherium tooth was found which led to the discovery of the human mandible fragment. I therefore used it in good faith to give a general view of the site. In 1935, we found that this picture was of a different part of the Kanam West exposures (about 400 yards away) where the first deinotherium tooth found in the area came from.

The sentence quoted above ends "and the deposits (said to be clays) are in fact of entirely different rock (volcanic agglomerate)". From articles in the Press (see *Discovery*, April 1935, etc.) and from conversations I have had, it is clear that this sentence has been very widely interpreted both in England, on the Continent and in the United States, as meaning in effect "Boswell says Leakey does not know the difference between a clay and a volcanic agglomerate!" I understand from Prof. Boswell that he did not mean this at all, and that the words were only meant to mean that the deposits visible in the wrong picture are agglomerates whereas the deposits at the site itself are (as I said) clays.

There are several other issues that I would like to discuss, including the meaning of the word 'horizon' in connexion with the Kanjera finds. I used the word in the sense defined by several geological text-books, but it seems to have a different meaning for Prof. Boswell. I will not, however, trespass further on space of NATURE, as I hope to have an opportunity before long to discuss the matter further.

L. S. B. LEAKEY.

Great Munden,
Ware,
Herts.

[1] NATURE, **128**, 724 (1931).

[2] NATURE, **131**, 397 (1933).

[3] "Stone Age Cultures of Kenya Colony", p. 14 *et seq.*

[4] NATURE, **129**, 903 (1932).

Colorimetric Estimation of Phosphorus

To determine the rate of colour formation and the optimum time for taking readings in the Fiske and Subbarow method of estimating phosphorus microchemically, we have used a simple type of photoelectric colorimeter (to be described in detail elsewhere) which allows the chemical reaction to be followed continuously until a state of equilibrium is reached. The method has been developed for the purpose of obtaining more accurate figures for the phosphorus content of the whole blood and its separate fractions (plasma, serum and red cells) than those hitherto obtained by other (visual) methods.

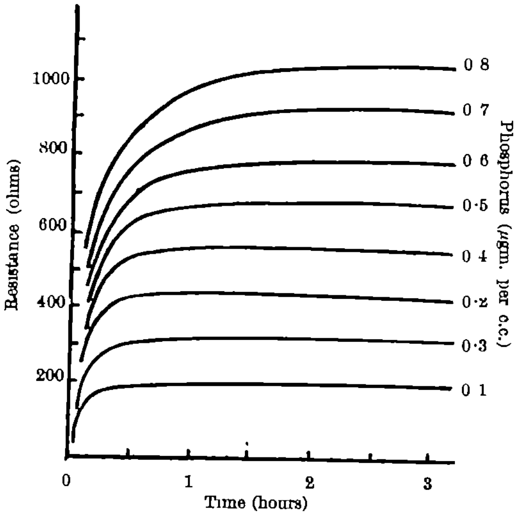

FIG. 1. Relation of colour intensity to time. Curves for the smallest amounts of phosphorus measured have been omitted; in the interests of clearness, the steep ascents in the earlier stages of colour formation have also been omitted.

Our apparatus enables us to detect 10^{-8} gm. of phosphorus per c.c. of solution, and to measure accurately changes of less than 10^{-7} gm. The reagent used, which differs slightly from that given by Fiske and Subbarow, consists of 0·1 gm. of 1 : 2 : 4 aminonaphthol-sulphonic acid, 5·48 gm. of sodium metabisulphite, 1·2 gm. of crystalline sodium sulphite dissolved in distilled water to make 50 c.c. of the solution. When the component substances are in these proportions, the acid remains in solution unless the temperature changes markedly. A beam of approximately monochromatic light which, passing through a liquid filter containing the solution to be examined, falls on to a photo-electric cell and so gives rise to a photo-electric current, is balanced against a current generated by a beam from the same source, which has, however, passed through a glass vessel containing only distilled water. After the addition of 2 c.c. of an ammonium molybdate and sulphuric acid solution and then of 1 c.c. of the modified Fiske and Subbarow reagent to the test solution, the characteristic blue colour that forms may be followed by means of a variable resistance which is manipulated so that the spot of light of a mirror galvanometer (of low resistance) remains undeflected.

By measuring solutions containing known amounts of phosphorus (from 0·03 to 1 microgram per c.c.) we calibrated the instrument to express intensity of colour in terms of the balancing resistance; it was found that, roughly, a difference of 0·05 microgram of phosphorus per c.c. produced a colour which caused a change of resistance of 50 ohms, a difference of 1 ohm producing an easily perceptible deflection even with an ordinary laboratory galvanometer. The calibration curve is very nearly linear. When the intensity of colour, expressed in ohms, is plotted against time, curves of the type shown in Fig. 1 are obtained.

These curves show that the colour begins to form immediately after the reagents have been added and increases rapidly in intensity until a comparatively steady state is reached: actually, the colour continues to deepen for many hours. When the quantity of phosphorus present is very small, this approximately steady value is attained in about 20 minutes, but when the amounts are of the order of 0·5 μ gm. per c.c., the colour should not be read until two hours have elapsed since the reagents were added. The curves shown in Fig. 1 are drawn from readings taken at intervals of 2½ minutes in the early stages, then 5 minutes, later 15 minutes and hourly. It also follows from these curves that, when the colours are read in the ordinary ocular colorimeters, the varying rates of development of colour in the standard and the unknown will escape notice owing to the relative insensitiveness of the method.

A merit of the present apparatus is that once the calibration curve for standard amounts of phosphorus has been determined, it is no longer necessary to prepare a standard for comparison with the unknown solution, since the liquid filter used to obtain an electrical balance need contain only distilled water. The advantage of being able to measure accurately the successive changes of colour in the solution is obvious.

The same method is now being applied to other standard colorimetric tests, and it appears probable that the interval of time within which the respective colours are to be read will be found, as in the present case, to be greater than that usually allowed, since more accurate results will be obtained when the measurements are made on the nearly horizontal branches of the resistance curves. In some tests, such as that for cholesterol, it will be possible to determine the optimum time for reading the colour before it begins to fade.

Under the auspices of the Cancer Research Committee of the University of Sydney, we are using the above method to measure the amounts of certain constituent substances in pathological human blood.

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HENRY L. BROSE.
ERNEST B. JONES.

Surface Properties of Non-Aqueous Solutions

A CLOSE study of the surface properties of capillary-active solutions of compounds forming homologous series has shown that the surface activity increases regularly with the molecular weight (Traube's rule). Only aqueous solutions have, however, been thoroughly investigated, and little is known of non-aqueous systems. Since organic solvents have much lower surface tensions than water, the changes produced by solutes will doubtless be much smaller, but the following results show that in certain solvents interesting effects of a similar nature can be observed.

I have determined the surface tension of solutions of different normal alcohols in aniline by means of a Traube stalagmometer. Aniline was chosen as solvent because of its comparatively high surface tension ($\varsigma_{20^\circ} = 42{\cdot}9$ dynes/cm.). Although the lowering of the surface tension ($\Delta\varsigma$) is much smaller than in aqueous solutions, it was clearly established that, as in water, $\Delta\varsigma$ is the greater the higher the concentration (c) of the alcohol and that for isomolecular solutions of different alcohols $\Delta\varsigma$ is the greater the higher the molecular weight. The surface tension-concentration curves were of the same type as generally encountered in aqueous solutions, that is, ς falls most rapidly at small concentrations. For dilute solutions (c less than 0·1 mol./lit.) $\Delta\varsigma/c = F$ can be regarded as constant and the following table gives the F-values for the different alcohols :

Alcohol	F
Ethyl	(1 6)
Propyl	3·4
Butyl	6·5
Amyl	9 6
Hexyl	12 8
Octyl	18 8
Decyl	25 2
Dodecyl	31 0

While in aqueous solutions F progresses geometrically as we ascend the homologous series, we find here a regularity of a less pronounced character, namely, from propylalcohol onwards the F-values form an arithmetical progression as do the molecular weights. Thus while in aqueous solutions F_{n+1}/F_n is a constant (generally 3), we find here $F_{n+1} - F_n =$ constant $= 3$.

The fact that F_{n+1}/F_n approaches the value 1 as we move up the series indicates that the influence of the additional CH_2-group upon the surface energy becomes the smaller as the hydrocarbon-chain becomes longer.

It remains to be seen whether in other cases where the solutes have much smaller surface tensions than the solvent similar relationships will be found.

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Aug. 25.

Rate of Absorption of Oxygen by Sodium Sulphite Solution

DURING the course of some measurements on the rate of absorption of gaseous oxygen by aqueous sodium sulphite solution, it was found that, under certain conditions, stirring the liquid beneath the surface without in any way agitating the latter *decreased* the rate of absorption below that of the unstirred liquid.

The apparatus used consisted essentially of a glass tube into the bottom of which a glass rod was sealed to act as a pivot for a glass stirrer below the liquid surface. This stirrer was hollow and contained iron wire so that it could be moved, by means of a magnetic field rotated externally, without breaking the liquid surface at any point. The other end of the tube was connected to a manometer. This portion was constructed in triplicate to ensure adequate control, and provision was made whereby the whole apparatus could be exhausted and the gas to be used admitted as required, each tube then being connected separately to its particular manometer.

Two tubes of approximately normal sodium sulphite solution were compared; each of these contained similar stirrers but only one of them was stirred (care being taken not to agitate the liquid-gas surface). After the initial rapid absorption, when the rate had become constant and after applying corrections, it was found that the rate of gas absorption by the solution the bulk of which was stirred was in general 48 per cent *less* than the rate at which the gas was absorbed by the unstirred liquid.

A systematic study of this phenomenon is being undertaken, and it is hoped to publish some of the results of the investigation shortly.

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Enolization of Oxycholesterilene

$\Delta_{5\,6}$-UNSATURATED sterols may be converted to the 7-dehydro compounds by the method of Windaus, Lettré and Schenck[1]. An alternative route, which is being examined in these laboratories, lies in the enolization of 7-ketocholesterol (I).

Acetylation of (I) resulted in the removal of the C_3-hydroxyl, oxycholesterilene and the acetate of oxycholesterilene being obtained. The latter compound (II) had m.p. 90°–92°, $[\alpha]_D$ $-222°$, $[\alpha]_{5461}$ $-283°$ (found: C, 82·0; H, 10·9. Calc. for $C_{29}H_{44}O_2$: C, 82·1; H, 10·4 per cent). Unless a shifting of the double bonds has taken place, this compound (II) will have the structure shown in Fig. 1. Its ultra-violet absorption spectrum has been examined by Dr. R. K. Callow, who reports that it is consistent with this formula. In view of the mobility of the ergosterol ring system, however, the product m.p. 90°–92° may be contaminated with an isomeride.

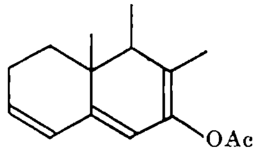

FIG. 1.

This point is at present under investigation. Methods for the preparation of $\Delta_{5\,6:7\,8}$-cholestadiene-3 : 7-diolacetate are being examined and the results will shortly be published elsewhere.

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Sept. 14.

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[1] *Ann.*, 520, 98 (1935).

Bilateral Gynandromorphism in Feathers

LILLIE and Juhn[1] suggested that the reactivity to œstrone sometimes manifested only on one side of a feather depends upon a low growth-rate of the tissue at the time, which rate they considered may be different on the two sides. These original views were immediately criticized by other workers[2,3]. They seem to have been greatly modified in exhaustive papers by Fraps and Juhn[4]; but it does not appear that the senior author has abandoned them.

Greenwood and Blyth[5] have shown that asymmetrically coloured feathers may be produced in the Brown Leghorn capon by the intra-dermal injection of small doses of œstrone. I have sectioned the bases of six asymmetrically marked feathers obtained in this way in which the rachis was substantially straight and the barbs on each side of a similar length. I have counted in a section the barbs cut on each side and compared the lengths of the two halves of the collar. The side of the feather which had reacted most to œstrone corresponded with the larger side of the germ and had therefore on the concrescence theory presumably grown more slowly (as required by the theory of Lillie and Juhn) in two cases. The opposite was true in three cases. There was no discernible difference in one case. The differences were small—perhaps trivial. Five of them lay between two and seven per cent of the total number of barbs cut in the section used. One specimen, however, showed nineteen per cent excess of barbs on the non-reacting side—the opposite of what Lillie and Juhn would seem to require. The differences in length between the two sides followed closely the differences in number of barbs. In each case the œstrone mark was on the side of the feather directed towards the site of injection.

These results do not appear to afford support to the theories of Lillie and Juhn, but seem to agree rather with the results of Greenwood and Blyth. It is hoped shortly to publish a fuller account elsewhere of this and similar work from this Department.

PAUL G. 'ESPINASSE.

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University College, Hull.
Sept. 17.

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[1] F. R. Lillie and M. Juhn, *Physiol. Zool.*, **5** (1) (1932)
[2] P. G. 'Espinasse, NATURE, **133**, 330 (1934).
[3] A. Hosker, NATURE, **133**, 382 (1934); *Phil. Trans. Roy. Soc.*, B, **226**, 143 (1936).
[4] R. M. Fraps and M. Juhn, *Physiol. Zool.*, **9** (3) (1936).
[5] A. W. Greenwood and J. S. S. Blyth, *Proc. Roy. Soc.*, B, **118**, 122 (1935).

Origin of the Word 'Solute'

IN view of the recent discussion as to the first use of the word 'solute'[1], it may perhaps be of interest to notice that the word is used in 1732 in the modern sense by Boerhaave[2], in the Latin form *solutum*. In discussing the action of solvents, he states that the effect is the division of the dissolved substance into particles which are thoroughly mixed with the particles of solvent: "ut particulae solventis inter partes divisas soluti", which Shaw[3] translates: "so that the particles of the solvent remain thoroughly intermixed among those of the solvend". The name is used by Boerhaave throughout his long discussion of solutions, although he sometimes speaks of *partes solvendi* as an alternative. Whether the name is used before Boerhaave I cannot say.

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Wembley,
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[1] NATURE, **137**, 831 (1936).
[2] "Elementa Chemiæ", Leyden (1732), vol. 1, p. 669.
[3] "A New Method of Chemistry . . . translated from the Original Latin of Dr. Boerhaave's Elementa Chemiae", London (1741), vol. 1, p. 489.

Points from Foregoing Letters

SIR C. V. RAMAN and N. S. Nagendra Nath give a brief outline of the several stages by which the theory dealing with the diffraction of light by high-frequency sound waves was developed, and state that its latest extension explains several additional facts, including the reason why supersonic waves can be seen directly through a microscope focused on a plane to the rear of a sound-wave cell.

A photomicrograph of a (111) face of diamond showing triangular markings of the size predicted by the 'mosaic' hypothesis of crystal structure is submitted by Dr. W. H. George. According to that hypothesis, even in a perfect crystal the uniform lattice structure is interrupted over narrow regions distributed periodically throughout the crystal.

Experiments with liquid helium by L. W. Shubnikov and A. K. Kikoin show that it does not form liquid crystals at 2·19° K. The anomaly in the specific heat of liquid helium observed at that temperature cannot therefore be ascribed to a transition to the liquid crystalline state.

The infra-red spectrum of heavy phosphine (PD_3) has been investigated by Dr. G. B. B. M. Sutherland and G. K. T. Conn. Their results (which agree quite well with those on the Raman spectrum of the molecule), do not agree so well with the frequencies predicted from the spectrum of ordinary phosphine (PH_3), thus indicating that a simple valence force field is not very satisfactory for correlating the vibration frequencies of a molecule of this type.

C. L. Pekeris points out that when the increase of temperature in the atmosphere between the levels of 30 km. and 50 km. is taken into account, the atmosphere is found to possess two modes of free oscillations of periods of 10½ hours and 12 hours respectively. In the 12-hourly oscillation there is a nodal surface at about 30 km., the atmospheres below and above it swinging in opposite directions. Various observed facts from the oscillations of the barometer, the propagation of waves of explosion and the diurnal variation of the magnetic field are thereby explained. It is also suggested that the anomalous behaviour of the F_2 layer might be associated with the semi-diurnal oscillations of the atmosphere.

Dr. L. S. B. Leakey, commenting upon Prof. Boswell's report on fossil human remains from Kenya, describes the events which led to the inadequate location of the sites.

A method of determining by means of a photo-electric cell the colour changes produced by chemical reagents, enabling the chemical reaction to be followed continuously, is described by Dr. H. L. Brose and E. B. Jones. Graphs are submitted showing the change with time in the intensity of the blue colour produced in the microchemical estimation of phosphorus by the method of Fiske and Subbarow.

The surface tensions of solutions of various alcohols in aniline have been measured by R. Aschaffenburg. As in aqueous solutions, the surface activity increases regularly with the molecular weight, but the regularity was found to be different from Traube's rule.

Stirring the interior of a solution of sodium sulphite (without disturbing the surface) *decreases* the rate at which it absorbs oxygen by 48 per cent, according to W. S. E. Hickson.

Dr. V. A. Petrow states that acetylation of 7-ketocholesterol leads to the removal of the C_3-hydroxyl and the formation of the acetate of 7-hydroxycholestatriene.

P. G. 'Espinasse reports that in six regenerating feathers examined there was no clear relation between the lengths of the two halves of the collar and the reactivity to œstrone of the two sides of the feather produced by them. As the feathers were substantially straight, it appears unlikely therefore that growth-rate determines this reactivity.

Research Items

Eskimo Cultural Origins in East Greenland

AFTER taking part in Helge Larsen's archæological investigations in Dødemandsbogten on Clavering Island, P. V. Glob excavated twenty-seven houses and a number of graves in Eskimo settlements in Kempe Fjord and King Oscar Fjord (*Meddelelser om Grønland*, 102, 2). These settlements had long been deserted when the fjords were first navigated and mapped by the Swedish expedition under A. G. Nathorst in 1899. Their culture in fact falls entirely within the eighteenth century. The finds from north-east Greenland have been classified into (1) an early culture, coming from the south, comprising Ingsuk types; and (2) a mixed culture in two stages, the early and later north-east Greenland culture, consisting of types from the north, the Thule culture, and local types. The Kempe and King Oscar Fjords settlements do not show evidence of the early culture. The characteristic oval house is absent and no house contains Ingsuk types only. The culture found is the Northeast Greenland in its earlier and later forms, though certain types are new. As found here, it probably originated outside the area, as the result of an admixture of Eskimo with a Thule culture from the north and Eskimo with an Ingsuk culture from the south. The house types fall into two groups, in the earlier of which the house type is large. The small house represents a late stage which was degenerate with diminishing numbers. In the group of large house types there is indication of an additional element from the south, marked by the four-sided house, as well as of the incoming of the later stage of Northeast Greenland from a source not evident, but clearly one in which the Thule types had persisted. A noteworthy feature was the occurrence in a number of houses, in which artefacts were usually numerous, of isolated human jaw-bones. Six in all were found. The reason for their occurrence is not clear, but it may be due to disposal of the dead by partial exposure.

Ethnology of Futuna

IN a report on the information collected during a visit to Futuna and Alofi, islands about 150 miles north of Fiji, in 1932 (Bull. Bernice P. Bishop Museum, No. 138), Mr. Edwin Burrows states that the islanders have been little affected by change. Some of their dances and ceremonies are still performed in the traditional manner, and activities, such as the construction of houses and canoes, agriculture, the preparation of food, and the making of bark-cloth and clothes are unaffected. In such small islands as these, the culture is simpler than in the large Polynesian units, and many features of Samoan and Tongan social organization are absent. For example, there are no talking chiefs and no village maids as in Samoa, nor are there sub-chiefs and a chiefs' language as in Tonga, nor is there the Tongan practice of assigning each individual a fixed position within the kindred. On the other hand, practices now lost elsewhere are here found as essential cultural features—for example, inheritance of the position of master craftsman. Futunan culture, therefore, is not only Western Polynesian, but early Polynesian. Thus, two methods of making bark-cloth are found, felting and pasting. Felting is practised as the only method of making bark-cloth in Hawaii, the Society Islands, the Marquesas, the Cook Islands, the Tuamotus and, in fact, throughout the eastern Polynesian area, with the exception of New Zealand. Pasting is the method of Samoa and Tonga. While both are present in Futuna, there is evidence that pasting is here the more recent. The distribution suggests that felting is the old method, while pasting was invented in Samoa and Tonga and the old method forgotten. The different methods of decorating bark-cloth seem to have a like local origin, freehand drawing being the oldest.

The Argentine Ant in the United States

SOME time previous to 1891 this ant, known as *Iridomyrmex humilis* Mayr, which is an inhabitant of South America, entered the United States at New Orleans. In less than fifty years it has come to invade and establish itself in more than 4,000 square miles of territory, including most of the Southern States and a considerable area of California. An account of this insect, together with methods of its control, has been written by Mr. M. R. Smith (*Circ.* No. 387, U.S. Department of Agriculture, May 1936). It appears that the ant becomes disseminated chiefly via railroad commerce, and is readily transported in consignments of lumber, plants, dry goods, etc. The hold which it has obtained in its adopted territory is due to its ability to produce enormous numbers of individuals able to exterminate competitive species. It thrives both in human habitations and in the open, and can exist up to 4,000 feet. It is chiefly as an indoor pest that it is most troublesome: it is omnivorous and swarms on foodstuffs, etc. Out of doors it affects poultry-keeping and often kills young chicks to obtain their blood: this ant also invades beehives besides fostering aphids and mealy bugs. The official recommendations for its control include systematically planned poisoning by means of a mixture of syrup and sodium arsenite, placed in small containers at specified intervals throughout infested areas.

Northern Harpacticids

KARL LANG has investigated the harpacticids from the Swedish Expedition to Spitsbergen 1898 and Greenland 1899, and although the material was difficult to handle, having been laid aside for more than thirty-five years in alcohol, he has found in it much that is new and interesting ("Die während der Schwedischen Expedition nach Spitzbergen 1898 und nach Grönland 1899 eingesammelten Harpacticiden. *Kungl. Svenska Vetenskapsakademiens Handlingar.* Tredje Serien. 15, No. 4; 1936). There are many new species and these were mostly taken in deep waters (1,750 m. and 2,700 m.) at a greater depth than any harpacticids have been collected before in these regions. The number of species is comparatively large, the number of individuals, in most cases, very small and often confined to a single individual. The present work is purely systematic, the author intending to deal with the geographical distribution in further publications. New species are described of *Cerviniopsis, Bradya, Stenhelia, Ameira, Paramesochra, Argestigens, Eurycledotes, Mesocledotes, Hemicledotes, Parananmopus* and *Rhizothrix*, whilst a new genus and species *Canuellopsis typica* is proposed for a form closely related to *Canuella*. *Eurycledotes echinatus* n.sp., collected at a depth of 1,750 m., possesses a very peculiar alimentary canal, the stomach reaching the third abdominal segment and being strongly lobed before narrowing to a funnel-shaped end with a thick circular muscle. At the sides are large glands, enormously developed. The author suggests that the hind part of the gut may serve for respiration in these great depths. Keys to the species of *Eurycledotes, Mesocletodes* and *Rhizothrix* are given.

A New Group of Filterable Organisms

Sir Patrick Laidlaw and W. J. Elford (*Proc. Roy. Soc.*, B, 120, 292; 1936) have been searching for new organisms in sewage. They removed all visible organisms by filtering the sewage through gradocol membranes with an average pore size between 0·6 μ and 1 μ. The filtrates contained a new group of organisms which may prove to be a link between the larger bacteria and the pathogenic viruses. The larger forms have a diameter of about 0·5 μ, and are visible under dark-ground illumination as small rings. The smallest forms have a diameter of about 0·15 μ. The organisms can be grown in a rich broth. If the small forms are filtered off and cultured, large forms develop, so that the same organism probably varies widely in size at different periods of its life history. The organisms appear to be purely saprophytic, because it was impossible to produce any obvious disease when cultures were administered in various ways to rats, mice and rabbits. Several closely related strains were distinguished immunologically in material from different sources.

Geometrical Laws of Egg Cleavage

It is obvious that the planes of cleavage in the developing egg are conditioned, within limits, by mathematical or rather geometrical laws. Monteil ("L'Oeuf." G. Doin and Cie, Paris, 1936) discusses these geometrical ideas so far as they are applicable to alecithal and telolecithal eggs exhibiting radial and oblique segmentation. The nucleus at the commencement of division tends to take up a position at the centre of gravity of the cytoplasm of the cell and this, while it does not have much effect in the alecithal ovum, is of great importance in the telolecithal ovum. In order to allow for the influence of the yolk in the latter type of egg and not to make the interpretation too complicated, the author deals with the yolk-containing portion of the egg as if it could be divided into zones each with simple proportions of cytoplasm and yolk and the proportions varying from no yolk to no cytoplasm. The axis of the spindle is in general parallel with a tangent to the surface of the egg sphere, and as the cleavage planes are at right angles to this it follows that the internal surfaces of the cells are walls of polyhedrons and not of cubes as is usually depicted in diagrams. Thus, for example, in the eight-celled stage of the frog's egg, the lower internal surfaces of the micromeres together form four sides of a tetrahedron the angles of inclination of which are determinable because they are at right angles to the spindle axes. While the geometrical figures involved in the early stages are simple, they become more and more complex as segmentation proceeds. The provision of short summaries and a large number of diagrams adds considerably to the ease of following the argument.

Pollination of Plums

The effective pollination of orchard crops is an essential factor in the production of satisfactory yields of fruit, and in many cases care must be taken to interplant self-sterile varieties with other sorts to act as pollinators, in which case the flowering periods must overlap. Though the main English plum varieties Czar, Purple Pershore, Victoria and Giant Prune appear to be largely self fertile, cross-pollination is advantageous, and with many other varieties is essential. A recent paper by C. H. Hooper (*J. South Eastern Agric. Coll., Kent*, 38; 1936) contains a classification of plums relative to their degree of self-fruitfulness, and a useful table is given to show varieties in flower at the same time. Pollination is brought about mainly by bees, but observations recorded in the paper cited show that the blossoms are visited by a number of other insects which were counted and identified. The data on flowering periods should prove a useful guide when plum orchards are being planted.

Bactericidal Action of Radiation

The bactericidal action of radiation depends on a number of factors such as the duration and intensity of the exposure, the wave-length, and the nature of the bacterium. A simple and accurate method of studying the effect of these factors has been described by G. Dreyer and M. L. Campbell-Renton (*Proc. Roy. Soc.*, B, 120, 447; 1936). The organisms are spread out evenly on an agar plate. Radiation is then allowed to fall on a localized area about 3 mm. in diameter. A number of such small areas can be treated with different times of exposure or different wave-lengths. The plate is incubated for 22 hours. It is then placed in the 'reading machine', in which a beam of light is thrown obliquely up and the amount of light scattered by the organisms is measured in a gas-filled potassium photo-electric cell. After applying a correction for the dead background, the authors calculate the percentage of survivors from the amount of light scattered in the spot, expressed as a percentage of the amount of light coming from a neighbouring untreated spot. They find that the product of the intensity and duration of irradiation for a given effect is constant over at least an 8-fold range. The shape of the curve connecting percentage growth with log (duration) varies when different organisms are used. The relative bactericidal action of different wave-lengths also varied irregularly and the effect was not proportional to the energy, but in all cases the line 2655 A. was the most effective. The effects of disinfectants were also studied by applying drops of different dilutions to localized areas on agar plates and measuring the effect by the method used in studying the effect of radiation.

Promotion of Nitrogen Fixation in Tropical Soils

At intervals since the beginning of the present century studies have been made of the value of molasses as a soil improver, and a number of investigators have examined the possibility that the action of the molasses was partly an indirect one, that of increasing nitrogen fixation. As there has been a certain conflict of results, particularly on the practical side, there is room for further investigation of the problem, and the contributions of Prof. N. R. Dhar and his co-workers at the University of Allahabad are to be welcomed. They have already shown considerable nitrogen fixation under tropical conditions when energy-rich materials such as soluble carbohydrates or molasses are added to the soil. They are now attacking the general problem of increasing soil nitrogen by supplying the nitrogen-fixing organisms with sources of energy, and in a communication to the Editor dated August 18, 1936, Prof. Dhar and Mr. S. K. Mukerji report appreciable gains in nitrogen content when soils, to which filter paper, dried leaves, or leaf juice had been added, were kept under laboratory conditions for several months. There were still greater increases in nitrogen content when molasses was also added, while soils exposed to sunlight for 6 hours daily gained slightly more than those kept in the dark. Sodium salts of organic acids, namely, sodium citrate, stearate, palmitate and oleate, exposed to light under similar conditions gave smaller but consistent increases in soil nitrogen From one half to two thirds of the added carbon was oxidized at the same time. The authors point out that since molasses and cellulosic materials not only increase the humus content of the soil and improve its physical condition, but also promote nitrogen fixation, the manuring of tropical soils with such substances should be a highly important practical proposition.

Original Laterite of Buchanan

MUCH of the controversy as to the nomenclature of laterites has resulted from the fact that no exact data concerning Buchanan's original laterite have been available. In order to settle the question, Dr. C. S. Fox visited the type localities in Malabar during 1933. His results are now published (*Rec. Geol. Sur. India*, 389–422; 1936). From this paper, it is clear that Buchanan's laterite consists mainly of what would now be called lithomargic laterite and even, in part, lateritic lithomarge. The rocks studied by Buchanan represent but a stage in the passage from granites and gneisses, through kaolin or lithomarge, to a rock consisting mainly of hydrated oxides of alumina and iron in which combined silica is characteristically absent. The latter portion of this process of weathering is now generally known as lateritization, and the finished product is called laterite. Thus Buchanan's 'laterite' is an intermediate form needing some qualifying adjective such as *lithomargic*. Dr. Fox has shown a sense of proportion in recognizing the facts of present usage. Otherwise, had he insisted on a purely academic application of the law of priority, the term laterite would have to be restricted to the lithomargic rocks studied by Buchanan; a completely new term would have to be adopted for the high-level fully formed laterites of the Deccan and elsewhere; and the term lateritization would have to be abandoned. Fortunately, there is no suggestion that any such confusion is likely to be introduced.

Constants of Diatomic Molecules

THE accumulation of spectroscopic data concerning such molecular constants as vibration frequency, ω_e, and internuclear distance, r_e, for diatomic molecules is stimulating further efforts to determine a more accurate relation between these constants. Allen and Longair, Badger and Douglas Clark have each suggested different modifications of the approximate Morse rule, $\omega_e r_e^3 =$ constant. It is found that the results are more satisfactory if attention is paid to the periodic groups to which the atoms forming the molecule belong. Consequently each of the three modifications contains a period constant. Douglas Clark and Howell have also shown that a simple relation exists between the ω_e values of such molecules as A_2, B_2 and AB where A and B belong to the same group. It appears that ω_{AB} is almost equal to the arithmetic mean of the frequencies ω_{A_2} and ω_{B_2}. Dr. N. R. Tawde, of the Royal Institute of Science, Bombay, has sent to NATURE a communication containing the substance of a paper by him, to appear in the *Bombay University Journal*, in which he discusses the same result and also describes his investigation of the variation of the ratio B_e/ω_e for molecules within a given periodic group. As a result of this study, he finds it possible to estimate values of B_e for a number of molecules, and, ultimately, to determine r_e from the relation $B_e = h/8\pi^2 M r_e^2$. Where it is possible to check these calculated values against those already established, agreements to within 2·5 per cent or better are obtained.

Refrigeration in Agriculture

"REFRIGERATION FOR THE FARM AND DAIRY" is the title of an illustrated bulletin by C. A. Cameron Brown, published by the Institute for Research in Agricultural Engineering, Oxford (1*s*. 6*d*.). The preparation of the bulletin was prompted by the number of inquiries on the subject of milk cooling recently received by the Institute, and it is specially intended for the guidance of farmers, small dairymen and in particular the producer-retailer. After an introductory account of the theoretical side of refrigeration, the compression and absorption systems for obtaining the low temperatures are discussed from the practical point of view, the comparative suitability of the various chemicals that can be used, the type of plant employed and its efficiency all coming under review. The second half of the bulletin deals with the application of refrigeration, chiefly in relation to dairying. A full description is given of the two principal methods for cooling milk, namely, the direct-expansion and the circulation methods. The important question of sterilizing is not overlooked, for the choice of cooling plant may be largely determined by the technique in sterilizing preferred. Cold storage is also considered in detail, the equipment required, its mode and operation being fully described, while figures for running costs are quoted from actual farms. Smaller sections are devoted to the question of portable cooling for the dairyman, and refrigeration on the fruit farm, in the bulb and market gardening industry and in poultry farming.

Ammonium Mandelate in Urinary Infections

IN a note in a former issue of NATURE (June 20, 137, 1027), reference was made to this agent in the treatment of *Bacillus coli* infections of the urinary tract, and to a granular form of this compound, 'Neoket', supplied by Boots Pure Drug Co., Ltd., Nottingham. Messrs. Boots now supply an 'elixir' in fluid form, in which the unpleasant taste of ammonium mandelate is successfully covered by the use of suitable flavouring agents, and which is therefore more palatable than 'Neoket'.

International Union of Geodesy and Geophysics

GENERAL ASSEMBLY AT EDINBURGH

THE sixth General Assembly of the International Union for Geodesy and Geophysics was held at Edinburgh during the period September 17–25, under the presidency of Dr. William Bowie (U.S.A.). Of the thirty-two countries that adhere to the Union, twenty-one sent delegates, and in addition thirty guests attended from ten countries (including Germany, Austria, Russia, India, Australia) that are not at present members of the Union. The delegates, guests and those accompanying them numbered in all 378, of whom 261 came from overseas.

At the opening meeting, held on September 17 in the McEwan Hall, the Union was welcomed by the president of the Royal Society, the Lord Provost of Edinburgh, the principal of the University of Edinburgh, and the president of the Royal Society of Edinburgh. The University of Edinburgh conferred its honorary doctorate on the president of the Union, Dr. William Bowie, in the course of the proceedings.

The scientific work of the Union is done by the seven international associations included in it, dealing respectively with geodesy, seismology, meteorology, terrestrial magnetism and electricity, oceanography, vulcanology and hydrology. Each of these held many meetings during the Assembly, some of them commencing their proceedings so early as September 14. Two evening lectures, by Dr. A. L. Day (U.S.A.) on volcanoes, and by Dr. Vening Meinesz (Holland) on gravity measurements in submarines, were given for the public of Edinburgh, and were largely attended.

Social hospitality was accorded to the Union by H.M. Government and the City of Edinburgh, both of which gave evening receptions; the City also gave a garden party. The British National Committee for Geodesy and Geophysics, which organized the meeting, with the aid of Government funds provided through the Royal Society, arranged a Sunday all-day train excursion to the Highlands, and an afternoon party on the closing day of the Assembly. Other afternoon parties were held at the Royal Scottish Museum, where an exhibition of geodetic and geophysical instruments, arranged in connexion with the Union meetings, was opened by Sir William Bragg; and at the Royal Society of Edinburgh, and the Castle. Excursions were also made in connexion with several of the Associations.

The scientific work of the Associations covered too wide and varied a field even to be summarized here. International co-operation is of special importance in the earth sciences, and many useful schemes of international work were initiated or continued. Co-operation between the different Associations is also of importance, and one step taken in this direction at Edinburgh was to set up a special joint commission of the Associations to investigate problems of the earth crust under the oceans.

Among the special papers discussed by the Association of Geodesy were two on pendulum and crystal clocks, by Sampson and Rayner respectively, and one by Bullard on gravity work in East Africa.

The Association of Seismology continued its support of the International Seismological Summary. Among the papers discussed by this Association were one on deep-focus earthquakes, by Gutenberg and Richter, and one on a new type of vertical seismograph, by Somville. On the proposal of Prof. Ishimoto it was recommended that seismic observatories should communicate, for the International Seismological Summary, the direction of the initial displacements in earthquakes.

At the Association of Meteorology about thirty papers were read, and in conjunction with the Association of Oceanography resolutions were adopted urging a more effective collection than heretofore of meteorological data over the oceans; they recommended (1) the creation, with the aid of merchant ships, of an ocean network of upper air soundings, (2) the stationing of a ship near 55° N., 30° W., the region where cyclones most often form, to make meteorological, ærological and oceanographic observations and to collect and re-transmit observations of merchant ships, and (3) an increase in meteorological (particularly upper air) observations in Iceland and the Azores.

Among the decisions made by the Association of Terrestrial Magnetism and Electricity was one to organize temporary observatories to take quick-run records of long-continued magnetic pulsations in Iceland, where they appear to be specially frequent.

Under the auspices of the Hydrology Association many meetings were held, including what appears to have been the first International Commission on Snow, which was largely attended. This Association, like those of Vulcanology, Magnetism, Meteorology and Oceanography, took part in special scientific excursions, in addition to the social excursions arranged for the whole Union.

The administration of the Union will continue to be in the charge of Brigadier H. St. J. Winterbotham as general secretary. The Executive Committee includes the presidents of the Associations, who were as follows: names in brackets indicate new elections for the forthcoming three years: Geodesy, Vening Meinesz, Holland; Seismology, Oddone, Italy (Heck, U.S.A.); Meteorology, V. Bjerknes, Norway (Chapman, Great Britain); Oceanography, Knudsen, Denmark (Helland-Hansen, Norway); Vulcanology, Michel-Lévy, France; Hydrology, Smetana, Czechoslovakia (Luetschg, Switzerland). The secretaries of Associations, in the same order (with new elections indicated in brackets), were: Perrier, France; Rothé, France; Wehrlé, France (J. Bjerknes, Norway); la Cour, Norway; Proudman, England; Malladra, Italy (Signore, Italy); Dienert, France (Frolow, France).

The administrative business of the Union included the election of Dr. D. la Cour (Denmark) as its next president; the continuance of the national subscriptions to the Union at the same rate as for the period 1933–36 (about £160 to £800 per annum according to the national population) and substantially the same division as before of the Union funds between the seven Associations; the adoption of new statutes together with new by-laws, in place of the existing statutes, and the acceptance of an invitation from the United States of America to hold the next General Assembly in Washington in 1939.

Structure of Proteins and of Certain Physiologically Active Compounds

By Dr. D. M. Wrinch, Mathematical Institute, Oxford

RECENT studies have discovered the fact that a number of classes of physiologically active compounds (for example, the carcinogens, the sterols and bile acids, the sex hormones, the heart poisons) have all a similar framework[1]. Two questions then arise. (1) What is the significance of this similarity of structure ? (2) Why do these compounds which have certain similarities of structure possess physiological properties so different as those, for example, of the sex hormones and the cardiac poisons ? In answer to these questions we suggest that for certain types of interaction with the organism it is necessary (though not sufficient) that a molecule possess an affinity for, in the sense of superposability on, some 'substrate' in the organism. This suggestion, which simply gives precise expression to an idea long since well established in physiological chemistry[2], accounts for the similarity of framework. The particular nature of the interaction may then be attributed to the degree of unsaturation (compare specially the carcinogenic hydrocarbons and cholesterol), to the occurrence of a lactone ring and to the occurrence and particular distribution of carbonyl, hydroxyl and methyl groups in the compounds in question.

In the course of an orderly search for some suitable substrate sufficiently widely distributed through the organism and yet possessing a common molecular surface pattern or mosaic, attention is naturally directed first to the proteins. More than any other chemical substance proteins have an inevitable connexion with living matter ; wherever there is living matter there proteins are found ; wherever there are proteins there is or was living matter[3]. Undeniably, proteins are connected with the physicochemical changes which occur during the life of an organism. They form a more or less permanent part of it, since only under conditions of starvation are they oxidized to release the energy required to perform the work of the cell[4]. Furthermore, many facts belonging to protein chemistry (for example, the interchangeability of proteins as substrates for certain enzymes) suggest that proteins can possess a common surface pattern. For these reasons there is an inherent plausibility in postulating that the substrate whose mosaic is to have a geometrical affinity to the classes of compounds mentioned above is protein*.

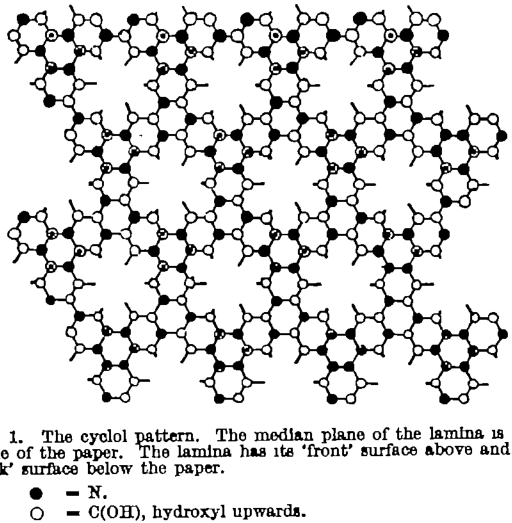

FIG. 1. The cyclol pattern. The median plane of the lamina is the plane of the paper. The lamina has its 'front' surface above and its 'back' surface below the paper.

● = N.
○ = C(OH), hydroxyl upwards.
○ = C(OH), hydroxyl downwards.
○— = CHR, direction of side chain initially outwards.
○- = CHR, direction of side chain initially upwards.

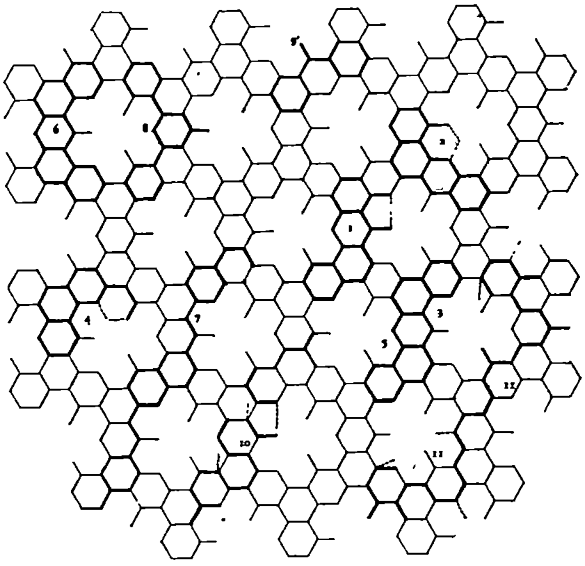

FIG. 2.

The fundamental fact about the structure of proteins is that they consist of condensations of amino (and imino) acid molecules. Leaving aside the intermediate stages, polypeptides or substituted diketopiperazines, which may or may not occur in biosynthesis, and which in any event yield an identical pattern by means of cyclization and polymerization respectively, we find that it is possible to construct a simple polycondensation pattern of the amino acids. This 'cyclol' pattern depends upon one and only one assumption, itself a simple extension of Fischer's classical hypothesis, namely, that amino acids can condense by means of single, double and triple peptide links. Given this assumption, the 'cyclol' theory of protein structure follows by means of purely logical and mathematical arguments[5]. The plane form of the cyclol pattern is shown in Fig. 1. Owing to the lævo character of all the amino and imino acids in proteins[6], the cyclol pattern is a dorsiventral lamina in the sense that from one surface all the side chains emerge, whereas the other surface is free from side chains. Here, then, is further evidence that it is possible for proteins with the most diverse chemical composition to share one common surface pattern, namely, that on the surface free from side chains. A number of the requirements of protein chemistry are thereby met; and the type of substance which is *a priori* most likely to be involved in reactions with the physiologically active compounds listed above, turns out actually to possess a common mosaic. Affinity with this mosaic then seems likely to be the explanation of the similarity of structure of these compounds. We have now to consider the details of this mosaic and its relation to the molecular framework of these compounds. On this occasion the question is discussed with reference to the carcinogens. The considerations adduced may also be applied to the sterols, the sex hormones, etc.

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* In a recent research on the effect of methyl cholanthrene on mouse fibroblasts *in vitro* (NATURE, 138, 291 ; 1936), Hearne finds that this carcinogen induces chromosome pairing and chiasma formation in somatic cells. In view of the protein in the nuclear membrane and in the chromosomes themselves (see Wrinch, NATURE, 134, 978 ; 1934. ibid., 135, 788 ; 1935), this result affords some support for the suggestion that the 'substrates' upon which carcinogens act are protein in nature.

It will give a fair picture of the situation as it stands to-day with respect to carcinogens if we consider the following substances, which are listed in a roughly decreasing order of potency: (1) methyl cholanthrene[7]; (2) 1,2-benzpyrene[8]; (3) 1,2,5,6-dibenzanthracene[9]; (4) 3,4-benzphenanthrene[10]; (5) 1,2,5,6-dibenzacridine[10]; (6) 3,4,5,6-dibenzacridine[10]; (7) 2-(*p*-aminostyryl)-6-(*p*-acetylaminobenzoylamino)-quinoline methoacetate[11]; (8) triphenyl benzene[12]; (9) tetraphenyl methane[13]. All these structures have a geometrical affinity to the cyclol pattern which is shown in Fig. 2 with its 'back' surface upwards so that all the side chains emerge below the plane of the paper. The frameworks of (3), (5), (6) and (7) are completely superposable on this mosaic: that of (2) and of (4) are superposable except for one atom, as shown by dotted lines. The case of methyl cholanthrene is interesting, in that complete superposability can be obtained by including an imino acid residue in the cyclol pattern. Alternatively, the framework is superposable, as shown in Fig. 2, except for the distortion of the five-membered ring, shown by the dotted line. Triphenyl benzene is superposable to the extent of 21 of its 24 carbons: furthermore, it can attain this superposability in three different ways. The position with respect to tetraphenyl methane is rather different since this compound is not even approximately plane. In Fig. 2, (9) shows part of its skeleton: 14 of its 25 carbons are superposable in the cyclol pattern. Since this molecule is non-planar[13], the possibility of the superposition of these 14 atoms on the cyclol pattern requires that the cyclol pattern shall not be plane at that point, but take up an orientation in which two neighbouring diazine rings do not share the same median plane, but have median planes making the tetrahedral angle with one another. The affinity of (9) to proteins is therefore not to the plane cyclol pattern as shown in Figs. 1 and 2, but to the general three-dimensional cyclol pattern, which has already proved useful in devising structures for the globular proteins[14].

This preliminary study of the affinities of the carcinogens for the cyclol mosaic presents two points of interest. Evidently a structure may be partially or even wholly superposable on the cyclol pattern without possessing the phenanthrene nucleus. Further, since the cyclol pattern need not be planar, there is no reason to expect that all carcinogens are planar. The substance (9), far from being an anomaly, may be the first of a new type of non-planar carcinogens which have a geometrical affinity to the non-planar cyclol pattern.

The suggestion that ordinal similarity of molecular structures is a necessary (though not sufficient) condition for certain types of physiological interaction, and that the special nature of these interactions is then determined by special atomic groupings, is in good accord with phenomena belonging to many fields of physiological chemistry. As an example we cite the case of the specific polysaccharides of types I, II, III, IV pneumococcus, which are antigenic when coupled to a protein, although the antigenic reaction is specific to the polysaccharides[15]. We may suppose that the importance of the protein constituent resides in its superposability on a protein substrate, the nature of the action being conditioned by the polysaccharide. It is perhaps appropriate to direct attention at this point to the far-reaching consequences which are logically entailed if, as is now suggested, proteins of different chemical composition can yet possess a common surface pattern.

The geometrical relationship of the cyclol pattern and the framework of the physiologically active compounds mentioned above further suggest that proteins may be the seat of biosynthesis. We suggest that cholesterol and carotene, for example, are formed in the organism by superposition on a cyclol template. The 'ingredients' may be pictured as long carbon chains which on superposition cyclize as shown in Fig. 2 (see (10) for cholesterol and (11) for carotene) or possibly as shorter carbon chains which then join up intermolecularly.

It appears that there is an important field for experimental work in the study of the processes of (intramolecular) cyclization and (intermolecular) polymerization with special reference to the use of large molecules of various types, including proteins, as templates. Such researches may throw light upon the mechanism at work in Nature which, from a vast array of possible structures, selects in fact only a few. Incidentally, they should confirm or refute the present suggestions, which amount to a simple interpretation of this mechanism in terms of the common mosaic of proteins predicted by the cyclol theory of protein structure.

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Administration and Technology in Industry

IN a paper on "The Place and Function of the Administrative and Technical Worker in the New Forms of Economic Structure" before Section F (Economic Science and Statistics) of the British Association on September 14, Mr. S. W. Smith directed attention to the growth and change of personnel which have accompanied the changes in the structure of industry and in industrial practice and technique in the last thirty-five years, particularly since the War. The mechanization and rationalization of industry have been accompanied by a significant growth in the importance of the technicians and scientific workers and the administrative staff, with a simultaneous reduction in the significance and proportion of unskilled labour and of controlling and directing owners of business. The bulk of the reorganization and modernizing work involved in the transformation of industry has been carried out by the technical and administrative staffs, and their importance has been further enhanced by the marked tendency for the proportion of professional, technical and administrative staffs to increase steadily in proportion to the remainder.

In support of his argument Mr. Smith referred to figures from the 1930 Census of Production showing that the administrative staff in productive concerns increased by 12·3 per cent between 1924 and 1930, excluding all those employed in shops, wholesale houses, banks, insurance companies, etc. Compared with 1907, while the total of operatives fell from 6,493,129 to 6,417,514, that of the administrative, clerical and technical staff rose from 490,947 to 723,920. Between 1911 and 1931, wages paid in industry receded from 42·5 to 41 per cent of the total, whereas in the same period salaries increased from 12 to 24 per cent. Between 1921 and 1931 professional workers increased by nearly 21 per cent, the increase in clerical staff being even more striking. Throughout the motor industry, the electrical and radio industries, and all branches of chemical industry the professional, scientific, technical and administrative staff played a dominant role, and it may be said that large business owes its existence chiefly to them. In turn, large business has provided them with the best and most abundant opportunity for their knowledge and skill. Virtually they constitute a new class, the most significant products of modern technique in industry and commerce, and in factory or office everywhere they occupy key positions.

The efficient functioning of large-scale business, whether manufacturing or distributive, largely depends upon these workers, who not only supply initiative and active control but also a constant flow of new ideas and inventions. Much the same holds with public utility corporations and municipal enterprises. Mr. Smith directed attention to the displacement or substitution of company proprietors or directors by responsible public officials, and the stipulation that a director should hold no shares whatever in order to secure that his dominant concern should be the public interest.

These changes have led to the question of training for industrial administration receiving growing attention. In the Post Office, a training school has been established in connexion with its Engineering Department where probationary assistant engineers receive a course of instruction in administration and finance. The conversion of potential proprietors into salaried managers and administrators also means that the speculative outlook of profit-seeking persons is replaced by the professional outlook with its prime interest in the efficiency of the work for its own sake. Since the salaried technician or administrator when reasonably and adequately paid tends to be interested in his work for its own sake, the functional outlook tends to replace the profit-seeking motive, care of the public interest and the spirit of service or trusteeship that of self-seeking or proprietorship.

This expansion of the administrative, technical and managerial sections of industry, with its increased stability of their income, has, however, been accompanied by a serious deterioration in the general security of all such salaried workers. The advent of unemployment among such workers who had previously been virtually immune has probably contributed to the widespread establishment among them of protective associations and trade unions, some fifty of which were represented at a Conference called a year or two ago by the National Federation of Professional Workers. Under present industrial tendencies, this increased precariousness and economic uncertainty of salaried workers is likely to continue, and its existence must be recognized in considering the significance of the place which administrative and technical workers now occupy both in industry and in society.

At a subsequent session on business administration, a number of these questions were again raised in Mr. C. A. Lee's paper on "Some Problems of a Small Manufacturing Business". The great asset of the small firm, Mr. Lee considers, is the way in which the closer contact possible with the head makes it possible for his personality to be felt right through the concern. This in itself is an important factor in developing a team spirit among the staff, which is just as important in a small as in a large firm for securing real co-operation, receptivity to new methods and keen interest in work. Moreover, the team spirit constitutes an effective check on slackness and grousing. Good leadership is most important and should endeavour to inspire the confidence that all concerned will be fairly treated, adequately paid and enjoy good working conditions. It is essential that the responsible staff should feel free to express ideas and have opportunity to advance. The problem of promotion may easily present real difficulty in a small firm. In regard to efficiency, while the small manufacturer cannot maintain the staff of experts employed by the larger firms, the use of outside consultants is a great help in introducing new ideas, and provided effective co-operation is secured with the staff, may be of real advantage in spite of the consultant's lack of knowledge of the particular business. In the discussion which followed, Mr. R. J. Mackay referred to the success which has attended the autonomous groups system described by M. H. Dubreuil before the Section in 1934.

The paper by Mr. E. S. Byng which followed discussed the claims of administration to be considered a definite profession, involving a special technique and requiring a systematic scheme of education. Empirical methods of approach can no longer be considered adequate when our economic units are so large and their administration so complex, and it has become necessary to distinguish between the trained administrator who adopts a scientific approach to his problems, and the man who continues on rule-of-thumb methods. Administration may be defined as the co-ordination and control of all the specialized activities necessary to the effective operation of an industrial or other undertaking. Administration and specialist functions are closely interwoven in the senior positions of an industrial undertaking. While, for example, the managing director may be regarded as exercising 90 per cent administrative and 10 per cent technical functions, the works manager 66⅔ per cent administrative and 33⅓ per cent technical, the sales manager 60 per cent technical and only 40 per cent administrative, it is surprising how far down the scale some proportion of administrative function is involved.

The chief characteristics of modern industrial administration may be summarized as: functional division and devolution of responsibility, involving specialization and simplification; co-ordination of activities, involving the generation of the team spirit on a large scale; and the substitution of fact analysis for guesswork, involving planning, costing and budgetary control. The impact of economic forces has driven industrialists to seek higher efficiency through the improved technique of specialists in all these departments. Their next problem is to bring about a parallel improvement in the technique of administration itself.

Mr. Byng referred to the way in which the responsibility of the administrator has been enhanced by specialized research into the conduct of industry, and stressed the importance of advances in industrial psychology and the study of human relationships. If the art of persuading men to work willingly and harmoniously is lacking, the real effectiveness of the undertaking is seriously impaired, and even complete failure may ensue. Sound laws of administration cannot be laid down without a clear understanding of human motives and desires embodying the characteristics of the group-mind, the effect of tradition, the response to varying incentives, the real causes of unrest and the emotional reactions to regulations and discipline. Accordingly, the responsibilities of the administrative function for the efficient development of industrial and commercial enterprise, for the effective use of capital and labour, and for the creation of means by which the increased wealth due to technological improvements in industry can be utilized for the greatest benefit of all concerned, carry social and economic consequences of national and indeed international importance.

Mr. Byng also discussed the question of education for administration both through such organizations as the Institute of Industrial Administration and within the ranks of industry itself. Finally, he urged that administration may justly claim to be a vital factor in industry and to offer an almost unlimited field of usefulness for the highest grades of intelligence. Our industrial future depends largely upon our methods of selecting and training administrators, and the general recognition of the high function they are called upon to perform.

New Ultracentrifuge Installation at the Lister Institute

On Tuesday, September 29, the Governing Body and the Director of the Lister Institute entertained Prof. The Svedberg of Uppsala and a number of interested physicists, biochemists and biologists on the occasion of the completion of the new ultracentrifuge plant. In welcoming the guests, Prof. J. C. G. Ledingham explained that in anticipation of Prof. Svedberg's visit to London on his way home from the Harvard celebrations, every effort had been made to put the finishing touches to the new installation. Dr. McFarlane, Lister Institute fellow in biophysics and a former pupil of Prof. Svedberg, had been almost entirely responsible not only for the design of the building to accommodate the new plant, but also for the supervision of the lay-out and assembly of all the accessory connexions, electrical, optical, refrigerating, etc., carried out by the Institute's engineering staff. Throughout the whole work, he had enjoyed the constant advice amd co-operation of Prof. Svedberg. The total cost of the installation, including the new building, was about £7,000, of which sum the Rockefeller Foundation had most generously contributed £3,400 in defrayment of the cost of the new machines.

The new laboratory is specially designed and equipped for investigations into the physical nature of very small particles, particularly protein molecules, but it is hoped also to extend its use to the study of the less well-defined entities such as viruses phages and antibody complexes.

The ground floor is largely taken up by two ultracentrifuges and their auxiliary machinery. Both machines, which were made in the workshops of the University of Uppsala to the design of Prof. Svedberg, have optical arrangements which make it possible to observe and photograph the contents of the rotating cell.

The smaller of the two machines is called the equilibrium centrifuge and is used for the determination of absolute particle size or weight. It runs at speeds up to 18,000 r.p.m. and usually for several days and nights continuously. The particles have then ceased moving, and a state of sedimentation equilibrium is set up, which allows of the calculation of absolute size from the final photograph.

The larger machine generates much greater centrifugal forces, up to half a million times gravity, and serves to throw down even the smaller protein molecules completely in a few hours. It is used to measure the sedimentation velocity constant of pure proteins and of the components of a mixture. In the case of native protein mixtures, such as blood serum, it is possible to centrifuge these without previous chemical treatment and to determine from the photographs the concentrations in which the component proteins are present.

The machine comprises a chrome nickel steel rotor of 7 in. diameter rotating inside a massive steel housing from which the air is evacuated and into which hydrogen is conducted at low pressure. The rotor is driven by high-pressure oil on the turbine principle, and the oil is also used to maintain the rotor at a constant low temperature. The usual speed is 60,000–70,000 r.p.m., and elaborate underground foundations are necessary to prevent the transmission of vibrations to the optical system. Owing to the position of the Lister Institute on a reclaimed bank of the Thames, it was necessary to drive piles to a depth of 40 ft. to support these foundations. The centrifuge is entirely controlled from an adjacent room in which temperature, speed, oil pressure, vacuum pressure, hydrogen pressure, etc., are measured and regulated with great accuracy. Photographs are taken every ten minutes through a window in the wall of the control room. Monochromatic light isolated from the mercury arc is used and the wave-length is chosen to suit the light absorption of the protein.

On the upper floor a roomy laboratory is provided for general chemical and physical investigations. A smaller room which is maintained at a constant temperature is intended for measurements of pH, conductivity, refractive index and cataphoresis constants. For measurements of the latter an optical system is set up, similar to those on the centrifuges, and this enables photographs to be taken of charged particles migrating in the electric field at a rate which is proportional to their charge. Two modernly-equipped dark rooms are provided, and in another room examination of plates is carried out and calculations made incidental to the various techniques in use.

The rooms in the new laboratory are supplied with compressed air, distilled water and refrigerated water, and are all electrically linked to a central distribution board from which they may receive various electrical supplies, including constant voltage D.C. of low and high voltage, and A.C. of variable frequency. Any room can communicate electrically with another through the main distribution board, and in this way remote electrical measurements may be taken rapidly without the need for transporting complicated apparatus.

Science News a Century Ago

Clarke's Magneto-Electric Machine

IN the *Philosophical Magazine* of October 1836 is a letter to the Editor from E. M. Clarke, of 9 Agar Street, West Strand, London, in which he describes his magneto-electric machine. The letter begins: "From the time Dr. Faraday first discovered magnetic electricity to the present, my attention as a philosophical instrument maker, has been entirely devoted to that important branch of science, more especially to the construction of an efficacious magnetic electric machine, which after much anxious thought, labour and expense I now submit to your notice".

Clarke's machine was designed primarily for physiological purposes. It had a permanent magnet of six laminations mounted vertically and an armature with soft iron cores wound with insulated wire, which could be revolved rapidly past the sides of the magnet poles. With what he called his "intensity" armature, which was wound with 1,500 yards of fine insulated copper wire, the effect, he said, produced "in the nervous and muscular system is such, that no person out of the hundreds who have tried it, could possibly endure the intense agony it is capable of producing; it is capable also of electrifying the most nervous person without giving him the least uneasiness". With his "quantity" armature, which was wound with fifty yards of thick copper bell wire, he could make the various experiments performed with a single pair of voltaic plates and could produce large and brilliant sparks by the light of which a person could read small print.

The Aurora Borealis of October 11, 1836

ACCORDING to *The Times*, shortly after 8 o'clock of the evening of October 11, 1836, "the Metropolis and its suburbs for miles around was thrown into a state of the greatest excitement by the northern hemisphere assuming a most awful fiery appearance, which seemed to indicate the existence of some dreadful conflagration in the north portion of the Metropolis. . . . Many of the fire engines were put into motion, and after scouring the northern parts of the City and suburbs in search of the supposed fire, it was at last discovered that the appearance of the sky had been caused by one of the most splendid of those remarkable phenomena known as the *Aurora Borealis*, or Northern Lights.

"From persons who had the opportunity of witnessing the magnificent spectacle from elevated situations, we understand there first appeared a large luminous arch, extending nearly from north to south, from which streamers appeared, very low. . . . Suddenly the whole hemisphere was covered with them, when the intensity of the light, the prodigious number and the volatility of the beams, the grand intermixture of all the prismatic colours in their utmost splendour, variegating the glowing canopy with the most luxuriant and enchanting scenery, afforded an awful, but at the same time the most pleasing and sublime spectacle in nature. . . ."

Braithwaite's Steam Floating Fire Engine

ONE of the most active mechanical engineers of a century ago was John Braithwaite (1797–1870), who with Ericsson constructed the locomotive *Novelty* which competed at Rainhill with the *Rocket*, and who with Vignoles laid out the Eastern Counties Railway. With Ericsson he constructed the first steam fire engine. In the *Mechanics' Magazine* of October 15, 1836, he described his "Steam Floating Fire Engine" for use on the River Thames. Though the superiority of the steam fire engine over hand-worked engines had been demonstrated at several fires in London, the London Fire-Engine Establishment, supported by various insurance companies, still clung to hand-worked engines.

The fire float of Braithwaite was a wrought iron boat 80 feet long, 13 feet wide drawing about 2 feet of water. It was fitted with a boiler "on Braithwaite and Ericsson's patent principle" and an engine of 30 horse power giving the craft a speed of about 9 knots. The engine could be coupled by gearing to either the paddle shaft or to double-acting pumps capable of discharging 4–5 tons of water per minute. In his communication to the *Mechanics' Magazine*, Braithwaite said that in spite of the various demonstrations he had given, the insurance companies declined to adopt his engine and "as things at present are I am minus about £3,500 by my invention".

Societies and Academies

Paris

Academy of Sciences, September 7 (*C.R.*, 203, 505–524).

Edouard Chatton and Félix Villeneuve: The sexuality and evolutive cycle of *Siedleckia* based on the study of *S. Caulleryi*, hologametogenous and blastogametogenous Sporozoa.

N. A. Slioskine: The rotation of a cavity filled with a viscous liquid.

Paul Muller: The Paris-Strasbourg gravimetric relation.

André Boutillier: Study of the dilatometric anomalies due to external forces in copper aluminium alloys containing 7–16 per cent of aluminium.

Henry Gault and Louis André Germann: 2-Methylene-1-butanol-3-one.

Raymond Furon: The existence of a Ural axis determining the structure of the Iranian Plateau.

Jacques Risler: The antiseptic power, either immediate or after prolonged action, of essential oils. The bactericidal power of essential oils can be prolonged by the addition of substances named 'abiotaxines'. Thus the addition of benzoin to oil of thyme prolongs the antiseptic action from 28 days to four years.

André Lwoff and Mme. Marguerite Lwoff: The nature of the factor V.

Henri Berrier: The influence of fasting in the tadpole of *Discoglossus pictus* on the proportion of substances acting as plant auxins.

September 14 (*C.R.*, 203, 525–548).

Edouard Chatton and Mlle. Simone Brachon: A protistan, parasite of the ciliate *Fabrea salina*: *Gregarella fabrearum* and its evolution.

Alexandre Ghika: The development in series of orthogonal functions, of analytical functions of two complex variables.

Marcel Mendes: The rotation of the heterogeneous ellipsoid studied by means of Lamé functions.

Douchan Avsec: The formation of convection vortices, in a gaseous layer, with thicknesses of the order of some centimetres.

J. Valensi and J. Sobieski: Tubes with mercury vapour at high pressure for illuminating smoke in aerodynamical studies. Description of a tube which can replace advantageously a carbon arc lamp in certain classes of photography.

Théodore V. Ionescu: The properties of an electron which rolls without slip and the radius of which varies inversely as the velocity.

Jules Farineau: The *K* spectrum and conductivity electrons of solid and liquid aluminium.

Horia Hulubei: Measurements of the *L* spectrum of radium (88).

Jean Cheymol: Verbenalol, aglucone and verbenaloside.

Boris Ephrussi, C. W. Clancy and G. W. Beadle: The influence of the lymph on the colour of the *vermilion* eye in *Drosophila melanogaster*.

Maurice Mathis: The diagnosis of yellow fever by intracerebral inoculation of the blood of the patient into white mice. Inoculation into *Macacus rhesus* has hitherto been the only certain test for yellow fever, but these animals are becoming more difficult to obtain. It is now shown that the macacus can be replaced by white mice.

Brussels

Royal Academy (*Bull. Classe Sci.*, 22, No. 7; 1936).

P. Stroobant: Observation of the eclipse of the sun on June 19, 1936, at the Astronomical Institute of the University of Brussels.

L. Godeaux: Cyclic involutions of the third order belonging to an algebraic surface.

F. Swarts: (1) Substitution of fluorine for other halogens with the aid of mercurous fluoride and the iodide (preparation of methyl fluoride). (2) Decomposition of cyclohexyl bromide in the presence of mercuric bromide and the formation of polymers of cyclohexene.

F. H. Van den Dungen: *A propos* of a theorem in statics due to M. Giovanni Lampariello.

J. Mariani: The principle of subjectivity and the theory of gravitation.

J. Jaumotte: Variation of the wind with altitude.

P. Gillis: A class of partial differential equations.

P. Bourgeois and J. F. Cox: The conditions of observation of the minor planet (1936 *CA*) = Adonis.

P. Burniat: Note on some canonical surfaces and on the surfaces of genus one.

M. Linsman: The singularities of the elementary curves in finite geometry (2).

B. Rosen and F. Bouffioux: Contributions to the study of the molecular spectra of the sulphur group.

E. Migeotte and E. Hoge: Observation of the eclipse of the sun on June 19, 1936, made with the equatorial of the Cointe Observatory.

Moscow

Academy of Sciences (*C.R.*, 2, No. 7, 1936).

K. Mardžanišvili: Simultaneous dissolution of whole numbers into *m*-th and *n*-th potentials.

L. Sretenskij: Determination of resistance to rolling of a vessel moving on the surface of water of finite depth.

G. Čelincev: Organic derivatives of potassium and their role in organic synthesis.

D. Mirlis and D. Deribas: Synthesis of tanning substances from carbohydrates.

V. Derwies: Genesis of the magnetite deposits of the Gora-Blagodat in the northern Urals.

B. Astaurov: New data on artificial parthenogenesis in the silkworm (*Bombyx mori* L.). Individual capacity for parthenogenesis is a hereditary character, probably due to a small number of genes having specific action.

B. Isačenko: Corrosion of concrete. There is some evidence of microbiological action on submerged concrete due to fungi (*Oospora Candida* and *Sporotrichum*).

A. A. Richter: An absorber of carbon dioxide for currents of atmospheric air.

V. Katunskij: Movement of growth-promoting substance and the growth of plants in an electric field. (Contribution to the study of electro-cultivation of plants.) A negative potential inhibits the movement of growth-promoting substance in the basipetal direction, while a positive potential stimulates that movement.

N. Konstantinov: The vernalization of tree-cotton.

T. S. Rass: Types of fish-eggs and their bearing on the classification of fishes.

(*C.R.*, 2, No. 8, 1936).

A. P. Dietzmann and S. A. Cunikhin : Classes and centre of a finite group.

S. Nikolskij : Linear equations in metrical space.

P. A. Walter : A current through a hydraulic grid with rounded lobes of small curvature.

A. P. Ilyina : Stratigraphy and fauna of the tertiary sediments of the western coast of Kamchatka.

W. A. Engelhardt and M. N. Ljubimova : The double mechanism of adenosine triphosphate stabilization in cells. (1) Reticulocytes.

W. A. Engelhardt and A. A. Bajev : The double mechanism of adenosine triphosphate stabilization in cells. (2) Nucleated avian erythrocytes.

A. I. Grečušnikov : Toxins of rust (*Puccinia*). The active principle of the toxin consists of two simple compounds, namely, ammonia and urea.

I. A. Stefanovskij : Influence of environmental factors on immunity of wheat. Retardation of sowing date increases the incidence of brown-rust.

V. V. Popov : The potential ability of various cells for lens development.

I. A. Rubtzov : A new Simuliid species (*Simulium oligocenicum*, sp.n.) from amber.

(*C.R.*, 2, No. 9, 1936).

I. Vinogradov : New results concerning the distribution of fractional parts of a polynomial.

L. V. Kantorovič : The elements of the theory of functions of a real variable with values belonging to a semi-ordered linear space.

V. Gavrilenko : Distribution of communicated velocities in turbulent uniform currents of liquid.

N. T. Fedorov and V. I. Fedorova : The problem of the curve of the spectral sensitivity of the eye.

V. Rasumovskij : Polarity and tautomerism.

N. I. Kobosev, B. V. Jerufejev and V. M. Savina : Hydration of aluminium nitride by active hydrogen.

A. E. Fersman : Application of *VEK*'s in geochemistry.

V. A. Novikov : The influence of the intensity of illumination on the development of the cotton plant. Cotton possesses a very wide range of physiological plasticity as regards intensity of illumination.

A. Machotin : Reduction phenomena in the morphology of the adult moth *Operophthera brumata* L. Loss of wings in the female leads to a greater development of the musculature of extremities. Reduction of digestive tract in the male is accompanied by the transformation of the stomach into an aerostatic apparatus.

J. Iežikov : Some considerations on the types of development of Metazoa from the egg.

Vienna

Academy of Sciences, July 2.

Max Pestemer, Trude Langer and Friedrich Manchen : Influence of substituted radicals on the ultra-violet absorption of benzene chromophores, both simple and conjugated with double bonds.

K. W. F. Kohlrausch : Studies of the Raman effect (58). Raman spectrum of organic substances (nitrogenous substances : (1), simple amines).

L. Kahovec and K. W. F. Kohlrausch : Studies of the Raman effect (59). Raman spectrum of organic substances (nitrogenous substances : (2), amino- and oxyacetic acid and its esters).

Otto Redlich and Walter Stricks : Raman spectra and vibrations of di- and tetradeuterobenzene.

L. Kuchler and F. Patat : Photochemical conversion of *o*-nitrobenzaldehyde to *o*-nitrobenzoic acid.

Gabriele Rogenhofer : Action of growth-promoting substances on bark formation in woody shoots.

L. Portheim : Action of β-indolylacetic acid on plants (1).

Kurt Lohwag : (1) A useful method of macerating wood tissues. (2) Preservation of the colours of the ordinary wood reaction.

Josef Kisser and Yoshio Kondo : Microchemical test of divalent and trivalent phenols by means of spot reactions.

Josef Mattauch : Measurements with a new type of mass-spectrograph.

Elisabeth Rona and Elisabeth Neuninger : (1) Artificial radioactivity of thorium. An actinium isotope of 42 hours half-period is formed on bombarding thorium with neutrons. (2) Artificial radioactivity of thulium. $^{170}_{69}\mathrm{Tm}$, formed by bombarding thulium with slow neutrons, has a half-period of $4 \pm \frac{1}{2}$ months.

Stefanie Zila : Development of a photographic method for the study of proton beams. Methods of sensitizing plates for the registration of protons are described.

Ernst Schäfler : Effect of γ-rays on desensitized photographic plates.

Kasimir Graff : Observation of the total solar eclipse of June 19, 1936.

Robert Willheim : The Pasteur-Meyerhof reaction in cancer glycolysis.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, October 12

University College, London, W.C.1, at 5.0.—Dr. R. J. Lythgoe : "The Physiology of Vision" (succeeding lectures on October 19, 26, November 2, 9).*

Tuesday, October 13

Society for the Study of Inebriety and Drug Addiction (at the Friends' House, Euston Road) at 4.—Prof. D. K. Henderson : "Alcoholism and Psychiatry" (Norman Kerr Lecture).

University College, London, W.C.1, at 5.—Dr. C. Reid : "The Endocrine Organs in relation to Metabolism" (succeeding lectures on October 20, 27, November 3).*

Illuminating Engineering Society (at the Lighting Service Bureau, 2 Savoy Hill, W.C. 2), at 5.30.—A. Cunnington : Presidential Address.

Thursday, October 15

Institute of Fuel (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1).

At 2.30.—Sir Philip Dawson : Presidential Address.

At 3.30.—Prof. Franz Fischer : "Production of Synthetic Motor Spirit" (Melchett Lecture).

King's College, London, W.C.1, at 5.30.—Dr. S. J. Davies : "Injection and Combustion in Oil Engines" (succeeding lectures on October 15, 22, 29, November 5, 12, 19).*

British Institute of Radiology, at 8.—Prof. J. A. Crowther : "Physics and Radiology" (Presidential Address).

National Smoke Abatement Society, October 14–17. Annual Conference to be held in the Science Museum, South Kensington, London, S.W.7.

Society of Chemical Industry (at University College, London, W.C.1), October 15–16. Conference on Automatic Control in Industry.

Official Publications Received

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh. Vol. 56, Part 2, Nos. 9 and 10: The Dynamics of the Formation of Cone-sheets, Ring-dykes and Caldron-subsidences, by Dr. E. M. Anderson; Note on Fracture, by Dr. Harold Jeffreys. Pp. 128–163. 3*s*. Vol. 56, Part 2, No. 11: The Relation of the Pituitary Gland to Muscle Creatine. By B. G. Shapiro and H. Zwarenstein. Pp. 164–168. 6*d*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [89

Memoirs of the Cotton Research Station, Trinidad. Series B: Physiology. No. 8: i. The Concentration of Solutes in Sap and Tissue, and the Estimation of Bound Water; ii. Further Studies on Transport in the Cotton Plant, 5: Oxygen Supply and the Activation of Diffusion. By T. G. Mason and E. Phillis. Pp. 437–499. 2*s*. 6*d*. Series A: Genetics. No. 13: Some Observations on the Inheritance of Form and Size in Asiatic Cottons. By J. B. Hutchinson. Pp. 399–410. 2*s*. 6*d*. (London: Empire Cotton Growing Corporation.) [89

University of London: University College, Faculty of Medical Sciences. Session 1936–1937. Pp. vi+285–320+xiii. (London: University College.) [99

The British Academy. Presidential Address, July 1936. By J. W. Mackail. (From the *Proceedings* of the British Academy, Vol. 22.) Pp. 12. (London: Oxford University Press.) 1*s*. net. [109

Queen Mary College (University of London). Calendar, Session 1936–1937. Pp. 284. (London: Queen Mary College.) [119

Report of the Commission appointed to Enquire into and Report on the Financial Position and System of Taxation of Kenya. (Colonial No. 116.) Pp. vii+282. (London: H.M. Stationery Office.) 9*s*. net. [149

The Royal Technical College, Glasgow. Calendar for the One Hundred and Forty-first Session, 1936–1937. Pp. 490+xix. (Glasgow: Royal Technical College.) [169

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1689 (2128): Contribution of Body and Tail of an Aeroplane to the Yawing Movement in a Spin. By H. B. Irving, A. S. Batson and J. H. Warsap. Pp. 16+26 plates. (London: H.M. Stationery Office.) 2*s*. net. [169

Ministry of Agriculture and Fisheries. Collected Leaflets No. 5: Birds. Pp. iv+36. (London: H.M. Stationery Office.) 1*s*. 6*d*. net. [179

How Allotments could be made an Amenity Asset to the Community. By Lady Allen of Hurtwood; Designs for Hut Units and Community Centre, by William Tatton Brown. Pp. 22. (London: The Housing Centre.) 3*d*. [179

Engineers' Study Group on Economics. Interim Report on the Design of a Family Budget with Special Reference to Food; Presented to a Joint Meeting of the Engineers' Study Group and the Association of Scientific Workers held on March 31, 1936, in the Rooms of the Royal Society of Arts. Second and revised edition. Pp. 48. (London: Engineers' Study Group on Economics.) 1*s*. 6*d*. [189

Birkbeck College (University of London). The Calendar for the Year 1936–37 (114th Session). Pp. 275. (London: Birkbeck College.) [189

Other Countries

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Jaarverslag 1935. Pp. 23. (Batavia: Koninklijk Magnetisch en Meteorologisch Observatorium.) [79

Państwowy Instytut Meteorologiczny (Institut National Météorologique de Pologne). Bibljografja prac Opublikowanych przez Pracowników i Dawnych Wspołpracowników Państwowego Instytutu Meteorologicznego wydana z okazji Konferencji Dyrektorow miedzynarodowej Organizacji Meteorologicznej odbytej w Warszawie w 1935 (Bibliographie des fonctionnaires et anciens collaborateurs de l'Institut National Météorologique de Pologne, publiée à l'occasion de la Conférence des Directeurs de l'Organisation Météorologique Internationale à Varsovie, 1935). Pp. 113. (Warszawa: Państwowego Instytutu Meteorologicznego.) [79

Southern Rhodesia. Meteorological Report for the Year ended 30th June, 1935, by the Department of Agriculture. Pp. 33. (Salisbury: Government Stationery Office.) [89

Bulletin of the American Museum of Natural History. Vol. 72, Art. 4: Hydraxes collected by the American Museum Congo Expedition. By Robert T. Hatt. Pp. 117–141+plates 18–22. (New York: American Museum of Natural History.) [89

Obras completas y Correspondencia cientifica de Florentino Ameghino. Vol. 21: Correspondencia cientifica. Dirigida por Alfredo J. Torcelli. Pp. 934. (La Plata.) [99

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 165: Trypanosoma observed in a Bird of the Genus Pyrrhula (*Trypanosoma faridi*). By Prof. Dr. M. Carpano. Translated from the Italian by Mohamed Abd el Salam el Lessi. Pp. 5+3 plates. 2 P.T. Bulletin No. 166: Studies on Pyrethrum (*Chrysanthemum cinerariæ folium* Trev.) in Egypt. By Dr. M. Shafik and A. H. Hindi. Pp. 24+7 plates. 5 P.T. Bulletin No. 168: Tonnage Tests of some Imported Sugar Cane Varieties. By Arthur H. Rosenfeld. Pp. 18+2 plates. 3 P.T. Bulletin No. 173: Manurial Requirements of Sugar Cane in Egypt. 2: The Kom-Ombo Phosphate Experiments. By Arthur H. Rosenfeld. Pp. 21+1 plate. 4 P.T. (Cairo: Government Press.) [109

Department of Scientific and Industrial Research. Bulletin No. 49: An Introduction to the Grasses of New Zealand. By H. H. Allan. Pp. 159. 4*s*. Apia Observatory, Apia, Western Samoa. Annual Report for 1933. Pp. 118. 5*s*. (Wellington, N.Z.: Government Printer.) [119

U.S. Department of Agriculture. Miscellaneous Publication No. 241: The Genera of Parasitic Wasps of the Braconid Subfamily Euphorinæ, with a Review of the Nearctic Species. By C. F. W. Muesebeck. Pp. 38. (Washington, D.C.: Government Printing Office.) 5 cents. [119

League of Nations. The Problem of Nutrition. Vol. 4: Statistics of Food Production, Consumption and Prices. Documentation prepared by the International Institute of Agriculture. Presented to the Mixed Committee on the Problem of Nutrition at its Second Session, June 4th, 1936. (Official No.: A. 12 (c). 1936. II.B.) (Series of League of Nations Publications. II. Economic and Financial 1936. II B.6.) Pp. 110. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 3*s*. [149

Commonwealth of Australia: Bureau of Meteorology, Melbourne. Bulletin No. 19, 1934: Thunderstorms in Australia. By Henry Barkley. Pp. 6+1 map. Bulletin No. 20, 1934: Zones of Relative Physical Comfort in Australia. By Henry Barkley. Pp. 7+1 map. (Melbourne: Government Printer.) [149

Indian Forest Records (New Series). Vol. 2, No. 4: New Indian Cerambycidæ. By J. C. M. Gardner. Pp. 127–140. (Delhi: Manager of Publications.) 7 annas; 9*d*. [149

Proceedings of the United States National Museum. Vol. 83, No. 2993: A Comparison of the Shallow-Water Sponges near the Pacific End of the Panama Canal with those at the Caribbean End. By M. W. de Laubenfels. Pp. 441–466. (Washington, D.C.: Government Printing Office.) [149

Report of the Kodaikanal Observatory for the Year 1935. Pp. 4. (Delhi: Manager of Publications.) 3 annas; 4*d*. [149

Observatoire de Zi-ka-wei. Annales de l'Observatoire astronomique de Zô-sè (Chine). Tome 19: Tables de petites planètes. Fascicule 3: Planète (434) et groupe Hungaria ($1250'' < n < 1350''$). Par le P. E. de la Villemarqué. Pp. ii+9C+26B. (Sung-Kiang: Observatoire astronomique de Zô-sè.) [149

Palæontologia Sinica. Series D, Vol. 7, Fascicle 4: Observations on the Form and Proportions of the Endocranial Casts of Sinanthropus pekinensis, other Hominids and the Great Apes; a Comparative Study of Brain Size. By Dr. Franz Weidenreich. Pp. 52. (Peiping: Geological Survey of China.) [149

Smithsonian Miscellaneous Collections. Vol. 95, No. 15: Further Evidence on the Dependence of Terrestrial Temperatures on the Variations of Solar Radiation. By C. G. Abbot. (Publication 3397.) Pp. ii+4. (Washington, D.C.: Smithsonian Institution.) [149

International Institute of Agriculture. The World Agricultural Situation in 1934–35 (World Agriculture: Conditions and Trends; Markets and Prices; Agricultural Policies and Conditions in the Different Countries). Economic Commentary on the International Yearbook of Agricultural Statistics for 1934–35. Pp. viii+534. (Rome: International Institute of Agriculture.) 25 lire. [149

Department of Agriculture: Straits Settlements and Federated Malay States. Scientific Series, No. 17: The Termite, *Microtermes pallidus* Hav., in relation to Tea in Malaya. By G. H. Corbett and N. C. E. Miller. Pp. ii+12+4 plates. (Kuala Lumpur: Department of Agriculture.) 50 cents. [149

Museums in the United States: their Exhibition Technique and some Applications to S. Africa. By Dr. E. L. Gill. Pp. iv+23. (Pretoria: Carnegie Visitors' Grants Committee.) 1*s*. [159

Publications of the South African Institute for Medical Research. No. 38: Entomological Studies—Studies on Insects of Medical Importance in South Africa (Part 3). By Dr. Botha De Meillon. Pp. 125–215. (Johannesburg: South African Institute for Medical Research.) [159

Brooklyn Botanic Garden Record. Vol. 25, No. 4: Prospectus of Courses, Lectures and other Educational Advantages offered to Members and to the General Public, 1936–37. Pp. xii+229–264. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) [169

U.S. Department of Agriculture. Circular No. 402: Blue Grama Grass for Erosion Control and Range Reseeding in the Great Plains and a Method of obtaining Seed in Large Lots. By Jess L. Fults. Pp. 8. (Washington, D.C.: Government Printing Office.) 5 cents. [169

Veröffentlichungen des Geophysikalischen Instituts der Universität Leipzig, Zweite Serie. Spezialarbeiten aus dem Geophysikalischen Institut und Observatorium. Band 7, Heft 4: Mikroklimatische Untersuchungen der Abkuhlungsgrosse in einem Waldgebiete. Von Helmar Lehmann. Pp. 189–256. Band 7, Heft 5: Die Synoptische Darstellung der ½ jährigen Druckwelle. Von F. Reuter. Pp. 257–296. Band 7, Heft 6: Die Brucknersche Niederschlagsschwankung uber Europa. Von Ernst Trautmann. Pp. 297–342. Band 8, Heft 1: Das Abkuhlungsklima in Walde und auf freiem Felde nach Frigorimeterregistrierungen. Von Reinhard Faust. Pp. 76. (Leipzig: Geophysikalische Institut der Universität.) [179

Zur Thermodynamik strenger und milder Winter. Von Otto Fink. Pp. 62. Bodentemperaturen unter besonderer Berucksichtigung der ausseren meteorologischen Faktoren. Von Ludwig Herr. Pp. 64. Über die virtuelle innere Reibung in den untersten Schichten der Atmosphäre in Abhangigkeit von der Stabilität der Luftmasse und der Rauhigkeit der Unterlage. Von Werner Keller. Pp. 48. Das Aprilwetter und seine Schauerserien. Von Erhard März. Pp. 70. (Leipzig: Geophysikalische Institut der Universität.) [179

Gold Coast Colony. Report on the Gold Coast Survey for the Year April 1935 to March 1936. Pp. ii+11+2 plates. (Accra: Government Printing Department; London: Crown Agents for the Colonies.) 1*s*. [219

Catalogues

Insulin—Boots in the treatment of Diabetes Mellitus. Pp. vii+55. (Nottingham: Boots Pure Drug Co., Ltd.)

Catalogue of Books and Journals bearing on Chemistry and Chemical Technology. (No. 490.) Pp. 26. (Cambridge: W. Heffer and Sons, Ltd.)

The Wild-Barfield Heat-Treatment Journal. No. 10, September. Pp. 15–28. (London: Wild-Barfield Electric Furnaces, Ltd.)

B.D.H. 'Spot' Test Outfit. Pp. 4. Price List of B.D.H. Organic Reagents for 'Spot' Tests and Delicate Analysis, as described in the B.D.H. Book of Reagents for 'Spot' Tests and Delicate Analysis. Pp. 4. (London: British Drug Houses, Ltd.)

Catalogue of Books on all Technical Subjects and Applied Science. Pp. 124. (London: W. and G. Foyle, Ltd.)

Catalogue of Books of Reference. (No. 204.) Pp. 64. (Leicester: Bernard Halliday.)

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The British School of Archæology at Athens

FOR a month—from October 14 until November 14—the British School of Archæology at Athens is marking the completion of its fiftieth year of existence by holding an exhibition illustrating its activities and achievement at the Royal Academy of Arts, Burlington House, London, W.1, which is also made the occasion of an appeal for funds to maintain the efficiency of the School. For the archæologist who lightly passes from one millennium to another in his exploration of the ages before our era, fifty years is but a brief span. Nevertheless, the fifty years of "the British School", as it is affectionately known to its intimates, relatively few though they may be, are not far from covering the whole period which has seen the development of archæological excavation on ancient sites as a scientific method of reconstructing the cultural history of the great civilizations of the past, of which, for the most part, all other record, if such there were, has vanished.

"Gone are the walls that were so good,
And corn now grows where once Troy stood."

Though this no longer will be true, thanks to the co-operation of the Turkish authorities in the work of archæologists from the United States at Hissarlik, it was only an inspired faith in the works of Homer that led Schliemann first to excavate there in 1866, and eleven years later to dig at Mycenæ on the mainland of Greece, thus initiating those explorations on the sites of long-forgotten and deserted cities, palaces and temples, which not merely have transformed previous conceptions of the pre-historic past in classical lands, but also have built them up anew.

Schliemann, however great his merits as a pioneer, was too intent on the more spectacular aspects of the results of his excavations to elaborate a technique that could be termed truly scientific. By his excavations at Troy, Tiryns, and more especially at Mycenæ, he established the existence of a great civilization of the bronze age. Yet notwithstanding the development in the methods of excavation which followed, especially under the influence of Dorpfeld, it was not until the work of the British School at Melos, and more especially on the site of Phylakopi, in the years 1895–99, that a stratified site in Greece proper was excavated on scientific lines.

The enthusiasm aroused in the world of scholarship by the discoveries of Schliemann and others led to the foundation of the British School at Athens in the autumn of 1886, following on an article written by Richard C. Jebb. His proposal that such a school should be instituted aroused the active interest of the Prince of Wales, afterwards King Edward VII, and among its most active supporters were Prof. Percy Gardner, J. E. Sandys, Sir Frederick Leighton, D. B. Monro (later Provost of Oriel) and James Gow, as well as Francis C. Penrose, who became the first director, George A. Macmillan, honorary secretary from 1886 until 1897 and chairman of the Committee of Management from 1903 until 1934, and Walter H. Leaf, treasurer from 1886 until 1906. To the generous devotion and benefactions of the two last named the School is indebted more than to any for its survival in days of stress.

The objects with which the British School was founded were sufficiently wide. It was intended to afford British students of the literature, art, architecture, archæology and history of Greece of all periods from the earliest times to Byzantine and modern days, adequate facilities for travel and research in Greece itself. How varied have been the interests for which it has provided may be gauged by the names of only a very few of its students, such as Ernest A. Gardner, archæologist, David G. Hogarth, archæologist and geographer, Marcus N. Todd, epigraphist, Montague R. James, whose recent death is deplored, R. Schultz Weir, Byzantine archæologist, John L. Myres, archæologist, geographer and historian, now chairman of the Committee of Management, Sir James Frazer, author of the monumental edition of Pausanias, and Sir Arthur Evans, the School's most distinguished and senior honorary student.

Of the academic side of the student's life at the School little is known to the outside world, nor indeed of the intense application, incidental to archæological study. Yet those who care to turn over the pages of the thirty-four volumes of the "Annual" of the School will be astounded at the range of exploratory work—topographical, linguistic and cultural—there recorded, and representing only part of the mass of information collected by the students in the extensive journeys they have been encouraged to make in Greece, the islands and Asia Minor in the course of their term of residence. Indeed it is no exaggeration to say that our campaign in the Eastern Mediterranean and the Balkans in the Great War ultimately came to a fortunate issue largely through the knowledge of local conditions and of the language, customs and mentality of the peoples, which was possessed by members of the School serving in the Forces.

It is an interesting and fascinating occupation for the visitor to the School's exhibition to follow catalogue in hand the excavations there illustrated, which have been conducted by its members, in their chronological succession and to mark how, with the development of scientific method—a development in which the School has taken no small part—the work gains in intensity, the results in breadth of application. Unfortunately, this development cannot be followed here in detail, though a word must be spared for one piece of early research shown, which stands outside the better known activities of the School. This is the Byzantine work of T. S. Weir in the early 'nineties, which was before its time.

Although the work of the School in prehistoric archæology may be not unknown to the public in general outline, it becomes impressive in detail with even a mere recapitulation of the names of some of the sites which have been excavated. Beginning with Phylakopi, and ignoring familiar names which went before, we have Minoan Palækastro in Crete, Sparta with its temple of Artemis Orthia, the epoch-making Mycenæ, sites in Thessaly, Macedonia, Lesbos—this last excavation which under Miss Winifred Lamb has recreated the background of Troy—and the important early Hellenic sanctuary of Perachora, near Corinth, upon which the School is still engaged.

Although comment upon the results which have been achieved by these excavations is not possible, a moment must be spared for a more general reflection on the influence of the School on archæological method. As already mentioned, Schliemann in his excavations achieved his object of establishing the existence of a great bronze age civilization, although as regards substantiating the works of Homer he raised more difficulties than he solved. Later work of other excavators aimed primarily at elucidating, with such scientific precision as was envisaged from time to time, the more or less complete history of the site upon which they were engaged. But even in early days, in the work of the School there may be discerned the first steps towards the ideal of the modern archæologist, the reconstruction of a complete culture complex and its contacts, such as that by which is now being built up gradually, for example, the cultural reconstruction as an integrated whole of pre- and protohistoric times from the Eastern Mediterranean to India and eastern Asia. The pioneers in this movement—speaking now only of members of the School—were Arthur Evans and J. L. Myres, the latter of whom as a young student in 1893 was the first British explorer of Crete, and whose identification of the Kamares ware, previously found by Flinders Petrie in Egypt, first demonstrated connexion between Egypt and the Greek world at a date earlier than the Eighteenth Dynasty. The full flower of this pioneer work is to be seen in the truly remarkable collection now at Burlington House illustrating Minoan culture from its earliest to its latest phase, and demonstrating its external relations with Egypt and the East, which has been staged by Sir Arthur Evans. It forms the *clou* of the exhibition. It illustrates an advanced but early culture in a manner such as has never been seen before, and probably will never be seen again.

Since the School at Athens was founded, similar British Schools have been established elsewhere. To them we could wish no better fortune than that when they complete their fiftieth year, the tale of their success may be as great as that of their prototype.

Plant Pathology in the Tropics

Diseases and Pests of the Rubber Tree
By Arnold Sharples. Pp. xvii+480+4 plates. (London: Macmillan and Co., Ltd., 1936.) 25*s*. net.

THIS is a most notable addition to books on the diseases of tropical crop plants. Since Petch's "The Diseases and Pests of the Rubber Tree" (1921) and Steinmann's "Diseases and Pests of *Hevea brasiliensis*" (1925) were published, there has been great activity in investigating, in a more detailed manner than was formerly possible, the major diseases to which the rubber tree in the Eastern plantations is prone. Nowhere has this activity been more pronounced or more productive of striking results than at the Rubber Research Institute of Malaya, to which the author of the present book was seconded as head of the Pathological Division in 1931, after being Government mycologist in the Department of Agriculture for many years.

The establishment of the rubber plantation industry, through the foresight of a former Director of the Royal Botanic Gardens, Kew, is one of the romances of commerce. At the present time, some millions of acres of land, formerly mostly under high forest, are devoted to the cultivation of *Hevea brasiliensis* in Malaya, Ceylon, the Dutch East Indies and other countries of south-eastern Asia. For example, in travelling by train from Penang to Singapore, one passes through an almost continuous rubber forest which stretches away for miles on either side of the railway track. Such large areas devoted to the cultivation of a single crop, under humidity and temperature conditions particularly favourable to the development of parasitic fungi, may seem to offer a terrifying prospect for the establishment of epidemic disease. Happily, the rubber plantation industry has never been seriously threatened in this way, and this has been largely due to the skill and foresight of the plant pathologists who have served the industry so well.

It is sometimes stated that disease in a crop plant is merely a symptom that cultivation is being carried on under unsuitable conditions. However true this may be with regard to certain crops, no one who has had experience of rubber cultivation can doubt that the incidence of disease is a serious factor even in trees which are growing with the maximum vigour. Again, it is sometimes claimed, and rightly so in some instances, that the menace of disease can be overcome by the utilization of disease-resistant varieties; unfortunately, there seems to be no prospect of amelioration along these lines as regards *Hevea brasiliensis*. So far, no strains of the rubber tree have been discovered which have the desirable properties of resistance to disease; furthermore, most of the fungi which attack this tree are not highly specialized parasites such as those against which the plant breeders have achieved certain notable successes. The price of security is unceasing vigilance, and as regards the rubber plantation industry, plant pathologists will have to continue to exercise this watchfulness without remission.

General considerations of this kind are emphasized in Mr. Sharples' book, which in fact can be looked upon as a general treatise on the principles of plant pathology with particular reference to rubber cultivation. For this reason the book will have a wide appeal to plant pathologists in general as well as to rubber planters, for whom in some respects the book has been primarily written. No better book could be placed in the hands of a young plant pathologist proceeding overseas for his first period of service in a tropical country.

The immense importance of environmental factors in determining the incidence of certain parasitic diseases is rightly stressed. For example, the author points out that pink disease, caused by *Corticium salmonicolor*, occurs seriously in Malaya only in the regions of highest rainfall and in the vicinity of large forest reserves. *Oidium Heveæ*, the powdery mildew of the rubber tree and a comparatively recent arrival in the plantations, only attacks under certain weather conditions the new foliage which develops after the 'wintering' or annual defoliation of the trees. *Ceratostomella fimbriata*, causing Mouldy rot of the tapped bark, becomes a menace only under extremely high atmospheric humidity. In connexion with this disease, the author sounds a note of warning in regard to the danger of encouraging dense semi-arborescent growths of other species among the rubber trees (following so-called forestry methods of rubber cultivation) because of the excessive humidity which they occasion.

One of the most interesting sections of the book is that dealing with the root diseases of the rubber tree, which in some ways are the most difficult to combat. Most of the rubber plantations have been established on land previously under high forest. After felling the trees, root parasites such as *Fomes* *lignosus* and *Ganoderma pseudoferreum*, which were kept under control in the natural forest, develop actively and become a menace to the newly established plantation. Thanks to investigations carried out recently, chiefly at the Rubber Research Institute of Malaya, much new light has been thrown on the biology of these root parasites, with the result that more rational methods of control can now be carried out than hitherto. With the replacement of worn-out stands of rubber by superior high-yielding strains of trees, the control of these root parasites has become all the more imperative.

Among other topics dealt with in this book are the damage to trees caused by lightning—a subject to which little attention has hitherto been paid in the tropics—the insect pests of rubber trees—fortunately not a formidable list—and the methods of cultivation now in vogue in rubber plantations. An appendix contains a list of fungi recorded on rubber trees in Malaya, most of which are saprophytes. The book is profusely illustrated and admirably printed.

All who take an interest in the cultivation of tropical crop plants will appreciate the value of this book, and the rubber plantation industry in particular should be under a deep debt of gratitude to the author for his enlightening and comprehensive survey of many of the major problems which concern their estates. The publication of Mr. Sharples' book is high testimony to the services of the scientific experts without whose aid this romantic industry could never have been established.

F. T. BROOKS.

Blood Pigments

Essai sur la biochimie générale et comparée des pigments respiratoires

Par Prof. Jean Roche. Pp. 170. (Paris : Masson et Cie., n.d.) 40 francs.

PROF. ROCHE'S monograph is the first book the reviewer has met which deals at length with the comparative properties of the four principal groups of blood pigments, the hæmoglobins, the hæmocyanins, the chlorocruorins and the hæmerythrins ; it fills a much-felt gap. The author has limited himself to those aspects of the subject on which he has been personally engaged, thereby excluding any extended treatment of that common property to which they owe their name, their oxygen-binding ability, so that the outstanding physiological function of these fundamentally important pigments receives only occasional incidental reference. This is a deliberate omission, which may have been wisely made, but which many of Prof. Roche's readers will regret.

The work contains a great mass of very useful material ; it is essentially a review of the author's own researches, supplemented by a fairly complete summary of the literature on these topics, which includes the elemental and amino acid compositions of the blood pigments, their ultra-violet absorption spectra, their isoelectric points, acid-base titration curves, and their molecular weights. As a reference work, however, the book would have been much improved if an index had been provided (an almost inexcusable omission in a book of this character), if each topic had been treated coherently instead of being broken up into subdivisions entitled "previous work" and "personal research", if the bibliography (itself excellent) had been provided with some key to the references in the text, and if the proof-reading had been a little less casual (to cite a single example, the table on p. 35 contains fourteen references of which three are incorrectly ascribed ; there are also at least two significant omissions).

The main theme of the book is the specificity of the blood pigments, the differences not only between the four main groups, but also between different species in the same group, and sometimes even between different individuals of the same species, and Prof. Roche provides enough evidence to convince even the most sceptical that blood pigments possess scarcely any properties which fail to display such differences, given sufficient accuracy of measurement. The correlation of these varying properties with the needs of the organism has scarcely been attempted up to the present ; the problem is one which will rightly challenge comparative biochemists and physiologists in the future.

The outstanding virtue of this very useful book is the author's first-hand experience with the substances about which he writes, for he has personally undertaken extensive and valuable experimental work on each branch covered. He is enabled thereby to speak with an authority and assurance which goes far to compensate for the exclusion from his survey of fields which still cry for adequate comparative treatment.

Medical Biography

(1) Great Doctors of the Nineteenth Century
By Sir William Hale-White. Pp. vii +325. (London: Edward Arnold and Co., 1935.) 15*s*. net.

(2) Benjamin Rush, Physician and Citizen, 1746–1813
By Nathan G. Goodman. (Philadelphia: University of Pennsylvania Press; London: Oxford University Press, 1934.) 17*s*. net.

(3) Franklin Paine Mall: the Story of a Mind
By Florence Rena Sabin. Pp. xiii +342 +8 plates. (Baltimore: The Johns Hopkins Press; London: Oxford University Press, 1934.) 12*s*. 6*d*. net.

(4) Those Were Good Days!
Reminiscences. By Carl Ludwig Schleich. Translated by Bernard Miall. Pp. 280 +9 plates. (London: George Allen and Unwin, Ltd., 1935.) 12*s*. 6*d*. net.

(5) The Proceedings of the Charaka Club
Vol. 8. (Published for the Charaka Club.) Pp. xvi +202 +31 plates. (New York: Columbia University Press; London: Oxford University Press, 1935.) 25*s*. net.

(1) SIR WILLIAM HALE-WHITE is to be congratulated on having employed his leisure on retirement from practice by the compilation in an intimate and attractive style of the life and work of seventeen eminent British physicians and surgeons of the nineteenth century, with some of whom he was personally acquainted.

General medicine is represented by Richard Bright, William Stokes, Thomas Addison, Sir William Gull and Sir Samuel Wilks; surgery by Sir Astley Cooper, Sir James Paget and Lord Lister; neurology by Sir Charles Bell, Marshall Hale and Hughlings Jackson; tropical medicine by Sir Patrick Manson and Sir Ronald Ross; public health by Edward Jenner and Sir John Simon; ophthalmology by Sir William Bowman; and anæsthetics by Sir James Young Simpson.

An added interest is given to the work by the remarkable versatility of several of these doctors. Richard Bright, for example, who is described as better known than any physician since William Harvey, was also a geologist and traveller, linguist and writer. Sir Charles Bell, in addition to being an eminent anatomist and surgeon and a pioneer in neurology, was also a skilful artist. Sir John Simon was alike eminent as a surgeon, pathologist and sanitarian, having been at different times president of the Royal College of Surgeons and principal medical officer of the Local Government Board, as well as author of a classical work on English sanitary institutions and a text-book on general pathology. Sir Ronald Ross, whose discovery of the mosquito as the transmitter of malaria is known to all, was also a poet, mathematician, novelist, water colour painter and musician. Sir John Young Simpson, who introduced chloroform anæsthesia, was president of the Society of Antiquaries of Scotland and member of several other archæological societies. With the exception of Addison, one of the ablest clinicians of his time, whose name is attached to pernicious anæmia and disease of the suprarenals, and Sir James Young Simpson, all were fellows of the Royal Society.

Short sketches of the lives of distinguished contemporaries of the principal characters are included, such as Robert Graves, author of the famous "Clinical Lectures", William Farr and Southwood Smith, the sanitarians, Henry Hill Hickman, a pioneer on nitrous oxide anæsthesia, and Thomas Hodgkin and Hilton Fagge, well-known physicians and contemporaries of Addison and Sir William Gull respectively.

(2) In his work on Benjamin Rush, Dr. Nathan G. Goodman gives a richly documented account of a man who was equally illustrious as a physician, humanitarian and patriot. His activities as an American patriot consisted in being the only doctor of medicine who signed the Declaration of Independence and in serving as Physician-General to the Middle Department of the Army. He has left classical descriptions of the relation of disease of the teeth to joint infection, cholera infantum, dengue and the hygiene of troops as well as a remarkable account of the yellow fever epidemic at Philadelphia in 1793.

By the introduction at the Pennsylvania Hospital of humane and judicious treatment of the insane, for whom he provided bathing facilities and occupational therapy, and by a careful study of the causes, symptoms and treatment of insanity in his essay on diseases of the mind, Benjamin Rush deserves the title given him by Dr. Goodman of "the first American psychiatrist". His humanitarianism was also shown by his denunciation of slavery and its attendant evils, his protest against capital punishment, his interest in prison welfare and his campaign against alcoholism. Lastly, as educator, Rush was the foremost teacher of medicine in America in his time and took an active part in the foundation of Dickinson College at Carlisle, Pennsylvania.

In addition to brief notes on the text, a bibliography of twenty-seven pages including manuscript sources, a list of Rush's published works, contemporary newspapers and secondary works is appended. The text is interspersed, among other illustrations, with portraits of Rush and his wife, pictures of his birthplace and last residence and of the Pennsylvania hospital to which he was attached.

(3) In her sympathetic study of Franklin Paine Mall, professor of anatomy at Johns Hopkins University, his former student, Miss Florence Rena Sabin, relates the life and work of a man who, like Osler, Welch, Flexner and Halstead, transplanted to the United States modern scientific medicine from Europe, where Mall was the pupil of His in anatomy and embryology and of Karl Ludwig in physiology. Before the return of this small but influential band of men from Germany in the 'eighties, the United States possessed no laboratories, no equipment and no money for education, but within a decade these deficiencies were made good. In addition to the active part which he played in the organization of scientific societies such as the Association of Morphologists and the American Anatomical Association, Mall was responsible for the appearance in 1901–2 of the *American Journal of Anatomy*, of which he edited the first seven volumes, as well as the first volume of the *Anatomical Record.*

Though primarily an anatomist who founded a school of anatomy in the United States and trained men who carried his teaching to other laboratories, Mall had also a profound influence on medical education in general. Miss Sabin quotes in full the appreciation of his work which appeared in NATURE, 96, 205 (1916); 106, 179 (1920). A bibliography of his most important publications is appended, as well as the German text of letters received from His and Ludwig, with whom Mall corresponded for many years after leaving Germany.

(4) In the autobiography entitled "Those Were Good Days", Carl Ludwig Schleich, the versatile and eccentric surgeon who died in 1922, gives a vivid account of his childhood, student life and tempestuous maturity, together with a living picture of pre-War Germany. After acting as assistant to a number of distinguished chiefs, including Langenbeck and Bergmann, the surgeons, and Virchow, the pathologist, to each of whom a chapter is devoted, as well as to Senator, the physician, and Olshausen, the gynæcologist, he founded a private clinic for surgery and gynæcology, where he initiated the method of regional anæsthesia for which he is best known. The method at first met with a hostile reception, but ten years later Miculicz, a leading German surgeon, announced that he had performed thousands of completely painless operations by this means. A special chapter is devoted to Ehrlich, as man and scientific worker, whom Schleich used to visit frequently in his Biological Institute at Frankfort.

Schleich's activities were not confined to his profession. He was an intimate friend of August Strindberg, the novelist and playwright, and of Richard Dehmel, the poet, and was himself the author of numerous poems and plays, a musician and painter. An epilogue by his friend Wolfgang Goetz is appended to the autobiography.

(5) The eighth volume of the *Proceedings of the Charaka Club* (a select band of New York practitioners interested in the history of medicine) contains several papers on medical biography. The first of these is a sketch by Dr. Archibald Mallock of the life of James de Berty Trudeau, artist, soldier and physician, and father of the better known Edward Livingston Trudeau, pioneer in the sanatorium treatment of tuberculosis. In addition to being general commanding the Louisiana Legion at New Orleans in 1861 at the outbreak of civil war, and author of a treatise on the organization of the militia for the defence of the State of Louisiana, Trudeau wrote a book on "Woman and her Diseases", and was the designer of several caricatural statuettes of well-known medical men which are here reproduced.

Dr. Casey A. Wood contributes an instructive paper on "Johannes Baptista Porta (1540–1615), Neapolitan Oculist and Natural Philosopher". Porta was also the founder of the "Accademia degli oziosi" and "Accademia secretorum" at Naples, which recorded a number of scientific discoveries, a writer of plays, many of which were staged with remarkable success, and a collector of natural history specimens, with which he converted his house into a museum. Porta's chief claim to be remembered, however, is that he discovered and described several optical instruments, including the camera obscura. He was also the author of "Magia Naturalis" (1558), by which he intended to destroy some of the prevalent superstitious beliefs, "Phytognomonica" (1583), which is described as a herbal, an advanced text-book on botany, a treatise on comparative biology, and a compendium of surgery, anatomy, medicine and pharmacology, and "De humana physiognomia". in which he proved himself a predecessor of Lavater.

Dr. Karl M. Vogel's paper entitled "Sea Surgeons in the Days of Oak and Hemp" contains a brief account of John Esquemeling, surgeon, buccaneer and writer; Lionel Wafer, another medical man of prominence in buccaneering circles; Thomas Dover, the pirate, who gave his name to the well-known powder; Tobias Smollett, the novelist; John

Atkins, author of "The Navy Surgeon", which contains the first detailed description of African sleeping sickness as occurring in the natives of the Gold Coast in 1737; and Savigny, one of the survivors of the shipwreck of the *Medusa*, which he related with its appalling consequences. In his essay on "Doctors and Gardens", Dr. Frederick Peterson refers to Linnæus, the father of botany, who was professor of medicine at Uppsala before he became professor of botany there; Dahl, his pupil; Gaulthier, of Quebec; Pierre Magnol, professor of medicine at Montpellier; Lobel, of Lille, physician to James I; Leonard Fuchs, professor of medicine at Ingoldstadt, and many other doctors who have given their names to well-known plants.

Yeast

Die Bierhefe als Heil-, Nähr- und Futtermittel
Von Dr. Julius Schülein. (Technische Fortschrittsberichte: Fortschritte der chem. Technologie in Einzeldarstellungen, herausgegeben von Prof. Dr. B. Rassow, Band 35.) Pp. viii + 194. (Dresden und Leipzig: Theodor Steinkopff, 1935.) 9 gold marks.

WHEREAS bakers' yeast remains in the bread after it has done its useful work, brewers' yeast remains as a by-product of brewing and is sometimes a waste product. This is certainly improper, and a great deal of work is going on in all countries to find uses for it either in medicine, or as a food for man and animals. It is claimed that the craze for synthetic organic pharmaceuticals is abating and that the medical man should restudy the old-fashioned natural materials in the light of modern knowledge—above all, yeast.

In England, a material—marmite—made from brewers' yeast has found extensive use for some considerable time, and is freely referred to in books on nutrition. It is one of the two foodstuffs which are rich in vitamin B_1, the other being wheat germ: it was supplied to the Army in the East for the prevention of beriberi during the Great War. In Germany, up to 1914, brewers' yeast was disposed of locally; the value of a pot of yeast, so-called young beer, as a blood purifier was known to the peasants, but most of it was thrown away. During war needs, the under-nourished population took to it, but the demand did not persist.

A very thorough investigation of the vitamin content of brewers' yeast has been made by a number of workers, as well as that of certain amino acids and glutathion. It has been established that the dried material is very rich in vitamin B_1 and B_2 in comparison with the usual foods, and that brewers' yeast extracts properly prepared are far superior to the flesh extracts which are so largely used; indeed these are regarded by some as an unnecessary waste of the animal material.

The author has collected a great deal of information in regard to these points and in particular to the beneficial effects of yeast in cases of malnutrition; his book contains more than four hundred citations to the original literature.

Whereas brewers' yeast is grown in the mash tun along with the nutritive elements derived from the germinated and malted barley, bakers' yeast is produced in quite a different manner under conditions of high aeration from molasses and inorganic nitrogen, the object being to manufacture a product from a single pure culture which is absolutely regular in its character and activity, so that a dough made from a standard flour mixture is properly fermented in a standard number of minutes. It is the aim of the yeast-maker in competition to reduce this time.

Modern bakers' yeast may be described primarily as a gas-making machine. Such yeast dried is eminently palatable, which is scarcely the case with dried brewers' yeast, and successful attempts are now being made to manufacture a special yeast for nutritional purposes in which the vitamin and other therapeutic content of the yeast is enhanced. Apparently the cost of the protein in such yeast is higher than the equivalent quantity as beef or mutton, but the vitamin content is far superior.

It is probable that the public will in future be offered genuine valuable yeast preparations, though some safeguards will have to be discovered to guard them from spurious preparations of inferior or no vitamin content, which they themselves will be unable to recognize.

The sale of vitamin-rich foods containing the requisite accessory factors to our normal unsatisfactory diets is bound in time to present the problem of their supervision. Quick and satisfactory tests of a chemical nature for the vitamins will have to be found in substitution for the present laborious tests on animals, so that the proper public authority may take the control in hand.

Poisons Law

a Guide to the Provisions of the Pharmacy and Poisons Acts 1852 to 1933 and the Dangerous Drugs Acts 1920 to 1932 for the use of Pharmacists and others concerned with Transactions in Drugs and Poisons. By Hugh N. Linstead. With a Chapter upon the International Background of Dangerous Drugs Legislation, by Sir Malcolm Delevingne. Pp. vi+448. (London: The Pharmaceutical Press, 1936.) 5*s*. net.

THE Act of 1933 made drastic changes in poisons law, and the Poisons List and Poisons Rules, issued by the Secretary of State on the advice of the Poisons Board, have brought complications and liabilities to all concerned, in whatever way, with transactions in poisons. The List, excluding esters and salts, approaches 200 entries, some covering ranges or groups of substances; the rules number 33, and 12 schedules are appended. Fortunately, this review is not concerned with the List or Rules as such, but only with the way in which the author explains and amplifies them. They appear involved and interdependent and it is obviously desirable to have them co-ordinated and explained for the assistance of those who are primarily concerned with their practical application. No one is more fitted to do this than he who is the Secretary of the Society which has been concerned with the administration of each Act dealing with poisons in Great Britain, and who is a member of the Poisons Board set up under the latest Act. He has dealt with the subject from the practical point of view and after discussing the question of labelling, he shows the application of the rules to, respectively, retail pharmacy, listed sellers, laboratories, manufacturers and wholesalers, medical practitioners (including dentists and veterinary surgeons), hospitals and manufacturers of animal medicines. In spite of the complexity of the subject and of certain essential repetitions, he has been able to compress these aspects to, respectively, 14, 7, 2, 11, 5, 6 and 2 pages of conveniently large print.

Nothing but praise can be given for completeness, conciseness and clarity. A few *ex cathedra* interpretations are given, and since it may be assumed that these express the attitude of the Pharmaceutical Society, they will probably be acted upon and become standard practice. The paraphrase on p. 98 of the proviso to Rule 23 (2) must be criticized, since it appears to deny completely to a shelf a storage function which the proviso only conditionally restricts. The book concludes with a useful list of poisons and substances containing poisons, with an indication of the special restrictions applying to each. J. R. N.

Alternating-Current Machines

By A. F. Puchstein and Prof. T. C. Lloyd. Pp. viii+582. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 25*s*. net.

IN the preface the authors state that the time devoted in technical colleges to the study of alternating current machines varies between wide limits. It is stated that a definite text-book is chosen and the syllabus is constructed from it. Granting this, it is of great importance that the text-book be comprehensive and thorough. The present volume is a treatise which covers a very wide ground. The authors admit that only a fraction of the material in the book can be studied in the classroom.

We think that, from the training point of view, the treatise would have been much more useful if it had been cut down considerably. Considering the many subjects which electrical students have to study nowadays, and that only a small number of them will take up seriously machine design and operation in their profession, it would have been better for the greater number of students if the authors had discussed only a few typical machines. The treatment is on orthodox lines and will be easily understood by the technical student. Many examples are given, but it would have helped those who try them to have had the answers given and to have more of them worked out.

Die menschlichen Rassen:

eine popularwissenschaftliche Einfuhrung in die Grundprobleme der Rassentheorie. Von Dr. Rudolf Lämmel. Pp. xv+283+48 plates. (Zürich: Jean Christophe Verlag, 1936.) 7 francs.

THIS clearly written treatise on human races belongs to the polemical class of literature, being more concerned in rectifying the errors of German professors than in laying before its readers a scientific presentation of modern ethnology. Readers can best judge of its scientific worth by noting the classification applied to men of the European type. It is proposed to divide them into thirteen races: these are Nordic, Baltic, Alpine, Dinaric, Armenian, the "Faelischen", Turanians, Mediterraneans, Orientals, Indides, Veddahs, Ainos, Polynesians.

The first essential of a classification of objects of any kind is that its groups must be capable of identification and that there is some degree of unity in the total assemblage. The classification in this book breaks these elementary requirements. A. K.

Motivation of Behavior:

the Fundamental Determinants of Human and Animal Activity. By Prof. P. T. Young. Pp. xviii+562. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 20*s*. net.

THIS is a very interesting and sound psychological account of the mainsprings of conduct under the caption of the motivation of behaviour. The work is well developed and well balanced, the evidence clearly put and the argument logically advanced. The author gives his own position by stating that the mind and the brain are one and the same reality, and that motivation is a process of arousing movement by physical energy transformations which are concurrent with behaviour.

At the end of the book is a collection of questions on each chapter—to anyone who has the energy and time to answer these questions seriously they cannot fail to be a great boon. We wish it was a usual practice.

The Harvard Tercentenary Celebrations

HARVARD celebrated its tercentenary on September 18 by a ceremony which was as impressive in its setting as it was comprehensive in its conception.

The scene was set in the "Yard"; for those to whom Harvard is a name, albeit a great name, a word must be said about the actual terrain. The Yard at Harvard, which forms the nucleus of the University, is situated in the town of Cambridge much as Trinity College is situated in Dublin; the buildings are less regularly disposed than those of the colleges at Cambridge or Oxford, and being detached from one another the arrangement into definite 'Courts' or quadrangles is less defined. The quadrangles, in so far as they exist, however, differ from those in the English universities in that they are planted with trees as well as with grass and therefore shaded completely with foliage. Of these leafy areas in the 'Yard', that which most definitely resembles a quadrangle is one bounded by the Memorial Church on the north and by the Widener Library on the south, both noble buildings, each at the head of an imposing flight of steps, and facing one another one hundred and thirty yards apart.

In this court the ceremony took place. The steps of the Memorial Church formed a terraced stage, from the centre of which the addresses were given. In the centre sat also the President of the United States, an old Harvard graduate, and the diplomatic and civic representatives, including Mr. Curley, Governor of Massachusetts. To the right and left sat the recipients of honorary degrees, and in the tiers behind them the delegates from other universities and corporations, and also the representatives of the faculties at Harvard. As the number of delegates was in the region of five hundred, there cannot have been less than one thousand persons who faced the assembly. For it fourteen thousand chairs had been placed in the court. "In the court" is perhaps not a good phrase, for at the back on each side of the Widener Library there is a gap in the buildings, and the rows of chairs stretched out into these two gaps until they were lost to sight beneath the trees.

The actual proceedings lasted about three hours. Over the whole of this colourful assembly hung the menace of storm. The weather for the preceding days had been perfect; but a hurricane was known to be on its way, travelling up the Atlantic coast. Rain-drops fell at the commencement of the proceedings and from time to time during its continuance, but the President, with resolution amply justified by the event, refused to transfer the programme to an alternative one which had been arranged in the event of wet weather. All knew that it was a race with time. Ten minutes before the termination of the sitting the skies broke, but the torrent of rain which poured from the clouds was no more than a reminder of what might have been. To some indeed the conditions may have seemed in a sense an allegory. What better symbol could there be of the determined growth of a University through three centuries of difficulty and strife to its present magnificence than the resolution of its President in carrying the tercentenary celebration to its climax through three hours of menacing storm.

The proceedings opened with a prayer and closed with a benediction—a detailed account of them would perhaps be out of place. Items of particular interest to English readers would perhaps be: (1) The fact that shortly after the opening prayer the chimes of Southwark Cathedral, that in which John Harvard was baptized, were broadcast across the Atlantic and listened to by the audience. (2) The Poet Laureate of England, John Masefield, who travelled 3,000 miles to deliver his tribute in verse . . . which, referring to John Harvard, concluded:

"Would that his human eyes untimely dead,
Freed from that quiet where the generous are,
Might see this scene of living corn made bread,
This lamp of human hope become a star."

(3) The conferment of honorary degrees. The degree of doctor of science was conferred as follows:

Prof. E. B. Bailey—a British geologist whose skilful questioning of the Scottish highlands drew forth revealing answers, telling of the origin of mountain ranges and their evolution in the past.

Dr. Kiyoshi Shiga—the discoverer of the cause of epidemic dysentery, a valiant and effective fighter in the international struggle for the prevention of disease.

Prof. T. Levi-Civita—a mathematician great in accomplishment, an intellectual leader of the land we all revere, the birthplace of the art and science of the present day.

Sir Arthur Eddington—a student of the cosmos who peers within the atom and surveys the expanding universe, an expounder to the multitude of the poetry of modern science.

Prof. A. H. Compton—a physicist who forces light itself to illumine the dark secrets of its still mysterious nature.

Prof. L. Ruzicka—a chemist, daring in his attack, brilliant in his methods, successful in his interpretations of the architecture of Nature's baffling compounds.

Prof. B. A. Houssay—a physiologist noted for his studies of the ductless glands, a leader of science in the new world to the south.

Sir Joseph Barcroft—an investigator of many phases of the respiration of higher animals, a beloved guide to younger men on both sides of the Atlantic.

Prof. C. Gini—a versatile sociologist and statistician who early turned his attention to that most vital problem, the growth of populations.

Prof. B. Malinowski—an anthropological explorer who initiated a new movement for the study of the gregarious habits of the human race.

Prof. J. Hjort—the naturalist of the northern sea, whose studies and explorations have benefited alike the science of biology and the fisheries of his native land.

Dr. F. Bergius—a modern magician, his knowing touch transforms coal to oil.

Dr. N. L. Bowen—a scientific Vulcan, in his laboratory furnaces he measures those forces which once formed our igneous rocks.

Prof. E. D. Adrian—a physiologist whose brilliant experimentation established new principles concerning nerve impulses and the action of sense organs.

Prof. P. M. F. Janet—a pioneer in studying the multifarious phenomena of mental pathology, his systematic analysis founded a branch of psychology.

Prof. J. B. Collip—a skilful biochemist, a bold explorer among the tangled complexities of the internal secretions.

Prof. A. Pannekoek—an astronomer who has gauged the distances of the dark nebulae, an astrophysicist who has assayed the stellar atmospheres.

Prof. E. J. Cartan—a versatile investigator in the realm of pure thought, a mathematician who has advanced his science on many fronts.

Prof. P. Debye—a large-hearted physicist who gladly lends the chemist a helping hand by elucidating the electrical properties of matter.

Prof. The Svedberg—a man who sees beyond the microscope, at his bidding centrifugal forces make giant molecules reveal their size.

Prof. H. Spemann—a biologist who experimented with embryonic tissue and discovered a new approach to those agents which determine organic form.

Prof. C. G. Jung—a philosopher who has examined the unconscious mind, a mental physician whose wisdom and understanding have brought relief to many in distress.

Prof. L. E. Dickson—a fruitful speculator on the significance of numbers, an algebraist noted for his stimulating work.

Prof. R. G. Harrison—an embryologist whose method of transplantation yields new insight into the process of development.

Prof. R. A. Fisher—a student of heredity, who has improved statistical methods and assisted agriculture by the application of his science.

Prof. S. A. S. Krogh—a physiologist for ever probing with new instruments the unknown mechanism of life processes.

Dr. K. Landsteiner—the master of the science of immunology, the discoverer of those fundamental principles which made blood transfusion possible, saving countless lives.

Prof. G. H. Hardy—a British mathematician who has led the advance to heights deemed inaccessible by previous generations.

Prof. A. C. Lawson—a geologist who has ranged widely both in time and space.

Dr. J. H. Northrop—a chemist turned biologist, a skilled manipulator of those catalysts on which life depends.

Dr. F. Silvestri—a brilliant entomologist who has searched many continents to find those parasites which guard our crops.

Prof. H. Fischer—a master builder of molecular structure whose labours tell us why grass is green and blood is red.

Prof. R. Carnap—a philosopher of penetrating insight who lights the way for those who seek through logic the unity of the world.

Sir Frederick Gowland Hopkins—the discoverer of the vitamins, a pioneer in many fields, whose work stands as a symbol of the ceaseless adventure of the human mind.

Among the other awards, the honorary degree of doctor of letters was conferred on the following, among others:

Prof. J. Piaget—a deft inquirer into the growth of those mental processes which mark the gradual development of the normal child.

Prof. V. Gordon Childe—a far-seeing archæologist whose writings allow us to behold the dawn of civilization in Central Europe.

Prof. R. Maunier—a contributor to our understanding of the functioning of social institutions, the director of research into the laws of simpler peoples in the colonies of France.

Prof. P. Pelliot—an intrepid explorer whose examination of the manuscripts and art of central Asia enhances our appreciation of a group of ancient cultures.

Dr. R. M. MacIver—an inquirer into the structure of society, a learned systematizer of our social theories.

Prof. M. I. Rostovtzeff—the social and economic historian of the Roman empire, whose fruitful study of antiquity accumulates for all who read centuries of rich experience.

(4) The most interesting feature of all was the oration of President Conant, a man, be it remembered, of less than forty-five years of age and until two years ago professor of chemistry, the courage and eloquence of which cannot be conveyed in a few words. Starting with the President's conception of the proper ordering of a university, the oration developed into a plea for citizenship based upon the search for truth in all departments of intellectual activity. To the man of science it was interesting to observe that to President Conant the health of a university depends upon the maintenance of a correct balance between four components: student life, the teaching of abstract subjects, professional training, and the search for new knowledge. Typical of the later part of the speech was the demand for "absolute freedom of discussion, absolutely unmolested

enquiry". This note of freedom was struck also by the President of the United States in his speech to the alumni of Harvard the same afternoon. "In this day of modern witch-burning, when freedom of thought has been exiled from many lands which were once its home, it is the part of Harvard and America to stand for the freedom of the human mind and to carry the torch of truth."

So much for the eighteenth of September, but it was only the climax. The proceedings of the two days previous may be passed over, though either of them would furnish matter for an interesting article. Rather would we go back to events still earlier and to a phase of the celebrations which possibly is without precedent.

Harvard determined if possible to make its celebration primarily an intellectual one. Before inviting universities and other corporations to send delegates, it drew out a list "of leading scholars in different parts of the world to a number which we trust will bring to the proposed conference some sixty or seventy men of high distinction from the whole field of learning". These received invitation to take part in a conference the intention of which was expressed in the following words: "It is hoped that we shall succeed in finding a meeting ground on which it will be possible not only for the results of research in detail to be communicated by scholars, to one another, but also for problems which concern a variety of disciplines to be the object of common attack."

The event proved overwhelmingly successful, so far, at least, as the present writer was able to judge from the proceedings kindred to his own subject, and from what he was told concerning others.

These 'proceedings', as indicated in the above quotation from the letter of invitation, fell into several forms. There were addresses on the general aspect of one broad subject such as that by Sir Frederick Hopkins on "The Influence of Chemical Thought on Biology"; "Diabetes as a Disturbance of Endocrine Equilibrium", by Prof. Bernardo Alberto Houssay; "Insect Polyembryony and its General Biological Aspects", by Prof. Filippo Silvestri; "Plants and Civilisations", by Prof. Elmer Drew Merrill. There were sittings devoted to a group of kindred subjects such as that on the "Applications of Chemistry to Biology" in which the individual papers were: (1) "The Use of Isotopes as Indicators in Biological Research", by Prof. August Krogh; (2) "The Formation of Enzymes", by Dr. John Howard Northrop; (3) "Protein Molecules", by Prof. The Svedberg.

There was no possibility of discussion on the great scale, but the effective 'meeting ground' was found in another way—after the communications, groups of those interested in the subject met and thrashed the matter out, or tried to do so. To take an example, after a communication on "The Fundamental Nature of the Respiratory Rhythm", a group consisting of two experimental psychologists, two pharmacologists, one physiologist and three anatomists had a most fruitful discussion on the initiation of neuro-muscular function in the fœtus, and one which will probably clear up many existing divergences of opinion. Such in its small measure admirably fulfilled the desire of Harvard "for problems which concern a variety of disciplines to be the object of common attack".

On this great scale, the same object was attained by the institution of symposia. These were classified as follows (Nos. 4 and 5 really were not symposia in the same ordered sense as 1, 2 and 3; they were groups of communications of the type of and including those already discussed):

(1) Factors determining Human Behaviour.

(2) Authority and the Individual.

The State and Economic Enterprise; Stability and Social Change; The Place and Functions of Authority; Classicism and Romanticism.

(3) Independence, Convergence and Borrowing in Institutions, Thought and Art.

Europe and the Near East; The Middle Ages; East and West.

(4) Biological Sciences.

Various Aspects of Biology; Experimental Morphology; Parasitism; The Applications of Physical Chemistry to Biology.

(5) Physical Sciences.

Mathematics, Astrophysics, Cosmogony (Sessions of the American Mathematical Society and the American Astronomical Society); Theoretical Physics; Cosmic Radiation; Nuclear Physics; Geology and Geophysics; Chemistry; Industrial Chemistry; Communication Engineering.

The first of the above symposia was attended by the complete conference in joint session and was indeed the inaugural meeting. The remaining four represented the four divisions into which learning was divided for purposes of convenience—human relations, arts and letters, biological sciences, and physical sciences.

As an example of how the plan worked in detail, the first symposium may be taken. The intention was to sample various aspects of the activity of the human nervous system, from the most simple to the most complex. The opening paper was by Prof. E. D. Adrian on the objective physiology of "The Nervous System". This was followed by papers on "Hormones in Relation to Human Behaviour", by Prof. J. B. Collip, "Les principaux facteurs determinant l'évolution intellectuelle de l'enfance à l'âge adulte et de la genese des principes de conservation", by Prof. Jean Piaget, "Psychological Factors determining Human Behaviour", by Prof. Charles Gustav Jung, "La force et la faiblesse psychologique", by Prof. Pierre Marie Félix Janet, "Logic", by Prof. Rudolf Carnap, "An Example from the Evidence of History", by President Emeritus Abbott Lawrence Lowell, and finally "Culture as a Determinant of Behaviour", by Prof. Bronislaw Malinowski.

The last of these took the form of an evening lecture. Other public lectures treating of subjects of general interest were by Frank Baldwin Jewett, of the Bell Telephone Laboratories in New York, on "The Social Implications of Scientific Research in Electrical Communication"; by Prof. Wm. Berryman Scott, on "The Laws of Mammalian Evolution"; by Sir Arthur Stanley Eddington, on the "Constitution of the Stars"; by Prof. G. H. Hardy, on "The Indian Mathematician, Ramanujan"; by Prof. E. J. Dent, on "The Historical Approach to Music"; by Prof. Corrado Gini, on "Authority and the Individual during the Different Stages of Evolution of the Nations"; by Prof. John Dewey, on "Authority and Resistance to Social Change"; by Prof. W. E. Rappard, on "Economic Nationalism"; and by Prof. Johan Hjort, on the "Biology of Whales".

Reviewing the activities of the congress, or such of them as fall within the scope of a biologist, it can only be said that the event far exceeded what might have been expected of it. It may be doubted whether any congress covering so wide a field has ever succeeded in at once reaching a level so sustained in matter, and in manner so intelligible to those not acquainted with the particular and specialized techniques of those who rose to so high a level.

Lastly, a word as to the hospitality poured with both hands upon the members of the congress. It is difficult to know where to begin or end in treating of it. American hospitality is the high water mark; to say that it reached the highest level of American hospitality is no less than the truth. One item, however, must be mentioned specifically, namely, the orchestral concerts, three in number, given by the Boston Symphony Orchestra. Two were instrumental, in the third the orchestra combined with the chorus of Harvard University and Radcliffe College. All were a sheer delight. At the close of the last concert, just before "Fair Harvard" was sung, President Conant walked up the hall, ascended the platform, shook hands with Dr. S. Koussevitzky, whose skill and enthusiasm as a conductor had been so largely responsible for this feast of pleasure. Dr. Conant said a few words, ending as follows: "I wish to say just two words 'Thank you'." A fitting ending, for there is no delegate who can have left Harvard with any other thought in his mind. Harvard—Thank you!

The Patterns of Experience*

By A. W. Wolters

SUMMING up his important contributions to the psychology of perception, Prof. E. Rubin demonstrated, in a paper devoted to the 'ways of seeing' read before Section J of the British Association at Norwich last year, that perceptual cognition is shot through with suggestions of movement and direction which are not reducible to the geometry of the object. The mind contributes structural principles to its own experience.

Like many scientific theories, this was not new. Many besides Rubin, and many earlier than he, have suggested that the mind, at least in part, makes its own experience. The value of his contribution lies in the beauty of his experimental development of the theme, and in the detailed application of it. But at least one of his demonstrations at Norwich was so new as to be thrilling. Those who were present will remember vividly how we were brought to recognize that pictures in European art have a definite left-to-right character, upon which their meaning and æsthetic appeal largely depend. I reported this to Mr. Betts, the head of the School of Art in the University of Reading. We went through his stock of lantern slides, and found that in nearly every case Rubin was clearly right. But our most exciting moment was that in which we discovered a drawing in which Rembrandt had gone astray. My colleague suggests that Rembrandt made his sketch from a mirror, a quite usual method, so that having posed his model correctly—that is, as Rubin would have had him do—and being absorbed by the technical problems of his sketch, he overlooked the extraordinary and unpredictable effect of the lateral inversion.

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* From the presidential address to Section J (Psychology) of the British Association, delivered at Blackpool on September 11.

It seems clear that there are pre-established manners of seeing, and we must expect the same to hold in the other modalities of sense. It appears that perception can be shaped by factors extrinsic to the material experienced. Under their influence the mind is creating, is actively patterning its experience, so that in some sense and to some degree (the limits being determinable by experiment) the mind makes the world it knows. To speak a little dogmatically, I hold that the mind informs its sensory material, making the percept consistent with certain subjective principles. This implies that the patterns of experience are in some sense already latent in the subject's mind as he confronts the world. Can we say how ?

Alas, not very well. We must be content for the present with a small but useful advance to be made along the following path. If one says that perceiving is a response of the organism, meaning what one says, it follows that the distinction between cognition and conation is not an ultimate one. The general utility of the traditional division is not in question, but in the end we have to recognize that the process of coming to know is an activity, a piece of behaviour linked up with and subordinated to other behaviour. Conation *must* be the fundamental concept, because the first duty of every organism is to remain alive, and it needs to manage and control its environment to that end. Let us look for a moment at other forms of behaviour.

It is agreed that behaviour exhibits certain regularities of sequence which entitle us to formulate laws. In describing the phenomena, the phrase which comes most readily to the tongue is that they exhibit patterns. The word has of recent years been very freely used. It requires no technical knowledge to understand the statement that a man's business activities show a constant pattern, no matter how varied the details with which he has to deal at different times. Our insight into the character of acquaintances mainly rests upon the observation of their behaviour patterns. It is very difficult to describe them, and still more difficult to analyse them, but they are easily recognizable. They are, in fact, the constancies without which social life would be impossible.

The outstanding example of patterns of behaviour is presented by the instincts. In them we have themes which can be recognized as essentially the same while the details of the activity vary thoroughly, just as the theme of a symphony can be recognized through its development. But to say this is to apply the term 'pattern' as an objective description, and not as an explanation. Whether in this field you prefer to speak of urges and drives, or of fields of force and closure, is indifferent to the present argument, which requires only two points conceded to it : first, that these patterns of behaviour are observable, it being in virtue of them that the adjective 'instinctive' is applied, and, secondly, that the character of the organism is among the causes which produce them. We note that the behaviour of the human individual displays patterns which are similar in their outline to those of animals, and which, arguing from them, we must assert to depend upon the connate character of the organism.

To argue the obvious a little more fully, if a pattern is observable in behaviour, it must be dependent either upon the detailed events themselves, or upon the organism. In many cases, such as the behaviour of insects or nest-building in birds, there seems to be no sense in the first alternative, and consequently we take the patterns to be determined by the nature of the organism. This is to assert that the pattern is latent in the organism ; but not after the manner of a 'blue-print'. The latent pattern is not open to inspection. It exists, to use an old and respectable term, formally. There is a character of the organism which gives a distinctive pattern to its reactions. But there are also patterns observable in acquired activities, and in this case we have an everyday term to designate the quality of the agent which produces it. We call it a skill, and regard it as inherent in the subject whether he is or is not engaged in the activity at the moment. But once more it is not inspectable as the pattern of the activity is. All we can observe is that A by economical and coherent actions consistently achieves success in a given field, while B as consistently fails in it. Believing that all phenomena have a cause, we ascribe to A a skill which B lacks. So far as language goes, we can say either that A is skilled, or that he possesses a skill. Both expressions are admissible, but I would suggest that the former is better in psychology, since we can neither observe, nor by deduction describe, a skill in itself. When we attempt to do so we usually find ourselves describing again the pattern of the activity. Let us take a skill to be a character of the individual, a manner in which he has been psychologically shaped by racial or individual experience. To say that a person is skilled means that he is prepared to deal adequately with situations of a particular kind, but prepared in an outline, flexible manner which is sensitive to the varying details of the moment. Skill is in this respect on a higher plane than tropism, reflex or habit. The organism's skill is displayed in controlling and organizing material on the way to achieving a goal.

Now we can return to our original problem of perception. No present-day psychologist can be content to regard perceiving as no more than reflecting the material world, or as a process to be studied in isolation. It is a preparatory reaction, prior to more far-reaching activities, its immediate goal being the organization of sensory data into manageable forms. So we come to the conclusion that the predetermined 'ways of seeing' of which Rubin spoke belong to the vast family of skills, and can be treated with the others. The range of processes in which the pattern of behaviour, and the pattern resulting from the behaviour, depend upon the mental characteristics of the agent would appear to cover the whole extent of human life.

At the London meeting of the British Association in 1931 I read a paper advancing the hypothesis that what is termed conceptual thinking can be dealt with in terms of skill, saying that what are termed concepts are best considered as outline preparations for response, and not as mental entities. I endeavoured to show that the behaviour of animals displays patterns parallel with those of a higher grade in human beings. I introduced the term schematic preparation, or more shortly 'schema', as a name for this subjective character. Five years later, fortified by the parallel advance of Prof. F. C. Bartlett in another part of the field, I am bold enough to claim that our conception will cover all parts of animal and human psychology, pulling together into a system many heterogeneous results.

Can we apply the outcome of this discussion in the field of social psychology ? The term 'social pattern' is in common use, and perhaps is employed with dangerous facility. In the first place, it appears to mean an observable system of relationships between individuals and their activities, constituting a unity of a higher order of complexity than that of any one of its members. Secondly, the social group is a part of the environment of each of its members and of persons who make contact with it from outside. It is a system of facts to which individuals have to adapt their behaviour. In this it is parallel to the inanimate environment, and since the principles of behaviour will resemble those already encountered, the matter may be left for a moment at that level. Thirdly, social groupings present a puzzling combination of determinacy and flux. To live in society is rather like rowing in rough water. Within a quite characteristic pattern of the whole there is an inconvenient mobility of the elements, which requires continual variability of response. The patterns of society are determinate but dynamic, and to react successfully to them demands skill.

To deal with this problem in a little more detail I turn to another paper read before Section J at Norwich, one by Prof. T. North Whitehead, since published in *The Human Factor*, 9, 381. A group of five girls working at the same tasks came in time to form a real social group with a complex but readily discernible pattern. An objective record of it was obtained by studying the relations between the output of individuals, and the investigator was able to reduce these to a clear diagrammatic form. Since conversation is the chief instrument of social relationship, the seating arrangements proved largely decisive for the pattern. When an experimental change was made in the seating order, the social and psychological pattern was broken and a new one had to be formed, output being adversely affected during the process.

Prof. Whitehead's interesting report is concerned mainly with the objective study of the group. There are, however, important implications on the subjective side. In the first place, like everything else, society is only apprehended by individuals, whose perception will be shaped in ways analogous to those revealed by Rubin in simpler material. This is the common handicap of all science, and no more need be said of it than to remind ourselves that each person must react to society as *he* sees it. A more important matter is that society, whose dominating influence we realize more and more, has proper significance for psychology only in its impact upon individua lives. It is, indeed, only actualized in those moments. Its components are individuals acting and their behaviour is informed by the principles studied earlier. Yet their activities form a system and we have to reconcile that with individua psychology.

A group only exists in virtue of conative tendencies developed by individuals in the course o accommodating their behaviour to each other's It requires skill to live socially, and I see no reason why we should not treat this as we did others Social skills are predetermined schematic preparations for adaptive responses to situations presented by the presence of other persons, whose behaviou forms a reciprocally interacting system, and so i is the psychological character of individuals which chiefly determines the social pattern. I should like to adapt a famous conclusion of Rousseau, and say that society becomes a topic for psychology jus because it exists immanently in the minds of it members. Whitehead's subjects did not build up a real unified group merely through the seating arrangements. The effects of the removal of th one who had become the leader show this. Th unity of the group broke up, and though he successor became even more popular it was neve fully reconstituted. So, at least, the writer maintains. But I venture to think that there wa formed a new and firmly integrated pattern of kind too subtle and intimate to be revealed by the test of correlative fluctuations of output. How otherwise can we account for the odd fact that when the former leader came back to replace her temporary successor the group was entirely broken up through the newly developed hostility to her, formerly the outstanding member of the group ?

What the experiment depicts is the gradual orientation of individuals to each other—in other words, their learning ways of living with each other. When the social environment is changed, a new set of behaviour tendencies has to be established, until in the final setting an environment was found to which the girls could not react successfully. But they had done so at an earlier stage, and we must conclude that in the intervening period some change had occurred in the other girls. The earlier objective conditions were repeated, but there was no unity. Can we avoid the conclusion that the unity had existed in the minds of the members, and those minds had changed to such an extent that the old reactions had become impossible ? An objectively observable group pattern is a product of the skill-characters, or behaviour schemata, of the constituent members. So a problem of group psychology reduces itself to one of individual psychology.

Social patterns are largely manifested in institutions and current ideas, and often in combinations of the two. The English Common Law provides an excellent example of the last. This remarkable invention of our race has been maliciously described as consisting of a vast body of decisions and pronouncements, all readily deducible from a very few simple and universally accepted principles, though no one knows what they are. I cannot say whether this description is true, but there is no psychological difficulty in it. Common Law principles are the ways of living together developed by English people, and like all skills (for skills they are) they were developed in pursuit of ends which did not include the purpose of inspection.

Pursuing a purpose and thinking about the pursuit are quite different processes. So for a long time, possibly always, they would not be amenable to analysis or description. To describe them necessitates the development of a new skill directed to the material provided by the prior one. This is in essence Bartlett's illuminating distinction between schemata as the instruments of reaction and schemata as objects to which reaction is directed. The Common Law is the expression of the directive tendencies of citizens bent on living together along determinate lines, though they may have never reflected upon them. Probably the majority of Englishmen have never heard of the Common Law, though it governs their lives in so fundamental a manner. It is quite usual to find that people who evince a great determinateness of behaviour are unaware of the principles which govern them. Why should they pause in the process of achieving their ends, if all is going well, to 'turn round upon the schemata' which are serving them ?

There is a danger in any form of expression which suggests an opposition between social psychology and individual psychology. The field marked out by the former term is one proper for the specialist, but it remains the study of individuals acting socially. It would avoid the risk of over-abstraction, with possibly something of mysticism arising from it, if we were satisfied to speak of the psychology of social behaviour. At bottom it is the study of the development and nature of schemata employed in orientation to other behaving organisms. They, too, act from schemata, and if they are to live together they must effect a considerable degree of uniformity. So the social pressure upon individuals is intensified by the establishment of institutions which are the outward patterns resulting from the psychological characteristics of the members of the group, and in return a potent means of shaping the next generation. Here the vital problem of society resembles that of the individuals (as must be the case) ; it is that of keeping the outline preparations for adaptive behaviour sufficiently fluid to be sensitive to variations in the problems presented. The Hegelian limit of efficiency is inflexible specific habit, which is a skill so perfectly developed as to become a hindrance.

Now to summarize briefly the thread of this discussion. The subject-matter of psychology is taken to be the activities of the individual organism striving to maintain its full integrity in the universe in which it lives. To obtain control it must organize the presented material of experience into patterns manageable by it, and to this end it develops skills in its activities. Naming these skills by a word not inconvenienced by overmuch usage, we have called them schemata, and the system of a person's schemata embodies all his experience up to the present moment, and determines the direction of his future experiencing. The patterns of experience are formed by them, though not independently of objective conditions. Thus in outline the 'ways of seeing' and the 'ways of living'—whether socially or otherwise—are reducible to a common psychological genus.

The value of this view to me lies in its providing a unitary point of view from which, it is hopefully claimed, one can survey the whole extent of psychological study. At least it may prevent a born eclectic like myself from degenerating into a kind of scientific jackdaw. So I invite you to regard experience, in the fullest sense of that word, as formed in a complex of patterns largely made by the experiencer, patterns in some cases interlacing, in others forming a hierarchy of increasing generality. Or, to start from the other end, let us take our science to be the study of all the detailed embroideries upon that most common and most comprehensive of patterns, the formula of which runs: He was born, and strove to master his world for his own safety; he mated, fought for his offspring, and died.

Campbell Swinton and Television

By Dr. J. D. McGee

THE successful inauguration by the British Broadcasting Corporation of the high-definition television transmitting station at Alexandra Palace has focused the attention of the technical world on the successful development of the all-electric, instantaneous system of transmission. The degree of success achieved shows that the cathode ray transmitting tube has at last emerged from the research laboratory to take its place as the complement of the receiving cathode ray tube. The latter is well known, and has been recognized for some years as the most effective means for picture reception, and is now a highly developed commercial product. Modern television technique, which will withstand the criterion of the flickerless talking picture, both from the producing and reception points of view, has only been made possible by the development of the receiving and transmitting cathode ray tubes. This development is the result of improvement in technique brought about by the work of many scientific investigators in research laboratories throughout the world.

The manufacture of the modern cathode ray tube for picture reception has evolved slowly as improvements in vacuum technique, glass manufacture, fluorescent materials have been made, while the transmitting tube inherits also the wealth of developments in photo-electric technique. Besides these key units, the whole television equipment—amplifiers, scanning oscillators, pulse generators, cables, radio transmitters, etc.—have each been improved to a stage where they are capable of dealing with the enormous frequency bands, exacting phase conditions, etc., which are necessary for the production of high-definition flickerless picture. This has been achieved by improvement in valve and circuit technique spread over the last twenty years.

The object of this article is to pay a tribute to the memory of a man who probably thought more deeply, clearly and disinterestedly about television than any other of his time and who, had he but lived six years longer, would, I believe, have agreed that his life-long dream had at last come true.

The late Mr. A. A. Campbell Swinton was the first to propose[1] an all-electric system of television in 1908, and continued to urge its claims[2] up until the time of his death in 1930. Sir Richard Gregory has recently reminded us of Campbell Swinton's early suggestions in connexion with television[3], but it might not be redundant to show how Campbell Swinton continued to develop his ideas as technical methods advanced during the remaining twenty years of his life. He first suggested the idea in a short letter to NATURE in 1908[1], later explaining and amplifying it in his presidential address to the Röntgen Society on November 7, 1911[4]. This plan of twenty-eight years ago only required the application of modern technique to become the non-mechanical system now installed at Alexandra Palace, and still in course of development in Germany and America.

It is worth while quoting at some length from the published papers of Campbell Swinton in order to emphasize not only the remarkable accuracy with which he visualized his scheme, but also the kindly unassuming manner in which he presented it to the world.

Campbell Swinton's definition of television is worth noting when considering modern developments, in order to appreciate the difference between television proper and telekinematography. He defines television thus[5]: "If you point a photographic camera at any view or object, whatever is in front of the lens is depicted on the ground glass screen, and what I mean by television is some method whereby what is depicted on such a screen, with any motions or other changes that may be taking place, is electrically transmitted to a distance and made reappear instantaneously on a similar screen at the distant station." This conception of television is implicit in all his early publications.

Referring to a letter from Mr. Shelford Bidwell in NATURE of June 4, 1908[6], in which the difficulty of obtaining synchronism with mechanical television systems was discussed, Campbell Swinton observed[1]:

> ". . . this part of the problem of obtaining distant electric vision can probably be solved by the employment of two beams of kathode rays (one at the transmitting and one at the receiving station) synchronously deflected by the varying fields of two electromagnets placed at right angles to one another and energised by two alternating electric currents of widely different frequencies, so that the moving extremities of the two beams are caused to sweep synchronously over the whole of the required surfaces within the one-tenth of a second necessary to take advantage of visual persistence.
>
> "Indeed, so far as the receiving apparatus is concerned, the moving kathode beam has only to be arranged to impinge on a sufficiently sensitive fluorescent screen, and given suitable variations in its intensity, to obtain the desired result.
>
> "The real difficulties lie in devising an efficient transmitter which, under the influence of light and shade, shall sufficiently vary the transmitted electric current so as to produce the necessary alterations in the intensity of the kathode beam of the receiver, and further in making this transmitter sufficiently rapid in its action to respond to the 160,000 variations per second that are necessary as a minimum.
>
> "Possibly, no photoelectric phenomenon at present known will provide what is required in this respect, but should something suitable be discovered, distant electric vision will, I think, come within the region of possibility."

This 1908 statement is, undoubtedly, the first published suggestion of a television system which has now been developed on a commercial basis to produce pictures of even higher order of definition than the inventor then proposed as a satisfactory minimum. In the elaborated account of this suggestion in his lecture to the Röntgen Society in 1911, Campbell Swinton gives more details of his proposed transmitting tube, and while it is crude in comparison with a modern transmitting tube, anyone who is familiar with the development of the subject will agree that it was an enormous step in the right direction. It is characteristic of the man that, in proposing his suggestion, he emphasized that[4]:

> "it is an idea only, and the apparatus has never been constructed. Furthermore, I would explain that I do not for a moment suppose it could be got to work without a great deal of experiment and probably much modification. It is, indeed, only an effort of my imagination, and can be useful merely as a suggestion of a direction in which experiment might possibly secure what is wanted. What, however, is claimed is that, so far as I am aware, it is the first suggested solution of the problem of distant electric vision in which the difficulty of securing the required extreme rapidity and accuracy of motion of the parts is got over by employing for these parts things of the extreme tenuity and weightlessness of cathode rays".

What must astonish the modern television engineer is the accuracy of Campbell Swinton's idea, when he reflects that, at the time it was suggested, radio communication was in its infancy, radio valves practically unknown, vacuum technique very primitive, photo-electric cells very inefficient.

In the period following the Great War, much time and money was spent in developing mechanical systems of television to the present high limits of mechanical efficiency, but the all-electric system has proved, after a comparatively short period of development work, to be much more powerful.

Campbell Swinton repeatedly pointed out the limitations of the mechanical methods, and repeatedly urged that the development of the all-electric system should be taken up seriously by some large industrial research laboratory. "There are, at any rate," he wrote[7], "no theoretical objections to the scheme, and it is now for some ingenious experimenter to work out the details of the apparatus and to give the world some form of television by this means."

It may justly be asked—"Why did not Campbell Swinton develop his own scheme ?" The answer is twofold—first, that he did carry out experiments along lines which have recently proved successful, and second, that physical technique was at that time quite inadequate to deal with the problem. In a letter to NATURE of October 23, 1926[8], Campbell Swinton wrote :

> "I actually tried some not very successful experiments in the matter of getting an electrical effect from the combined action of light and cathode rays incident upon a selenium-coated surface. . . . The transmitting apparatus consisted of a home-made Braun oscillograph in which a metal plate coated with selenium was substituted for the usual fluorescent screen, the image to be transmitted being thrown by a lens upon the selenium surface, and the end of the cathode ray beam being caused electromagnetically to traverse the projected image. Experiments were also tried in receiving with a Braun tube which I purchased in Germany, but in its then 'hard' form it proved very intractable."

It is interesting to note that this actual experiment has been repeated recently in the Research Laboratories of Electric and Musical Industries Ltd., under the direction of the present writer, and has proved successful. Two important features of the modern transmitting tube are described in this short note, namely, the use of a 'signal plate' and the projection of the optical image on to the same surface as is scanned by the electron beam—another step in the right direction.

This solution of the problem of high-definition television was not a 'one-man-job', as Campbell

Swinton saw clearly[9], but one which could only be solved by the close co-operation of a large band of research workers having at their disposal the facilities of a well-equipped research laboratory. The problem has been attacked during the last decade in many of the large industrial research laboratories in America, Germany and Great Britain, and the progress in many of these organizations has been roughly parallel, but it is fitting that Great Britain should be the first to inaugurate a public television service employing the system which was first outlined twenty-eight years ago by a distinguished British scientist.

[1] NATURE, **78**, 151 (June 18, 1908).

[2] "Autobiographical and other Writings". A. A. Campbell Swinton, pp. 131–137. (Longmans, Green and Co., Ltd.)

[3] NATURE, **137**, 984 (June 13, 1936).

[4] *J. Rontgen Soc.*, Jan. 1912, p. 7.

[5] *Wireless World*, **14**, 51 (1924).

[6] NATURE, **78**, 105 (June 4, 1908).

[7] "Autobiographical and other Writings". A A Campbell Swinton, p. 137.

[8] NATURE, **118**, 590 (Oct. 23, 1926)

[9] *Wireless World*, **14**, 118 (1924).

Stratosphere Flight

THE recent world's height record, for aeroplanes, of 49,967 ft., set up by Squadron-Leader F. R. D. Swain, R.A.F., piloting a Bristol monoplane fitted with a special type Bristol Pegasus engine, has served to focus a certain attention upon the question of flights at great altitudes, and the possible advantages to be derived therefrom.

The most obvious gain comes from the reduction of the resistance to the aircraft's motion as the density of the air to be displaced decreases, which, if other conditions remained the same, would result in increases of speed of a valuable order. For example, in round figures, an aeroplane of maximum speed 180 miles per hour at sea-level would travel at 550 miles per hour at a height of a little more than ten miles. This is equivalent to London to New York (3,000 miles) in 5½ hours, neglecting the time taken to climb to and descend from that altitude.

Other probable advantages are a relative wind in a direction opposite to the rotation of the earth, if a shear effect in the belt of atmosphere rotating with the earth may be assumed; the absence of meteorological and electrical disturbances with their effect upon accurate navigation, that would also allow routes to follow the shortest line from point to point irrespective of the conditions upon the earth's surface, as for example across the polar regions; and the psychological effect of constant sunshine, lack of clouds and equable temperature conditions are possibly not to be ignored.

The principles upon which the flight of the present-day heavier-than-air machine are based, however, make use of the density of the atmosphere in several ways in which its rarefaction at great heights would be a definite disadvantage, and may possibly set a limit upon entering the stratosphere which will make it not worth while, at least as a commercial transport proposition. The importance of doing so for the purpose of research into the physical conditions comes within a different category.

The power plant gives the machine a forward motion through the medium of an airscrew, this being required in order that the circulation of air around the lifting surfaces may be set up, resulting in the necessary lift and control. A reduction in air density will lessen this thrust and thus reduce the lift indirectly by reducing the speed, in addition to the direct loss of lift. Further, use of full power would result in excessive rotational speed of the airscrew due to the thinness of the air. Variable pitch propellers, already a practicable proposition to a limited extent, will help in this respect.

The internal combustion engine, the present-day power plant, requires a definite weight of oxygen for the proper combustion of its fuel. The rarefied and poor quality air can be forced into the engine, up to a certain limit, by super-chargers, and after this it does not appear to be impossible to carry a supply of oxygen under pressure to make up this deficiency, more especially as a supply will probably have to be carried for the occupants of the aeroplane. The physiological requirements of the passengers and crew will call for extra size and weight of the cabin, which will have to be of sufficient capacity for the required change of air, to carry apparatus for storing the oxygen and for absorption of the carbon dioxide and moisture exhaled, and will almost certainly have to be heat insulated. This may be against the low temperature of the surrounding atmosphere, or against heat generated by the friction set up by the rubbing of the air at these high speeds. Which will predominate, and how far one will balance the other, will depend upon the heights and speeds attained.

This state of affairs is already partly achieved, and its consummation does not appear to be beyond the bounds of possibility, at least, as a scientific experiment. As an everyday transport proposition, experiment alone can settle whether the balance between total loads carried, and the part left for useful carrying capacity, after the elaborate equipment is installed, and the effect of the artificial conditions, accelerations and such discomforts upon the passengers, will make it worth while. It has been suggested that under these conditions, and with existing materials and aerodynamic design as now accepted, there are theoretical reasons for thinking that a limit will occur upon speeds at about 650 miles per hour.

To travel without this limit in the higher regions of the stratosphere will necessitate the use of some new method of propulsion, not dependent upon the presence of air for its functioning or the application of its tractive effort. The obvious solution that comes to the mind in this case is rocket propulsion. A certain amount of experiment has already been carried out in this respect; one quite serious proposal was made not long ago to fire mails from France to England across the Straits of Dover. The principal problem to be solved is that of control of the orientation of the machine while in flight. If this calls for the presence of the human element, the effect of the terrific accelerations at the start and finish cannot be ignored. Should this prove insuperable, automatic control of some kind does not appear impossible, but it will necessarily exclude passenger traffic.

A possible midway step between the two that has often been suggested is reported to be under construction and nearing completion in Soviet Russia. An aeroplane fitted with the usual internal combustion engine and propeller also carries rocket tubes. These will continue to give the necessary forward movement by reaction propulsion after the normal tractive effort has become negligible by reason of the reduction of the density of the air. This is not the complete rocket propulsion, and its efficiency would still appear to be largely dependent upon the air density for its reactive effort.

With regard to flight in the stratosphere by lighter-than-air craft, this is a much simpler problem. It becomes a matter of calculation as to the displacements of the balloon at the anticipated air density at the maximum height proposed, and the design of the envelope and the passengers' car to withstand the pressure differences. Such flights are of importance for the investigation of conditions in the upper air, and the perfection of such meteorological information will be of importance in the development of heavier-than-air craft under similar conditions. There does not appear to be any direct value in them from the point of view of controlled air travel. The height record for free balloon travel in the stratosphere is 72,395 ft., reached by Captains Stevens and Anderson, United States Air Corps, in the balloon *Explorer II* on November 11, 1935.

Obituary

Mr. J. W. Gordon, K.C.

MR. JOHN WILLIAM GORDON, K.C., who died in his eighty-third year on September 21 last, was the son of Mr. John Lewis Gordon, and was called to the Bar in 1884. He was a well-known Patent Law expert and was always strongly attracted to scientific and technical investigations. He was a member of the Commission appointed to inquire into the pitch industry of Trinidad; assisted in drafting the Patent Act of 1907; was formerly honorary secretary of the Royal Microscopical Society; received the gold medal of the Society of Engineers for his work on railway surveying by photography; and throughout his long life he never lost his interest in optical and allied subjects. It is, perhaps, by his work in connexion with microscopic resolution that he will be best remembered in the future.

Mr. Gordon also did some interesting and valuable work with regard to the plotting of surveys from air-photographs, and in his book "Generalised Linear Perspective", which was published in 1922, he describes how he rediscovered a method originally devised by Brook Taylor (of Taylor's theorem) two hundred years ago. Briefly, the method is this; if there are three points in a line in the cartographic field and the real lengths of the two segments are known, then it is easy to calculate the position of the point where the given line cuts the horizon; and if there is available a second similarly divided line, the horizon can be drawn.

The system is essentially a point-by-point method of plotting, and there are cases in which it may be of value, especially when the photographic plate is considerably tilted. But Mr. Gordon was inclined to claim somewhat too much for this method, which, after all, is only one of many. Nowadays we are in the more intricate region of stereoscopic air-photography and of mechanical plotters, and, except in very simple cases, we have left point-by-point methods behind us. But Mr. Gordon's book has its own place in the history of the subject, and perhaps that is as much as it will be possible to say of the writings of most of us.

Mr. A. E. Clarence Smith

It would be difficult to over-estimate the contribution made by the late Capt. Alton Clarence Smith, who died on September 16 at the age of forty-nine years, to the development of the Department of Chemistry at University College, Southampton, during the seventeen years in which he was responsible for the teaching of physical chemistry.

Mr. Clarence Smith was a man of wide culture, interested in biology as well as in physical science. He had also an unusual degree of mechanical skill and a marked taste for architectural design, gifts strikingly shown in the planning and equipment of the laboratories which he designed for the use of his students. His research work lay chiefly in the domain of photomicrography, on which he was an acknowledged authority, and his papers on this subject in the *Journal of the Quekett Club* and similar publications led to his being frequently consulted by biologists and others interested in the use and construction of microscopes.

But Clarence Smith was in the first instance a teacher, and it is as a great teacher of physical chemistry that he will be remembered by the students who in successive years listened to the extraordinarily clear discourses with which he illuminated the difficult field of study embraced in physical chemistry. He took infinite pains in the presentation of his subject; the notes which he prepared for his lectures were models of clear thinking and accurate expression. He was genial and sympathetic with his students, appreciating fully their difficulties, and he had in full measure their affection and respect. His knowledge, experience and that critical judgment which was one of his outstanding characteristics, were always at the service of his colleagues; the research work of the Chemistry Department at Southampton owes a great debt to him for the interest, the counsel and the generous help which he gave so freely.

The loss which the death of Clarence Smith brings to the teaching strength at University College, Southampton, is very great; but, above all, he will be missed for the charm of his personality, from which there radiated always the virtues of sincerity, courage and goodwill. D. R. B.

We regret to announce the following deaths:

Mr. Alan Blakeway, director of the British School of Archæology at Athens, on October 9, aged thirty-eight years.

Sir George Buchanan, formerly senior medical officer in the Ministry of Health, on October 11, aged sixty-seven years.

Prof. W. E. Praeger, emeritus professor of biology in Kalamazoo College, Michigan, known for his work in ecology, on August 13, aged seventy-two years.

Prof. Camille Sauvageau, formerly professor of botany in the University of Bordeaux, aged seventy-five years.

News and Views

International Relations promoted by Broadcasting

An international convention on the use of broadcasting in the cause of peace was adopted at a Conference at Geneva on September 23 and signed by representatives of eighteen countries. Soviet Russia signed with some reservations, but Hungary did not sign the convention although the Hungarian delegation had taken part in the proceedings throughout. The Italian delegation, which had also followed the proceedings with close interest, had previously been instructed to withdraw from the conference, and left expressing good wishes for its success. The text of the convention does not differ essentially from that prepared by the International Institute of Intellectual Co-operation at the request of the Assembly of the League of Nations. There are fifteen articles, of which six deal with matters of substance. The purpose of the convention is to ensure that broadcasting is never used in a manner prejudicial to good international understanding. A distinction is made between messages in the nature of a direct appeal to the inhabitants of another country and those designed primarily for national listeners. The former are prohibited in so far as they incite to acts incompatible with the internal peace or security of the territory of another party. States are bound under the convention to prohibit any broadcast likely to prejudice good international understanding by statements the incorrectness of which is, or ought to be, known to those responsible for the broadcast and to ensure that such statements are rectified immediately. Under a special provision, Governments agree, especially in time of crisis, to ensure the accuracy of the information concerning international relations broadcast within their territories. Provision is also made for the exchange of information calculated to promote a better knowledge of civilization and the conditions of life in the countries concerned and also for arbitration and conciliation procedure in the event of a dispute.

Co-operation between Oxford and Cambridge

In Convocation at Oxford on October 7, the Vice-Chancellor announced a scheme for co-operation in academic work which has been discussed by the governing bodies of the Universities of Oxford and Cambridge. It is proposed to promote legislation to allow students, whether undergraduate or post-graduate, from either university to go to the other for special courses of study and to keep residence while doing so. Facilities available at one of the universities only may thus be made available for common use, and studies of insufficient general interest to make it worth while for each university to have its own department need not be duplicated; it is possible that some existing duplication can be eliminated and the funds thus set free used for urgent needs. At first sight, this proposed innovation seems a great break with the traditions of the older universities; but there is no doubt of its excellence in principle. The college authorities, it is expected, will be less in favour of it than the university, but this is probably all to the good. They will see to it that the proposed freedom to migrate for a term or more will not be abused; that, in fact, only those who will greatly benefit by the change will be encouraged to enjoy it. With respect to facilities for instruction and research in science, it is likely that Oxford students will benefit more than Cambridge from the new proposal, at least at the undergraduate stage. The honours man at Oxford in science has generally but one subject to specialize in and consequently has time to take extra courses elsewhere; at Cambridge he is partly occupied with other subjects: and, of course, at Cambridge facilities for work in science are on a much more generous scale than at Oxford.

Research in Social Studies

THE Vice-Chancellor also spoke encouragingly of the scheme for research in social studies at Oxford made possible by the five-year grant from the Rockefeller Foundation which has now been in operation for a year. An institute of statistics has been started, several research lecturers have been appointed, and promising schemes of combined research in Colonial Government, in politics, in social services, and in economics have been begun. The first year of the experiment has been a great success. Research activity in other humane studies is also increasing remarkably. Since 1931 the number of those working for research degrees in the humane faculties has risen from 145 to 256.

Rhodes Memorial Lectures: Dr. E. Hubble

THE Rhodes Memorial Lectures at Oxford will be delivered during the Michaelmas Term by Dr. Edwin Hubble, of the Mount Wilson Observatory. They will be given at 5 p.m. on October 29, November 12 and November 26 in the Milner Hall of Rhodes House, Oxford. The lectures will bear the general title of "The Observational Approach to Cosmology", and will deal in turn with the observational characteristics of that region of the universe accessible to telescopes now in operation, secondly with empirical tests of the physical nature of the spectroscopic 'red-shift', and finally in the third lecture with the possible models of the universe which follow from the previously established interpretation of 'red-shift'. Dr. Hubble, who is himself a former Rhodes scholar, is well known in England. As a result of his discovery of Cepheid variables in the extra galactic nebulæ, and his determination of their periods, nebulæ such as those in Andromeda were first definitely revealed as systems of stars comparable in dimensions with the huge galactic system of which our sun is a part. Working out from the nearer of these objects, and using his own determinations of their apparent luminosities, Hubble was enabled by statistical methods to find the distances of these objects in a volume of space of 300 million light years radius; from these distances and the velocity determinations of Slipher and Humason, he first established in 1929 the existence of a linear relation between distance and velocity (assuming the observed spectroscopic 'red-shift' to be due to Doppler effect).

HUBBLE'S law, it need scarcely be added, is basic to all discussions of the expanding universe, whether in the relativistic form of Lemaître, Eddington and de Sitter, or in the kinematic form of Milne. As clearly set out in his Halley Lecture at Oxford in 1934, Hubble himself, however, has been led to seek whether there do not exist observational methods of determining whether this 'red-shift' is due to a velocity of recession, or to some other, as yet unspecified, physical cause. There will, therefore, be a widespread interest in his Rhodes Memorial Lectures, not only because they will reveal the conclusions which he has reached in this matter, but also because they may be expected to show the results of the furthermost exploration of the universe which can be carried out with the existing instrumental equipment.

Radcliffe Travelling Fellowship in Astronomy

THE Board of Visitors of the University Observatory, Oxford, is inviting applications for the Radcliffe travelling fellowship in astronomy. This new fellowship in observational astrophysics, open to all suitably qualified astronomers irrespective of nationality, carries an annual salary not in excess of £700, the exact amount of which is fixed by the Board. The fellow will divide his time approximately equally between the new Radcliffe Observatory in Pretoria with its 74-inch reflecting telescope, and the University Observatory, Oxford, with its new solar equipment, and will work on problems of his own choosing in observational astrophysics. The tenure of the fellowship is normally three years, but this period may be extended (or shortened) if this seems desirable in the case of a successful candidate. The fellowship therefore represents a stage in restoring the balance between observational and theoretical astronomy in England, now overweighted in favour of the latter, and at the same time marks the beginning of a new period of friendly and close collaboration between the two observatories concerned. The fellowship is being financed by the Radcliffe trustees, as an earnest of their interest in the study of astronomy in Oxford, while the nomination to and the emoluments of the fellowship are in the hands of the University.

The Harvard Tercentenary Celebrations

ELSEWHERE in this issue (p. 667) we print an account of the impressive functions by which the tercentenary of the foundation of Harvard University at Cambridge, Massachusetts, was celebrated as an outstanding event in the history of knowledge by a great gathering representative of all branches of learning and drawn from all parts of the world. A tribute of a different character came from six of the industrial leaders of the United States, in the form of a letter to President Conant directing attention to the indebtedness of American industry to the universities. They pointed to the large and increasing number of university trained men in industry and business as evidence of the influence of university education on industrial progress, and stated that, having caught the spirit of research from the universities, industry has applied its methods successfully and with noteworthy results. During the past twenty-five years, the number of industrial research laboratories in the United States has grown from a handful to more than 1500, and is rapidly increasing. "From the universities also flows much of the basic knowledge of science on which modern technical industry has built and will build in the future." The letter is signed by Walter S. Gifford, president of the American Telephone and Telegraph Company ; Alfred P. Sloan, jun., president of the General Motors Corporation ; Thomas G. Watson, president of the International Business Machines Corporation ; Pierre S. du Pont, chairman of the board of E. I. du Pont de Nemours and Company ; Owen D. Young, chairman of the board of the General Electric Company; and Walter C. Teagle, president of the Standard Oil Company of New Jersey. It is a striking tribute to the significance of university institutions in industrial progress.

African Problems

A wide and varied field was covered in the discussions which engaged the attention of the twenty-third biennial session of the International Colonial Institute held in London on October 6–8. As Mr. Ormsby-Gore pointed out in a speech at the banquet at which the delegates were entertained by the British Government, the Colonial Powers are all confronted with a number of problems, human, political and social, which have to be studied objectively in common. To this end the mere interchange of views and experience is useful, even though no very decisive conclusion may appear to emerge. In this respect, the pooling of experience and discussion of methods of meeting the new problems raised by the introduction of newspapers, broadcasting and the cinema are highly instructive. This, too, is perhaps the most beneficial outcome it is legitimate to expect from the discussion of the detribalized native, which was opened by Lord Lugard and occupied a considerable part of the session. It was evident, as might have been anticipated, that measures applicable to one area may not be possible in another. Thus the conclusion put forward by Father Charles, that tribalism can be revived successfully only under rule on tribal lines and by the use of native courts, may be accepted as a general proposition. Clearly, however, it cannot meet transitional cases, such as those to which Mr. Ormsby-Gore referred, when he spoke of the product emerging under missionary influence, for example, in the towns of the west coast, which it is difficult to fit into the evolution and progress of tribal life and the social organism. On the other hand, Prof. Basil Williams, while expressing approval of the system in the Belgian Congo, under which the mine-workers are encouraged to bring their wives, admitted that it has been impressed upon him that such a system would not be practical on the Rand, where mine-workers number a quarter of a million.

Natural Resources Conservation

One of the important questions discussed at the recent World Power Conference was the conservation of natural resources. Science Service, of Washington, D.C., has issued reports of papers, dealing with this subject, which formed the basis of a discussion at the Conference. It is stated that whether the business systems are capitalist or socialist or a combination of the two, we must organize our activities to meet the demands of natural law, and all civilized nations are struggling towards this end each in its own way. The principles laid down for 'resource planning' by the writer of the reports are to keep soil, water, forest and grass as at present, but to economize by every possible means in the use of irreplaceable minerals. Nature lays down the terms, and we must either obey or suffer. We can come to terms with Nature in regard to the self-renewing resources by using them only as fast as they are replaced. With regard to the non-replaceable minerals, we can come to terms only by finding new and abundant substitutes faster than we use up the older materials. It is a race between technology and waste. Face to face with the inexorable demands of Nature, we suffer from human weakness. The consent of the people has to be obtained in spite of the propaganda issued by those whose interests are opposed to the public welfare. The laws of a federal union of sovereign States are a tangle of inconsistent rights and powers that hampers the action of the nation. The United States are now struggling to acquire legal and political powers commensurate with their necessities. If it fails, we are threatened by a crisis when essential materials are exhausted and it becomes necessary to reduce the population.

British Chemical Manufacturers

Reporting on its activities during the year ended May 31, 1936, the Association of British Chemical Manufacturers justly claims to have rendered substantial assistance to an industry which is one of our most important national assets. It is concerned with the organization of displays of British goods, such as that provided by the British Industries Fair, with legislation and the incidence of taxation, with commercial treaties with foreign countries, with the Ottawa agreements and means for stimulating trade within the Empire, with transport, safety precautions, and in fact with any problem relating to the industry other than questions involving wages, hours and conditions of work. There is, however, much still to be done, and the Association is anxious to realize that expansion of services which would be rendered possible by an increase in its membership to include every chemical manufacturer in Great Britain. In his speech at the annual general meeting held on October 8, the chairman referred to the successful outcome of many of the enterprises which the Association has undertaken in the interests of its members, including in his survey a reference to the measures which are being undertaken to protect our factories against air attacks in the unfortunate event of war. The Association has also participated in investigations concerning the detection of toxic gases in industry. It is announced that the first pamphlet of the series, that dealing with hydrogen sulphide, will shortly be published by the Department of Scientific and Industrial Research. Dr. E. F. Armstrong was re-elected president for the coming year.

The Velocity of Light

FROM time to time, Mr. M. E. J. Gheury de Bray has published in the columns of NATURE communications on this subject. He has now brought together the results of his investigations in an article published in *Isis* (25, 2; September 1936), entitled "The Velocity of Light: History of its Determination from 1849 to 1933". Reprints of the article have been prepared and can be obtained from Mr. Gheury de Bray, Imperial Patent Service, First Avenue House, High Holborn, W.C.1 (price 1*s*.).

Pavlov Institute of Aviation Medicine

As successful flying over long distances or to high altitudes depends not only on the efficiency of the aeroplane and the skill of the pilot but also to some extent on such minor details as the clothing and diet of the pilot, the structure of the cabin, etc., an Institute of Aviation Medicine dedicated to Prof. I. P. Pavlov was organized about a year ago in Soviet Russia. The laboratories of the Institute make tests of clothing, oxygen apparatus and anti-noise helmets, and study the problem of producing light, warm and comfortable clothing for airmen. Oxygen apparatus used in flights is produced under the direct supervision of the Institute, and the fitness of airmen wishing to ascend to high altitudes is tested in the Institute's barometric chamber.

Early Photographic Instruments

SOME of the earliest instruments in the history of photography have just been acquired by the Science Museum, South Kensington, on loan from the Royal Photographic Society of Great Britain. They include three instruments used by Fox Talbot, the inventor of the first paper photographic process: (1) A camera lucida, the use of which on the shores of Lake Como in 1833 first suggested to him that the invention of a sensitive paper would record such scenes more perfectly than sketches made by hand. This is the instrument mentioned in his "Pencil of Nature", published in 1844. (2) Fox Talbot's solar microscope, with which the earliest photomicrographs on paper were produced. (3) A Culpepper type microscope, *c*. 1820. With other instruments and specimens which have recently been acquired and are in course of classification prior to exhibition, the representation of Fox Talbot's work in photography bids fair to be complete.

"Annual Tables of Constants and Numerical Data"

THE publication of the "Annual Tables" having lagged behind schedule since vol. 10 (1930), the new managing committee (Institut de Chemie, 11 Rue Pierre Curie, Paris, 5^{e}) proposes to make up for it by publishing the data for 1931–36 in a more condensed form and more critically edited, in separate fascicules by subjects, partly separately for 1931–34 and 1935–36 and partly for the whole period 1931–36. The set of these fascicules will form vols. 11 and 12 of the "Annual Tables". This programme is to be completed in 1937: the numerical material published in the "Annual Tables" will then be brought up to date. In addition, an index volume by substances for vols. 6–10 (1923–30), like that published for vols. 1–5 (1910–22), is to appear towards the end of this year. A new index volume by substances will be prepared for vols. 11 and 12, to be published in 1937. The Committee would welcome inquiries about the "Tables", and state that the back numbers have now been greatly reduced in price. The new fascicules are being issued at a very modest price, which will place them at the disposal of all scientific workers likely to need them in their investigations. The preparation of the "Annual Tables", which is a purely scientific and non-profit-making undertaking, is a worthy task deserving the active support of men of science in securing their prompt publication.

Dr. A. H. Mackenzie

IN announcing the death of Dr. A. H. Mackenzie, in NATURE of October 10, he was described, following "Who's Who", as "Pro-Vice-Chancellor of the Osmania University, Hyderabad". Prof. M. S. Ahmed writes to say that the correct official title is "Pro-Vice-Chancellor of and Special Propagandist for the Osmania University of Hyderabad". He adds: "Dr. Mackenzie was appointed to the position of Pro-Vice-Chancellor of the Osmania University in which capacity he had to work six months in the year at Hyderabad, and the remaining six months he had to spend in Great Britain in doing special propaganda in the British Universities on behalf of the Osmania University".

A Nova in Sagittarius

THE discovery of a nova on October 6 (the third to be discovered since last June) has been announced by telegram from the International Astronomical Union's Bureau at Copenhagen. The position is given as R.A. $18^{h}\ 4{\cdot}5^{m}$: Dec. 34° 21′ south: magnitude 6 on Oct. $6^{d}\ 0^{h}$ U.T. This position places the nova in the constellation of Sagittarius and roughly midway between the 3rd magnitude stars, γ Sagittarii and η Sagittarii. The discoverer is Mr. C. Jackson, of the Union Observatory, Johannesburg, who less than a month ago discovered a faint comet (1936 c). Owing to its southern declination of −34°, it will not be possible to observe the nova from the latitude of Greenwich, and further news of its behaviour must be awaited from southern observatories.

Announcements

The Royal Society of New Zealand has awarded the T. K. Sidey Summer-Time Memorial Medal and Prize for 1936 to Sir Leonard Hill. This award, which consists of a gold medal and £100 in New Zealand currency, is made to the person who in the opinion of the Council of the Society has made a valuable contribution to human knowledge by original research into the effect of light and solar radiations on human comfort.

The Huxley Memorial Lecture of the Royal Anthropological Institute will be delivered in the rooms of the Royal Society on October 27 by Prof. E. Westermarck, who will take as his subject "Methods in Social Anthropology".

The following appointments and promotions in the Colonial Service have been made: H. M. James, to be agricultural superintendent, Cyprus; C. H. F. Walker, to be agricultural officer, Nigeria; J. M. Waterson, to be plant pathologist, Agricultural Department, Bermuda; C. J. Taylor, to be assistant conservator of forests, Gold Coast; J. A. Allan, to be lecturer in botany, chemistry and physics, Department of Science and Agriculture, Barbados; L. P. Henderson (late agricultural officer), to be agricultural officer, Nigeria; Capt. J. R. Mackie (assistant director of agriculture), to be director of agriculture, Nigeria; F. B. Notley (entomologist, Kenya), to be entomologist, Agricultural Department, Tanganyika; D. F. Chesters (senior assistant conservator of forests), to be conservator of forests, Nigeria; Dr. J. C. Tull (Government pathologist and professor of pathology, Straits Settlements), to be pathologist, Cyprus; S. G. Willimott (Government analyst, Cyprus), to be assistant Government analyst, Straits Settlements.

The Institute of Hygiene of Czechoslovakia is carrying out important studies in connexion with vitamins in the diet of the poor, especially in winter, when most of their food contains only a very small quantity of antiscorbutic principles.

The central administration of the perfumery and cosmetics industry of the U.S.S.R. is to open an Institute of Cosmetics and Hygiene at Moscow in November. The Institute will consist of three departments devoted respectively to cosmetics, physiotherapy and plastic-therapeutic gymnastics, with a staff of specialists in dermatology and physical therapy.

We are asked to state that the address of the publisher of "The Way to Happiness for Humanity" noticed in Nature of October 10 (p. 636) is 93 Braybrook Street, London, W.12.

Messrs. Willibald Keller, Hindenburgstr. 94, Leipzig, are issuing shortly a new edition of the classical work "Die Alpen im Eiszeitalter" by Albrecht Penck and Ed. Brückner. The new edition will contain an additional chapter in which Albrecht Penck has given a survey of the present development of knowledge of the glacial period and the progress since the publication of the first edition. The subscription price of the work, consisting of three volumes, is 66 gold marks until November 30.

Applications are invited for the following appointments, on or before the dates mentioned:

One resident engineer, two senior engineers and one junior engineer for airport construction—Secretary, Office of Public Works, Dublin (October 21).

An assistant engineer in the Ministry of Transport—Establishment Officer (October 21).

A records officer in the office of the Industrial Research Council of the Department of Industry and Commerce, I.F.S.—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin, C.8 (October 22).

A junior assistant in the Department of Civil Engineering, Queen's University, Belfast—Prof. Hummel (October 23).

A teacher in engineering and an engineering workshop instructor at the Kenrick Technical College, West Bromwich—Director of Education (October 23).

A technical assistant (electrical, mechanical and civil engineering industries) for a War Department inspection establishment at Woolwich—Under-Secretary of State (C. 5), War Office, London, S.W.1 (October 24), quoting "Appts./1".

An assistant director of horticultural education and an agricultural advisory officer to the Norfolk County Council—The Clerk, The Shirehouse, Norwich (October 24).

Two assistant drainage engineers in the Ministry of Agriculture and Fisheries—Secretary (October 26).

A public analyst to the Metropolitan Borough of Chelsea—Town Clerk (October 29).

A professor of philosophy and a lecturer in the Department of Education and Philosophy, Canterbury University College, Christchurch, New Zealand—Secretary, Universities' Bureau, 88A Gower Street, London, W.C.1 (October 31).

A lecturer in the Department of Pathology, University, Birmingham—Secretary (October 31).

A head of the Science Department, West Ham Municipal College—Town Clerk and Education Officer, West Ham (November 6).

An assistant curator (male) at Somerset County Museum, Taunton Castle—The Curator.

A civil engineer for the Public Works Department, Government of North Borneo—Secretary, British North Borneo (Chartered) Company, Staple Hall, Stone House Court, Bishopsgate, London, E.C.3.

Civil engineering and architectural assistants in the Drawing Office, H.M. Dockyard, Portsmouth—Civil Engineer-in-Chief, marked "D.O. Assts., Portsmouth".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 688.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Calculation of Structure Factors and Summations of Fourier Series in Crystal Analysis: Non-centrosymmetrical Projections

Two useful methods for carrying out these operations have recently been described in NATURE. The Fourier synthesis reduces to summing series of the type

$$\Sigma\Sigma A \cos h\theta_1 \cos k\theta_2 \text{ and } \Sigma\Sigma A \sin k\theta_1 \sin k\theta_2,$$

θ_1 and θ_2 being co-ordinates in a projection of the structure, expressed as fractions of the cell sides. In the method described by C. A. Beevers and H. Lipson[1], strips of numbers are printed giving all the values of $A \cos h\theta_1$ from $A = +99$ to $A = -99$, $h = 0$ to $h = 20$, and θ_1 at 6° intervals from 0° to 90°, the latter 15 numbers being printed in a row along the strip. The synthesis then reduces to selecting the correct strips, placing them over each other, and adding up the columns of numbers.

In the calculation of structure factors a similar summation is involved, but in this case θ_1 and θ_2 are the co-ordinates of the atoms in the unit cell, and the coefficients A depend upon their scattering power. In the method described by W. L. Bragg[2], contoured graphs of the function are prepared for different combinations of the indices h and k, from which component terms in the structure factor can be read off.

The object of this note is to point out that a numerical method which I described some time ago[3] for the summation of Fourier series can be applied equally well to the calculation of structure factors. The method is similar to that of Beevers and Lipson, but the strips of cosine factors are prepared for different values of A only, the different values of h being obtained by moving the strip along an appropriate scale, graduated in terms of θ_1, when the required result appears under a fixed column. The method may not be quite so fast as that of Beevers and Lipson, as the strips have to be moved along the scales for each successive value of θ_1, but this loss is partly balanced by the greater ease of selection of the strip, only 100 being required instead of about 4,000 in the method of Beevers and Lipson.

In order to use the method for the addition of structure factors, we note that the co-ordinate θ_1 now refers to the position of an atom in the unit cell, and may therefore have any value. If the given values are restricted to multiples of 6°, then there is a maximum possible error of 3° in assigning the position of the atom. This is not important if the value of the index h is 1, but for high values of the index the error is serious. This difficulty is overcome by extending the set of *scales* to cover all values of θ_1, from 0° to 180°, at one degree intervals (or half-degree intervals, if still greater accuracy is required). The same strips of cosine factors are used as before, with the same sorting board and fixed columns, but the new scales prevent the error of position of any atom ever exceeding the maximum of 3° no matter how high the index of the plane may be. Some examples of the new scales are shown in Fig. 1, from which their construction and use will be clear, on reference to the previous description[3]. The numbers are written on strips of cardboard with V ends, for easy attachment to the sorting board. The scales for $\theta = 6°$, 12°, 18°, etc., are identical with the scales for $h = 1, 2, 3$, etc., used for Fourier synthesis. For Fourier summations, the numbers on the scales represent successive values of the co-ordinate θ_1, in steps of

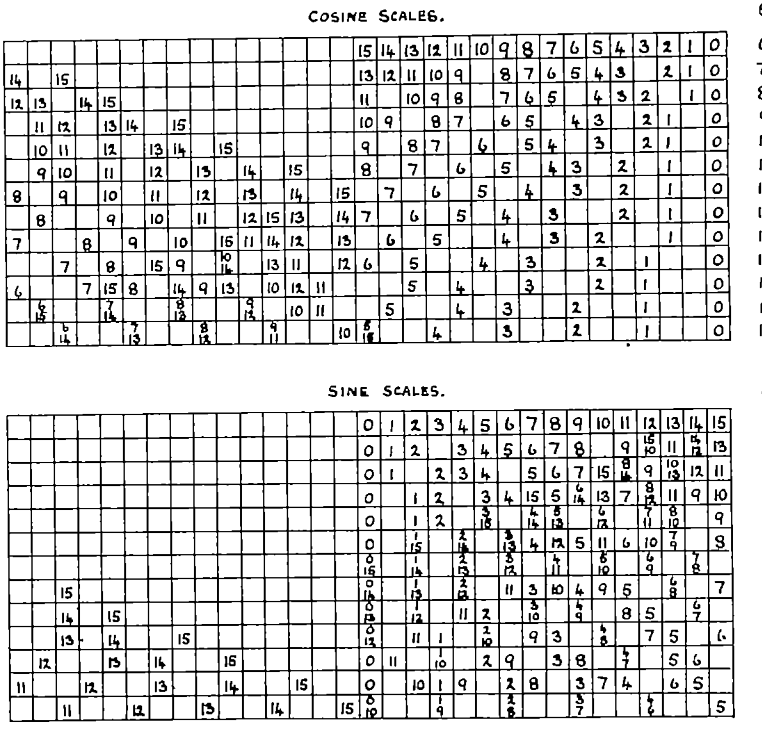

FIG. 1.

6°, and a separate scale is used for every different value of the index h. For structure factor summations, the numbers on the scales represent successive values of the index h, and a separate scale is used for every different value of the co-ordinate θ_1, the number of scales required being equal to the number of atoms in the asymmetric unit.

In practice, the calculation of a number of structure factors can be made with the same facility as the calculation of the electron density at the same number of points on a projection of the structure. The first factor, $A \cos h\theta_1$, is evaluated for a number of values of h, and these results are used as coefficients for the final summations. The method is particularly useful for structures containing large numbers of atoms of rather similar scattering power, such as occur in organic compounds, where sufficient accuracy can be obtained by using the same atomic f-curve for all the atoms, but weighting the coefficients in proportion to the atomic numbers.

As a further supplement to my previous paper[2], I should like to point out that the Fourier synthesis of non-centrosymmetrical projections can be carried out very easily either by my method or that of Beevers and Lipson if the arbitrary phase constant, α, is first combined with the measured F values. The series

$$\Sigma\Sigma\ F \cos (h\theta_1 + k\theta_2 - \alpha)$$

may be written

$$\Sigma\Sigma\ [(F' \cos h\theta_1 + F'' \sin h\theta_1) \cos k\theta_2 - (F' \sin h\theta_1 - F'' \cos h\theta_1) \sin k\theta_2]$$

where $F' = F \cos \alpha$ and $F'' = F \sin \alpha$.

Examples of such projections are given in a recent paper on the structure of resorcinol[4]. Further simplification of the formulæ often follows from relations between the phase constants in the different quadrants of the reciprocal lattice. These relations are summarized for the different space groups in a recent book by Dr. Lonsdale[5].

J. MONTEATH ROBERTSON.

Davy Faraday Laboratory,
Royal Institution,
London, W.1.
Sept. 22.

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[1] NATURE, **137**, 825 (1936).
[2] NATURE, **138**, 362 (1936).
[3] *Phil Mag.*, **21**, 176 (1936).
[4] J. M. Robertson, *Proc. Roy. Soc*, A, in the press
[5] "Structure Factor Tables", by K. Lonsdale (G. Bell and Sons).

Self-Interaction of Neutrons and Protons

IT is known that, starting with Fermi's expression for the coupling between a heavy nuclear particle and the field of electrons and neutrinos, we get in the second approximation the law for interaction between proton and neutron[1]. This law:

$$\sim \frac{g^2}{hc} \frac{(h/mc)^{2s}}{r^{5+2s}}$$

(g is Fermi's constant, the best choice for s is 3) gives a divergent result at $r \to 0$, which shows the impossibility of constructing a point model of a heavy particle, just as the classical and quantum electrodynamics both lead to infinite self-interaction of a point charged particle on Coulomb's formula. The only reasonable method so far proposed to remove this difficulty of classical electrodynamics is the non-linear generalization of Maxwell's equations developed by Mie and Born[2], who introduced a new characteristic length (the analogue of the radius of the electron).

Fermi's theory also introduces a universal length $r_0 = \sqrt{g/hc} \sim 10^{-16}$ cm., or better $r_0 = \sqrt[s+2]{(h/mc)^s g/hc} \sim 10^{-13}$ cm. with $s = 3$, say, which fact changes the whole situation of the interaction problem, as well as that of the theory of scattering[3]. Let us compute the interaction between heavy particles transferred not only by a single pair, but by 2, 3 . . . n pairs of light particles, electrons and neutrinos. In electrodynamics this would correspond to the transfer of energy by 2, 3 . . . n photons, afterwards emitted and absorbed by two charged particles. Putting $\bar{\psi} = \psi_0 + \psi_1 + \ldots \psi_n$ for the wave function of two heavy particles, we get for the interaction, as far as the $2n$th approximation:

$$V = -\frac{g^2}{hc}\left(\frac{h}{mc}\right)^{2s} \frac{1}{r^{2s+5}} \sum_{n=0}^{\infty} (-1)^s \alpha^n \left(\frac{r_0}{r}\right)^{2n(2+s)}$$

where α_n are numerical coefficients of the order unity.

At great distances ($r \gg r_0$) we obtain, of course, the previous law, but at small distances $r < r_0$ the successive members of the series are of the same order of magnitude, which corresponds physically to the *intensive interaction transfer* not only by one pair but also *by many pairs of light particles*, or as we may say, by *showers* of particles.

Though at $r \to 0$ each member of the series tends to infinity, the whole sum can be finite, which is best illustrated by the example of the following expression, the expansion of which is quite similar to our series, differing from it possibly only in the values of numerical coefficients:

$$V = \frac{g^2}{hc}\left(\frac{h}{mc}\right)^{2s} \frac{1}{(r^{2s+4} + r_0^{2s+4})^{1+1/(2s+4)}}$$

As the exact values of the coefficients are at present not of great importance owing to the preliminary character of the whole of Fermi's theory, it is very attractive to admit this law as the general form of interaction, giving the required finite proper energy of a heavy particle Mc^2 at $r \to 0$, just as the potential of Born's non-linear theory leads to the finite value of mc^2 for the electron. We find in this manner that Fermi's r_0 plays the role of the radius of a heavy particle. We see that by taking into account the shower-like character of energy transfer, realized by many particles, or photons, we are led immediately to the non-linear law of interaction.

D. IWANENKO.
A. SOKOLOW.

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Tomsk.
Sept. 13.

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[1] D. Iwanenko and A. Sokolow, *Verhandl. d. Sibirisch, Phys.-Techn Instituts*, (Russ.), 4, 67 (1936). NATURE, **138**, 246 (1936). *Z. Phys.*, **102**, 119 (1936)
[2] M. Born, *Proc. Roy Soc.*, A, **143**, 410 (1934)
[3] W. Heisenberg, *Z. Phys.*, **101**, 119 (1936).

A New Kind of Ring Phenomenon in Sputtered Metallic Films

AN interesting ring phenomenon which is expected to throw light on the mechanism of condensation of sputtered particles was noticed while working on cathodic sputtering. Details will be published elsewhere.

It was noticed that if a small bead of plasticine or a small drop of oleic acid is placed on a specially cleaned (not degased) glass plate, and the plate given a deposit of cathodically sputtered silver or copper in air, a set of coloured rings is formed surrounding the bead or the drop. The distance between the successive sets of coloured rings increases with the distance of the ring from the centre. In monochromatic light the rings appear alternately dark and bright.

The drop of oleic acid does not spread on the glass until the discharge is started. Within a few minutes of the starting of the discharge the drop flattens into a white patch, which shows a grey deposit when observed under a magnifying eyepiece. The ring formation occurs around this patch.

A small bead of paraffin was also tried instead of plasticine. The paraffin melted and spread on starting the discharge, but no marked rings were obtained though colours could be seen, being usually blue in the centre with a wide yellow circular band round it.

The same experiment using a small piece of pure aluminium instead of the oil did not show any rings.

Some separate experiments showed that oleic acid does not spread to any appreciable extent when placed on either a freshly prepared or an old mirror made by a cathodically sputtered deposit even when heated up to 100° C.

The formation of the rings may be explained by assuming the condensed metallic sputtered particles to form a liquid expanded film or a gaseous film. The experiments of Ditchburn[1] on the surface motion of cathodically sputtered cadmium lends support to this view. The oleic acid spreads on this fluid film, and thus gives rise to the interference rings. It is quite likely that adsorption between the metal particles and the organic molecules also plays a part in the formation of the rings.

The spreading of the oleic acid drop into a patch may be explained by assuming the cohesive forces on the surface of the acid drop to be decreased by the adsorption of the metallic particles on the acid surface. Moreover, the surfaces in contact now are not glass-acid-air but metallic fluid-acid-air.

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Aug. 31.

[1] *Proc. Camb. Phil. Soc.*, **29** (1933).

Surface of Copper formed by Solidification *in vacuo*

MECHANICAL or chemical treatment is usually required to prepare a surface for electron diffraction examination. This may lead to distortion of the structure which is undesirable, particularly when comparison with X-ray data is required. A surface formed by solidification of a molten metal *in vacuo* may be regarded as probably the most satisfactory obtainable. In the present investigation the purest available copper was melted in an alundum boat in a fused silica tube which was connected to a Hyvac pump. The surface of the specimens was bright and smooth. Both electron diffraction and X-ray photographs were taken. Both gave sharp spots indicating the presence of large crystals, but whereas X-rays showed that the orientation of the crystals differed from specimen to specimen, electron diffraction showed spots from copper crystals orientated with either {111} or {100} planes parallel with the surface, the {111} orientation being most frequent. Twenty photographs gave similar results.

We also examined specimens which had been maintained for a long time at 950° C. The results were identical. Even a single crystal acquired, after heating, a layer of crystals orientated with their {111} and {100} planes parallel with the surface, independent of the structure underneath. A silver specimen behaved similarly.

It would be necessary to examine a large number of metals of different structures before venturing to give an explanation of these results. It may be connected with surface tension, by which the planes of highest atomic density arrange themselves parallel with the surface. It is interesting to note[1] that the first layer of cuprous oxide formed on polycrystalline copper is orientated so that a [111] direction is perpendicular to the surface. In our experiments no trace of oxide was found and no distortion.

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Sept. 29.

[1] G. D. Preston, and L. L. Bircumshaw, *Phil. Mag.*, Ser. 7, **20**, 706 (1935).

A New Electron Oscillator

A NEW arrangement of electrodes in a vacuum tube has enabled me to generate electron oscillations of higher intensity and with more ease than by the split-anode magnetron, with which I first succeeded in producing the intense micro-waves by connecting it in 'push-pull'.

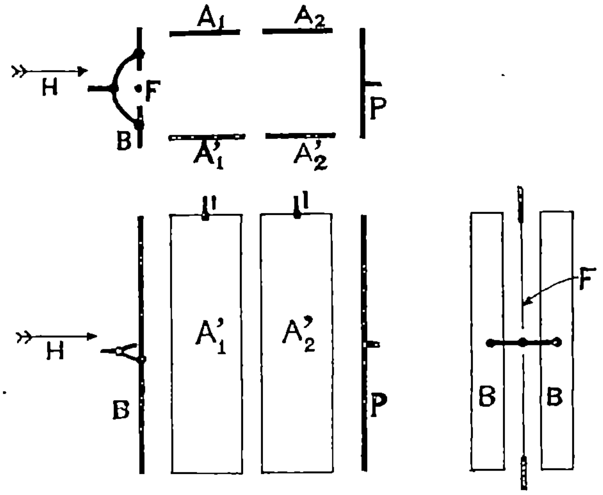

FIG. 1.

In Fig. 1, F is a straight filament cathode which is stretched in about the same plane as the plate-electrodes B. P is an end plate on the other side. Both B and P are kept at a low positive or negative potential.

A_1, A'_1, A_2, A'_2 are rectangular slab electrodes which are all kept at a high positive potential. A magnetic field is applied in the direction H. Now A_1 and A'_1 are connected together, and so are A_2 and A'_2. When a parallel wire circuit is connected to A_1 and A_2, a strong oscillation current is obtained in the circuit, the wave-length of which is determined simply by the circuit constants.

The adjustment is not at all critical, and the wave-length may be varied within a comparatively wide range about the value estimated as the simple oscillation of electrons between the two opposite plates B and P.

A large number of modifications and different combinations of electrodes are conceivable.

When the magnetic field is gradually increased, oscillation appears at a certain range and then stops, and reappears again at a higher field strength in some cases. If the magnetic field is inclined a certain number of degrees from the symmetrical axis of the arrangement, oscillations of much longer wave-lengths may be generated with the frequency as determined by the oscillation circuit.

The principle of operation of this oscillator may be considered either as the B–K oscillation with positive grids of novel construction and a magnetic field applied in order to straighten the paths of electrons, or as the split-anode magnetron oscillation when the electron stream is differently directed and the split-anodes assume accordingly different shapes. In order to distinguish these tubes of new principle, we are calling them 'Osaka tubes' in our laboratories.

The static characteristic shows no negative resistance effect, but it must naturally be understood that, under oscillation conditions, the negative resistance relation obtains dynamically, so that the electron oscillation may be maintained by the timely retroaction from the circuit.

A useful output of a few watts was easily obtained, when the input was about twenty watts and the wave-length was about eighty centimetres.

With the present tube, the micro-waves were successfully produced by connecting together A_1 and A_2 as well as A'_1 and A'_2, and also by connecting a parallel wire to A_1 and A'_1.

I wish to express my thanks to Prof. Yagi for his valuable suggestions.

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Insect Coloration and Natural Selection

THE letter from Prof. E. W. MacBride in NATURE of August 29 (p. 365) escaped my attention while on holiday, and since my return I have not been able to find time to consider it until now.

The central point of the letter, dealing with the occurrence and inheritance of mutations, should be answered by more competent hands than mine, but certain points bearing more particularly on the work in which I am chiefly engaged require comments.

It is much to be regretted that so many critics of the theory of mimicry confine themselves to the phenomena as exhibited by butterflies. Let us disregard altogether the Lepidoptera, for the present; then the argument against mimicry so often stressed by my friend on *negative* evidence falls to the ground. For other orders of insects are attacked by birds and insectivorous mammals to a very high degree, and exhibit abundantly the phenomena of mimicry. Therefore the current explanation of mimicry cannot be set aside because in one particular group there is not considered to be sufficient evidence of attacks by enemies which could have a selective influence. Meanwhile, evidence of attacks by birds on butterflies continues to come to hand, and I would ask those who have not witnessed such attacks to consider again the striking evidence presented by Mr. T. H. E. Jackson[1].

Regarding the influence of environment, I directed attention in NATURE some years ago[2] to a well-known case of mimicry which refutes that argument: the Lycoid insects. But since the minutiæ of geographical variations are so often disregarded by critics, the following example of another difficulty is given. The ease with which minor variations can be studied on the large wings of butterflies is responsible for their use in illustrations: I have no doubt that analogous examples will be found among other orders when they have been studied to the same degree.

The female of the butterfly, *Papilio cynorta*, wherever it occurs in tropical Africa closely resembles superficially other butterflies having all the characters of aposematic species. On the west coast, it is like the female of the Acraeine *Bematistes* (= *Planema*) *epaea epaea*, both having a white pattern on a dark background: the male *epaea* has the paler parts of an orange brown. This species, like many others of the West African region, ranges eastwards into Uganda where it undergoes a change. The sexes are alike, the dark background becomes greyish-brown and the paler pattern cream coloured, the pale areas much reduced in size. This is the race *paragea*. The *Papilio* female (race *peculiaris*) undergoes a corresponding change in appearance: the male remains as in West Africa.

Both species extend into south-west Abyssinia and undergo further changes of importance for the argument. We find, as in Uganda, that both sexes of the *Bematistes* are alike but for a different reason: in Abyssinia the female has adopted the orange-brown coloration of the male, which is very little different from the western form: for this reason the Abyssinian race is named *homochroa*.

What happens to the *Papilio* in Abyssinia? According to the argument from environment, it also should respond to Abyssinian influences by becoming orange-brown. Incidentally, it may be remarked that, on this argument, the conditions in Abyssinia must be nearer to those of West Africa than are the conditions in Uganda: a conclusion which I feel sure would not be admitted by geographers. The Abyssinian *Papilio cynorta*, discovered by Sir Arnold Hodson, does not follow the usual model: one may presume that it is because it does not possess the gene for the orange-brown colour. *P. cynorta arnoldi* is black and white, somewhat different in pattern from the western race mimicking *B. epaea epaea*, and resembling the Abyssinian race *aethiops* of the abundant Danaine *Amauris niavius*. The highly interesting fact is that in West Africa the Danaine model is present for the *Papilio* to mimic, but the latter has, so to speak, found it easier to approach the Acraeine *Bematistes*. But when the *Bematistes* adopts in Abyssinia a garb impossible for the *Papilio* to assume, the latter has recourse to an appearance which is within its power, by slight modification of its western form: this latter, however, is supposed to be the result of West African conditions.

Finally, no account is taken, by the advocates of environmental causation, of the highly significant fact that, in complete accordance with the demands of natural selection, mimetic resemblances are superficial. Mimicry deceives the artist but not the anatomist. Moreover the details of the likeness between model and mimic are not the same. It is a commonplace that apparently the same effect may be produced by different means, a fact also in accord with natural selection.

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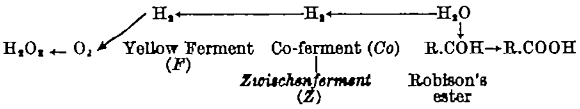
Oct. 1.

[1] See NATURE, **135**, 194 (Feb 2, 1935).

[2] NATURE, **123**, 661 (April 27, 1929); **124**, 183 (Aug. 3, 1929)

Keilin's Cytochrome *c* and the Respiratory Mechanism of Warburg and Christian

ACCORDING to the investigations of O. Warburg and his co-workers[1] on the reaction



the yellow ferment (F) acts as a more or less specific dehydrogenator of the di-hydro-co-ferment ($Co\mathrm{H}_2$), which cannot be oxidized either by molecular oxygen, or by methylene blue. The *cozymase* reacts in a manner analogous to the co-ferment (H. v. Euler and co-workers[2]).

Until now it has been uncertain whether the direct re-oxidation of the leuco-form of the yellow ferment ($F\mathrm{H}_2$) by molecular oxygen really takes place to any considerable extent in the living tissue cells, where the oxygen pressure is often very low, and whether the $F\mathrm{H}_2$ possibly could be re-oxidized by other substances in the cells, for example the cytochromes.

I have recently investigated the kinetic relations between oxygen, cytochrome *c* and the yellow ferment. The experiments were performed in the following manner: Co, Z, HCN, $m/50$ $NaHCO_3$ and in certain cases F were mixed in a glass cell of 1 cm. thickness to the volume of 3 ml. Z was used in such small amounts that the oxidation velocity of Robison's ester was proportional to the quantity of Z. After ten minutes the solution was saturated with nitrogen or oxygen or mixtures of both, and then a small quantity of oxidized cytochrome *c* ($\mathrm{Fe}^{\cdots}\mathrm{OH}$; pure, from beef heart[3]) was added. The pH of the solution was 7·35. The light absorption at 550 mμ was determined photo-electrically. Now the substrate, the potassium salt of pure Robison's ester, was added and the light absorption at 550 mμ was followed.

A priori, three different reactions would be expected to be possible:

$$\begin{aligned} O_2 + F\mathrm{H}_2 &= H_2O_2 + F \quad \ldots\ldots\ (1)\\ 2\mathrm{Fe}^{\cdots}\mathrm{OH} + F\mathrm{H}_2 &= 2\mathrm{Fe}^{\cdot\cdot} + F + 2H_2O \ \ldots\ (2)\\ 2\mathrm{Fe}^{\cdots}\mathrm{OH} + Co\mathrm{H}_2 &= 2\mathrm{Fe}^{\cdot\cdot} + Co + 2H_2O \ \ldots\ (3)\end{aligned}$$

The experiments proved that reaction 3 does not take place. Thus cytochrome *c*, like oxygen and methylene blue, is unable to oxidize the di-hydro-co-ferment directly.

Reaction 2, on the contrary, takes place most rapidly. If molecular oxygen and oxidized cytochrome *c* were both present in the solution, the relative velocities of reactions 1 and 2 were dependent on the oxygen pressure, but within wide limits independent of the concentration of oxidized cytochrome. The accompanying table shows the relation between the oxygen pressure and the relative reaction velocities at 22° C.

Oxygen pressure (mm.)	Per cent $F\mathrm{H}_2$ oxidized by oxygen	Per cent $F\mathrm{H}_2$ oxidized by cytochrome *c*
760	69	31
150	54	46
38	20	80
0	0	100

About the same values for an oxygen pressure of 150 mm. were found at 31° C.

In the living tissue cells, the average oxygen pressure is much lower than 38 mm. *Thus the re-oxidation of the yellow ferment by cytochrome seems to be the physiological method* occurring in cells containing the Warburg-Keilin iron-porphyrin system—that is, nearly all known cells. It should be pointed out that nothing is said above about another problem, namely, how much of the total cell respiration takes place by means of the yellow ferment.

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Aug. 29.

[1] O Warburg and W. Christian, *Biochem. Z.*, **254**, 438 (1932); **257**, 492 (1933); **260**, 499 (1933); **266**, 377 (1933); Warburg, Christian and Griese, *Biochem Z.*, **279**, 143 (1935); **282**, 157 (1935), etc.

[2] H. v. Euler, E. Adler and H. Hellstrom, *Svensk Kem. Tidskr.*, **47**, 290 (1935); *Z. physiol. Chem.*, **241**, 239 (1936), etc.

[3] H. Theorell, *Biochem. Z.*, **279**, 463 (1935); **285**, 207 (1936).

An Effect of X-Radiation on the Blood

IN the treatment of malignant disease by X-rays or radiation, a highly important question is that of dosage. So far as we are aware, there is no simple method of determining quantitatively, even only approximately, the effect of a given dose except by observation of the effect on the irradiated tumour.

It is well known that irradiation produces marked changes in the blood, but no systematic examination of the cause of these changes during a prolonged course of treatment appears to have been made. We have undertaken therefore to investigate whether such irradiation produces a measurable change in some definite constituent of the blood, so that there may be a check on the effect of the radiation administered. By a new and accurate photo-electric method of estimating the total (and also the acid-soluble) phosphorus in the red cells, plasma, serum and whole blood of the patient under treatment, we have been able to ascertain, by taking measurements before and after irradiation by X-rays or radium, that the ratio of the whole phosphorus in the red cells to that in the plasma (a ratio which is usually high in the case of cancer patients but of the order of 5 or less in that of other patients) is reduced, even after only one treatment, by so much as 50 per cent in extreme cases, so that the phosphorus-partition falls within the normal range.

Our results indicate that it may be possible to judge of the effect of X-ray dosages by measuring changes in the phosphorus partition in the red cells and the plasma. As an example the following two cases may be considered, in which the figures given denote milligrams of phosphorus per 100 c.c.

	Whole blood	Red cells	Plasma	$\frac{\text{P in cells}}{\text{P in plasma}}$
Case I (before irradiation)	25·5	53·0	6·0	8·8
(after ,,)	38·75	69·0	14·5	4·8
Case II (before ,,)	22·5	49·0	4·5	11·0
(after ,,)	20·0	54·0	8·75	6·8

These figures were obtained for blood taken from the patients when fasting. The results of the phosphorus partition in the blood elements of a large number of patients will be published in a later communication. It seems to us that a periodic examination of the blood along these lines during a course of treatment may be a valuable guide to the changes in the condition of the patient.

This work has been done under the auspices of the Cancer Research Committee of the University of Sydney.

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Formation of Carbon Dendrites

THE formation of long carbon dendrites in the electrolytic reduction of aqueous colloidal dispersions of graphitic acid was recently reported by Luke, Madgin and Riley[1].

If instead of the slightly viscous solution, a micellar solution of high viscosity[2] is employed, this phenomenon is also shown clearly, as the movement of the colloidal particles away from the cathode towards the anode is hindered. In the near future a detailed description of other experimental results will be published.

It has been found possible to transform a colloidal solution of graphitic acid into a transparent gel which contains much water and is very similar to the gel of gelatine. The movement of the lamellæ of graphitic acid under an electrical potential is still further hindered in the gel. On touching a small piece of the gel with two platinum electrodes at a potential difference of 220 volts, carbon is formed by reduction at the cathode before the relatively large lamellæ have time to move away. The orientation of the disordered lamellæ under the influence of an electrical field observed under the microscope in polarized light[3] is confirmed by Messrs. Luke, Madgin and Riley[1].

The electrochemical reduction of graphitic acid makes possible the following experiment. A thin film of graphitic acid[4] moistened with a few drops of water can be transformed into a thin film of graphite. It is possible to write on a film of graphitic acid, which may be formed on a piece of paper, using a platinum electrode.

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Sept. 10.

[1] NATURE, 138, 161 (1936).
[2] *Z. anorg. Chem.*, 190, 145 (1930).
[3] *Koll. Z.*, 56, 129 (1931).
[4] *Forsch. u. Fortschr.*, 10, 408 (1934).

Points from Foregoing Letters

A RAPID numerical method for the calculation of structure factors and the summation of Fourier series in crystal analysis, which is also applicable to non-centro-symmetrical structures, is described by Dr. J. Monteath Robertson.

The interaction between two heavy nuclear particles is computed by Dr. D. Iwanenko and A. Sokolow on Fermi's theory, assuming the interaction transfer, not by one alone, but by an arbitrary number of pairs of electrons and neutrinos. The generalization of the previous law obtained gives the finite self-energy of a proton or neutron, just as Born's non-linear theory leads to finite self-energy of a point charge, which was impossible on the usual Coulomb formula.

The formation of coloured rings when silver or copper is 'cathodically sputtered' upon a glass plate, on which a drop of oleic acid has been placed, is described by U. K. Bose. The author explains the phenomenon by assuming that the condensed metallic sputtered particles form a surface film of the 'liquid expanded' or 'gaseous' type.

Surfaces of copper crystallized from a molten state by cooling *in vacuo* have been investigated by S. Dobinski and Dr. C. F. Elam both by means of X-rays and by the electron diffraction method. X-rays showed that the orientation of the crystals differed from specimen to specimen, while the electron method showed spots from copper crystals preferentially arranged. The authors suggest that this arrangement may be due to the planes of highest atomic density, (111) and (100), arranging themselves parallel with the surface.

Diagrams illustrating a new arrangement of electrodes in a vacuum tube, by means of which electron oscillations of higher intensity than those obtained with the split-anode magnetron can be produced, are submitted by Prof. K. Okabe. A useful output of a few watts was obtained with an input of about twenty watts. The wave-length was eighty centimetres, but may be varied within a comparatively wide range.

Further evidence in support of the view that natural selection rather than environmental conditions determines mimicry in insects is adduced by Prof. G. D. Hale Carpenter.

Experiments with several constituents involved in the mechanism of respiration of cells, carried out by H. Theorell, show that citochrome *c* (a pigment found in muscle tissue, etc.) is unable to oxidize the di-hydro-co-ferment directly, but does oxidize the leuco-form of the 'yellow pigment'.

The ratio of the phosphorus content of red cells and the plasma of the blood is found by Dr. H. L. Brose and E. B. Jones to be changed after treatment with X-rays or radium. The authors give two examples and suggest that the change may possibly serve as a measure of the effect produced upon the patient by a given dose of X-rays or radium.

Further experiments illustrating the reduction of graphitic acid at a cathode and the formation of carbon dendrites are described by Dr. H. Thiele.

Research Items

Brain Size in Man and the Great Apes

Dr. Franz Weidenreich, who has succeeded the late Dr. Davidson Black as honorary director of the Cenozoic Research Laboratory of the Geological Survey of China, has made the endocranial cast of Peking man the basis of a comparative study of the size of the brain in man and the great apes (*Palaeontologica Sinica*, Ser. D, 7, 4). To the two casts of the original skull and the reconstructed specimen, he has now added a third from a composite reconstruction by himself from material freed from the matrix recently. He points out that previous studies have dealt with the relief of the casts, but the material now available makes it possible to deal more generally with shape and proportions and to show the direction of development. The first feature to strike the observer is the small size of the brain of *Sinanthropus*, even when allowance is made for the fact that the first skull is that of an immature individual. Taking the three together, the cubic capacity may be put at approximately 1,000 c.c., as against 900 c.c. for *Pithecanthropus* and 1,450 c.c. for modern man (male) and 1,300 c.c. (female). Among the anthropoids the gorilla is not quite 600 c.c. and the chimpanzee below 500 c.c. The general average of modern man is below that of Neanderthal man, which works out at 1,425 c.c., so that it would appear that the hominids reached the maximum of skull capacity in that type, and in modern man it is on the decrease. A further point which emerges is that the size of the brain, especially in the hemispheres, increases almost equally in all directions during the development of the hominids, while relative as well as absolute increase is greater in the direction of height, next of length and least of breadth. *Sinanthropus*, *Pithecanthropus*, the Neanderthal group and recent man represent different stages in human evolution which are well marked off one from another.

White Rats and Lamarckism

The experiments of McDougall, in which he trained rats to discriminate between the light and dark exits from a water tank by giving them a tetanizing electric shock when they chose the lighted exit, are well known. He claimed that the effect was inherited, so that after some generations the descendants of rats which had been trained in every generation learned much more quickly than untrained controls. He neglected, however, to record pedigrees or to keep the individual records of every animal. His work has now been repeated by Prof. F. A. E. Crew (*J. Genetics*, 33, No. 1) using more critical genetical methods. With 18 generations of rats, 1,445 trained and 1,014 controls, the average number of errors in the trained stock did not decrease, and showed no difference whatever from the control stock. Analysis of the pedigrees shows, however, that genetic factors are heavily concerned in determining the scores, quickness to learn being a general dominant to slowness. The parent-offspring correlation for learning was 0·3. A 'quick' strain was developed by selection. Preliminary experiments with each rat, in which the light was constant at both exits and no shock was administered, showed that many rats chose regularly the right or left hand exit and others were photophobic. The genetic basis of these conditions is being further investigated, but the claim for a Lamarckian effect is found to be without foundation.

Imaginal Buds of the Appendages in *Drosophila*

Dr. Charlotte Auerbach has recently traced the development of the imaginal buds of the legs, wings and halteres in *Drosophila* from the first larval instar onwards (*Trans. Roy. Soc. Edinburgh*, 57, 787 ; 1935). The basis of the work is genetical, and the problem as to how the mutant genes influence the development of organs and parts cannot be properly answered unless the normal growth of the parts is known. The account given of the formation of the thoracic appendages and their connexions with associated organs is exceptionally complete. This is followed by a preliminary description of the development of certain mutant wing-types. The time in development when such mutants deviate from typical growth is recorded and the deviation followed in some detail. In wing-development there are four recognizable periods of morphogenetic significance, and various external factors, operating at definite periods, induce the manifestation of certain mutants. The paper is very fully illustrated, and forms a useful contribution to the subject concerned.

The Genus *Keramosphaera* Brady

In December 1935, Mr. E. Heron-Allen read a paper before the Royal Microscopical Society upon this mysterious genus of Foraminifera, lost sight of for forty years, in which he compared it with other almost legendary organisms, such as the flying squirrel (*Eupataurus*) of Kashmir ; the emu-like bird *Pesophax* ; and the water-rat (*Crossomys*), which was found by Monckton in British Guiana in 1906 and has never been seen or heard of since. Beyond the two original specimens of *Keramosphaera* sent home by Brady in 1874, it was never seen again until 1914 and 1931, when single specimens were recorded from the Antarctic by Pearcey and Wiesner. The original Brady specimens were lost, until Mr. Heron-Allen re-discovered them during the assemblement and systematic rearrangement of the scattered collections of Foraminifera at the Natural History Museum. Thus encouraged, he re-examined the Brady (*Challenger*) material and brought three more specimens of *Keramosphaera* to light. These are illustrated in his paper recently published in the *Journal of the Royal Microscopical Society* (56, 113 ; June 1936). Between the reading and the publication of this paper, two further specimens of *Keramosphaera* were recorded by Mr. A. Earland from some *Scotia* material, which was worked upon, described and illustrated by F. Pearcey many years ago. In his paper, Mr. Heron-Allen directs attention to a partially lost and wholly unpublished paper by his late friend, F. W. Millett, who died in 1915. This paper he found during the sorting, so far as was possible, of the mass of papers and material left behind by Millett on his death in 1915. It deals with the shore sands of Misaki, Japan, and though it was evidently begun and abandoned in 1904, it contains a fortunately full and complete description, with two drawings, of a further species of the genus *Keramosphaera*, to which Millett gave the name *K. densa*. His two beautiful drawings are reproduced in the paper under notice, together with Miss Barbara Hopkins's drawings of the newly discovered specimens, but the type-specimens of *K. densa* have totally disappeared, though Mr. Heron-Allen discovered an empty and damaged slide, which had contained them, among the debris left behind by Millett.

The Trisomic Mutations of *Œnothera Lamarckiana*

Œnothera Lamarckiana is known to have a ring of twelve chromosomes and one free pair. Dr. D. G. Catcheside (*J. Genetics*, 33, No. 1) has determined the various possible primary trisomic mutations which can arise through non-disjunction in these conditions. Thirteen dimorphic forms such as *lata* (giving *Lamarckiana* and *lata* when selfed) will arise from simple non-disjunction. It is shown that double non-disjunction on the same side will produce trisomics which breed true and are therefore called monomorphic. These will number 48 and fall into four categories according to the number of chromosomes between the two non-disjunctions in the ring of twelve chromosomes. A further twelve monomorphic trisomics, called by de Vries 'accessories', correspond with each of the twelve dimorphic trisomics, having an extra chromosome from the ring, thus making a total of 73. The dimorphic trisomics will segregate a monomorphic-I trisomic when selfed, provided it is viable. The latter, pollinated by *O. Lamarckiana*, should produce *Lamarckiana*, the monomorphic and the dimorphic trisomic from which it was derived. This analysis of the possible types of trisomics is confirmed in various cases by the genetical and cytological behaviour of known trisomics, such as *lata*, *albida*, *scintillans*, *oblonga* and *cana*. The whole constitutes a valuable analysis of the possibilities in this type of cytological change.

A New Disease of Mushroom Beds

A SHORT note by Mr. P. H. Williams (*Gard. Chron.*, Aug. 22, 1936) announces the discovery in Britain of a new fungal competitor of the mushroom, previously known only in the United States and Denmark. A truffle, *Pseudobalsamia microspora*, has been found in the casing soil of experimental mushroom beds at the Cheshunt Research Station, and though it does not appear to attack the mushroom themselves, it is a rather serious menace by virtue of its energetic competition for food. This discovery strengthens the plea for sterilizing all casing soil before addition to a mushroom bed.

Solar Temperature

A RECENT article by Messrs. W. W. Coblentz and R. Stair (*Bur. Standards J. Research*, July) sums up the results of their measurements of the energy in the ultra-violet of the solar spectrum within and outside the earth's atmosphere, and the conclusions to be drawn from them. Their measurements are made by means of a standard radio tube and a photoelectric cell, coupled in such a way that, when the cell is illuminated, an audio signal is produced the frequency of which is diminished to one or two per second as the illumination is reduced to zero. The wave-length of the light is restricted by suitable filters, and the tube is coupled to a radio transmitter the frequency of which it modulates. The arrangement is attached to a sounding balloon and sent aloft, and from the signals received from the balloon at different altitudes, the distribution of energy between wavelengths 2900 and 3400 tenth-metres outside the earth's atmosphere is calculated. The graphs show that this distribution is most nearly represented by that of a black body at 4,000° K., and that it is incorrect to assume that solar radiation is identical with that of a black body at 6,000° K.

Invertase and Dyestuffs

J. H. QUASTEL and E. D. Yates have extended their study of the action of dyestuffs on enzymes to invertase acting on sucrose (*Enzymologia*, 1, 60; 1936). The enzyme is inactivated by both acid and basic dyestuffs, though not all are toxic. It is considered that the basic dyes combine reversibly with an anion of the enzyme, the compound being catalytically inactive, whereas acid dyes combine with the cation. Sucrose competes with both classes of dyestuffs for the enzyme. Glucose competes with basic dyestuffs to a greater extent than with acid dyestuffs for the enzyme, whereas with fructose the reverse is the case. The results cited have led the authors to regard invertase to be acting as a *zwitterion* the oppositely charged groups of which are bridged by sucrose: the glucose section is attached to the anion and the fructose moiety to the cation of the enzyme. Such a theory, however plausible in terms of ionic nomenclature, disregards the effect of stereochemical changes in the sugar molecule in rendering invertase inoperative.

Photographing Meteor Trails

IN *L'Astronomie* of May there is an interesting article entitled "Détermination du Radiant de l'Essaim des Étoiles Filantes du 9 Octobre 1933", by S. Arend and G. Camille Flammarion. It describes the results of photographing 25 meteors between $20^{h}\ 03^{m}$ and $20^{h}\ 55^{m}$ at the Observatory of Juvisy. An objective 12·5 cm. in diameter and with focal length 60 cm. was used, and α Lyræ was utilized as the star for guiding purposes. Of 25 recorded trails only 8 were retained, the remainder being either very short or extremely faint. The equations of the great circles for these eight trails were used, and the method of least squares applied to determine the radiant with the greatest accuracy. An interesting comparison is made between the results and those obtained on the same night at the Observatory of Uccle with an exposure of 38 minutes. The computed positions of the radiants were almost exactly the same, at $\alpha = 262{\cdot}29°$, $\delta = 53{\cdot}74°$ (referred to the equinox of 1933.0), after making corrections for zenithal attraction and diurnal aberration. These photographic results gave a very accurate determination of the radiant of the Giacobinids on the night of October 9, and show that the radiant was well defined, not a diffuse area, whereas visual observations led to the conclusion that the radiant was diffuse, due to the observational errors which are almost impossible to eliminate in the usual visual work. This conclusion is very important in view of the fact that wherever meteor work is conducted now by competent observers, there is an increasing tendency to treat the results as provisional and approximate, pending more accurate methods of observation.

Some Properties of Aluminium and its Alloys

PARIS MEETING OF THE INSTITUTE OF METALS

AT the invitation of the Bureau International des Applications de l'Aluminium, the autumn meeting of the Institute of Metals was this year held in Paris, on September 14–19. As a natural consequence of this invitation, the majority of the papers presented for discussion at this meeting dealt with various aspects of the metallurgy of aluminium and its alloys.

CONDUCTIVITY OF ALUMINIUM

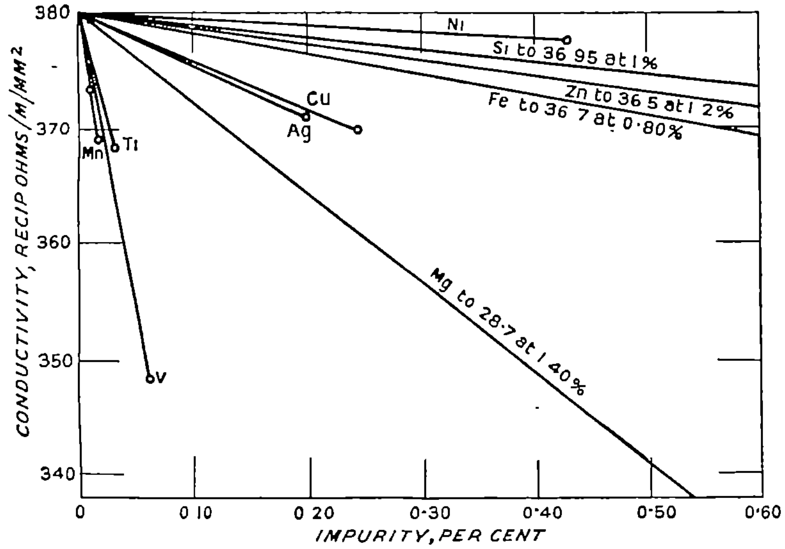

FIG. 1 Mean decrease of conductivity in alloys of aluminium as a function of the content of alloying element added.

The first paper presented, by M. Gaston Gauthier, dealt with the conductivity of super-purity aluminium and the influence of small metallic additions. The aluminium employed in the investigation exceeded 99·99 per cent purity, and the added elements were those which may occur as impurities in commercial aluminium. The high purity of the basis metal made it possible to determine accurately the effect of each one of the added elements in the almost complete absence of other impurities. The accompanying diagram (Fig. 1) summarizes the results; it shows the average decrease of conductivity brought about by the various elements within the limits investigated. It is possible to divide the elements into three groups:

(1) Gold, gallium, nickel, silicon, iron and zinc, all of which have little effect.

(2) Copper, silver and magnesium, which have rather more effect.

(3) Titanium, vanadium, manganese and chromium, all of which exert a considerable effect.

In spite of the precautions taken in preparing his samples, the author's figures do not support Norbury's law, to the effect that the increase in resistivity brought about by the addition of the same number of atoms is larger, the greater the separation between the added element and the basis metal in the periodic system. M. Gauthier is considering whether another generalization cannot be established.

INDIRECT FACTORS

Between the initial development of a light alloy and its general utilization in industry there is usually encountered a number of unsuspected and troublesome factors. The Marquis de Fleury, assisted by Dr. H. Portier, presented an analytical study of these factors and the laws governing them in the course of a paper entitled "The Complex Interdependence of the Properties of Alloys and the Industrial Conditions of their Manufacture, Testing and Use". Factors which are apparently unrelated are shown to be actually so interdependent that a simple modification of one can upset the equilibrium of the whole cycle of the life of a casting. This interdependence has been studied in the particular case of aluminium alloys, although the problem is, of course, the same for all metals. Metallurgists are warned against the unconsidered application of new alloys, and engineers against hasty condemnation of the materials with which they are supplied. In spite of careful forethought, unsuitable applications will be encountered which will throw a prematurely advertised material into disfavour; this is the explanation, according to the authors, of the amazing setbacks to be remembered in the history of the most logical developments.

PROPERTIES AFTER PROLONGED HEATING

An investigation of the strength of pure aluminium and various aluminium alloys after heating for long periods at 75°–300° C. was described by Prof. A. von Zeerleder and Dr. R. Irmann. The strength properties of these materials were also determined in the state of complete stabilization. The heating periods employed extended over approximately two years. After treatments of different duration at elevated temperatures, some specimens were cooled and tested at room temperature, others being tested at the treatment temperature. For complete softening at 250° C., for example (that is, to obtain the properties observed in completely stabilized samples), heating periods of at least six months are required in the case of pure aluminium and Anticorodal, and of more than two years for Avional and 'Y' alloy. A still longer heating time is necessary in the case of the alloy 'R.R. 59'. To determine the decrease in strength of any material after heating for long periods at elevated temperatures it is necessary, therefore, to carry out tests of long duration.

The values of the yield-point observed in the normal short time test after heating periods of one year form a basis for calculations for engineers. The permissible loads can be ascertained only by observation of the creep limit, and this property is being studied by the authors.

ALUMINIUM REFLECTORS

It is well known that the power to reflect incident light is possessed by various metal surfaces to a very varying degree even when such surfaces have been reduced to the same condition so far as possible by grinding, polishing, etc. Not only does the reflectivity vary over the visible range taken as a whole, but it also varies for different wave-lengths and not always in the same manner. The reflectivity of a silver mirror, for example, is very high when measured on the longer waves, but decreases to almost vanishing point over a narrow band in the ultra-violet. In a paper presented by Mr. N. D. Pullen, a description is given of a dual anodic process designed for the treatment of aluminium surfaces in order to produce a high degree of reflectivity. The first bath, in which the electrolytic brightening is produced, is a mixture of sodium carbonate and sodium phosphate in the approximate proportions of 3 : 1 having a strongly alkaline reaction. The second bath, in which a reinforcing film is produced, consists preferably of a strong solution of acid sodium sulphate. Data are given showing the reflectivity of aluminium surfaces treated by this method compared with a standard silver mirror and other surfaces such as chromium plate, nickel plate, etc.

THE FUNDAMENTALS OF FORGING

All metallurgists are familiar with Prof. Portevin's methods of treating the practical problems of industry in a fundamental manner. The complex properties of castability and weldability have been greatly elucidated by his publications in the past, and now, together with his colleague Dr. Paul Bastien, he has applied the same method of treatment to the study of forgeability. In their paper, "Study of the Forgeability of Various Light and Ultra-Light Alloys", the authors have endeavoured to determine, by means of laboratory tests, the optimum conditions for hot-working. With this in view they have compared the results obtained from static bending and compression tests and dynamic bending and tensile tests. They have indicated the important part played by the rate of deformation, and have shown that the bending test appears to be the most convenient, speedy and sensitive. The tests were carried out on aluminium; on copper-aluminium alloys containing 6 and 12 per cent of copper; on aluminium-magnesium alloys containing 5, 10 and 15 per cent of magnesium; on magnesium; on magnesium-copper alloys containing 5, 10 and 15 per cent of copper; and on magnesium-aluminium alloys containing 3, 6 and 9 per cent of aluminium. The methods of testing employed have made it possible to define the capacity for hot-work of these various alloys.

International Quaternary Association

CONFERENCE IN VIENNA

THE Third Conference of the International Quaternary Association (INQUA.) was held in Vienna on September 1–8 under the patronage of Dr. Kurt von Schuschnigg, the Austrian Chancellor, and Dr. Hans Pernter, Minister of Education. Dr. Otto Ampferer, director of the Geologisches Bundesanstalt in Vienna, who is well known for his researches on the interglacial gravels of the Alps, presided over the Organization Committee, and Dr. Gustav Gotzinger was president of the meeting. To these latter and to the genial and multi-lingual secretary, Dr. Helmut Gams of the University of Innsbruck, the meeting owed its undoubted success. That the attendance far exceeded expectations may partly be ascribed to the opportunity of hearing the veteran Prof. Albrecht Penck, who acted as honorary president and spoke on most of the subjects discussed during the Congress.

The geographical situation of Vienna is ideal for such a conference, being accessible without undue travelling to most European nations. To those from the west, the opportunity of seeing a country which, during Quaternary times, took on the character of a pronounced steppe, was a great temptation, and the thick loess deposits of the Austrian Weinviertel north of the Danube came in for much attention. Here in both fossil and recent examples it was possible to study two of the climatically controlled soil types which the researches of Russian scientific investigators have recently brought into prominence, namely, the black-earth or *chernozem* which margins the steppes, and the brown-earth or forest soil of the better-watered areas. This utilization of the physical character and colour of the soil to interpret the climatic conditions under which it was formed is a novelty to glacialists from the leached podsol areas of the north-west, and seems to afford a subtle and useful criterion of changing climate. The main fossil soil zone of the Austrian sections lying between the Younger and Older Loess is locally dated by archæological finds of Aurignacian type just above it, and is therefore presumably of interglacial or Riss-Wurm age, the loess being glacial. These sections were ably demonstrated by Dr. Gőtzinger, who, with others, wrote a descriptive guide book for the Congress.

During the visit to Krems, a halt was made at Spitz in order to be present at the unveiling of the memorial to Josef Beyer, the celebrated Austrian archæologist. On a subsequent visit to Eggenburg, Beyer's collections were inspected in the museum, and those who visited this town will long remember the hospitality of its inhabitants. An excursion in the Austrian Alps on September 9–23 was largely attended and enabled the participators to see the terraces and moraines of the quaternary glaciers and a number of interglacial deposits, including the famous Höttıng breccia.

The difficulties of language were keenly felt by many members of the Congress. Most of the papers were delivered in German, but, one understands, not always in German as spoken north of the Danube. Many were read from manuscript at undue length and at a speed which made them unintelligible to foreigners. It is surely possible to find some cure for this. Much would be gained if authors would make a point of reading their papers in abridged form in some language other than their own. This procedure, which enables preparation to be made, would not be much of a linguistic feat for most members of the Congress and would add greatly to the intelligibility of the proceedings.

There was a universally expressed desire on the part of the members to meet in England at some future date in order to see the classic sections of East Anglia and Yorkshire.

Contributions of Chemistry to Pharmacy and Medicine

THE Hanbury Gold Medal of the Pharmaceutical Society of Great Britain, which is awarded for "high excellence in the prosecution or promotion of original research in the Chemistry and Natural History of Drugs", was presented to Dr. F. Pyman at the opening of the School of Pharmacy on October 7.

Dr. Pyman afterwards delivered the inaugural sessional address, in which he reviewed the contribution made by chemistry to pharmacy and medicine during the twentieth century. He pointed out that whereas medicine has contented itself for many thousands of years with the use of drugs of animal, vegetable and mineral origin and of their simple extracts, it is only within a comparatively short period of the world's history—barely 130 years—that the development of organic chemistry and other sciences has enabled these crude drugs and pharmaceutical preparations to be replaced in many instances by principles isolated from them in the form of pure chemical compounds. This tendency has been reflected in the diminution in the number of crude drugs and galenical preparations included in successive British Pharmacopœias. This isolation of the pure active principles of drugs has been of importance not only as an end in itself, but also as a means of giving the organic chemist opportunities of working on the constitution of these compounds both analytically and synthetically.

Expense may prevent the widespread substitution of the synthesized product for that obtained from natural sources but, Dr. Pyman noted, the improvement in the methods for the production of tropinone by Robinson is at least one example of a laboratory synthesis which has brought the time appreciably nearer when both atropine and cocaine may be commercially available as synthetic products. The extraction of chemical constituents of vegetable drugs has stimulated the search by biochemists for the active principle of biological products. Raw liver taken by sufferers from pernicious anæmia over long periods caused nausea, and many patients were unable to continue the treatment. The work of Cohn led to the introduction of a method by which the activity present in the original liver could be concentrated in a fraction which represented about one thirtieth of the original bulk, while further work has enabled still more concentrated preparations to be made. Attempts to effect still further concentration and to isolate the active principle are making slow progress, firstly owing to the instability of the active principle and secondly to the fact that there is no satisfactory animal test for its efficiency in pernicious anæmia.

The consideration of these researches led Dr. Pyman to review the development of chemotherapy, research in which postulates co-operation between chemist and biologist. It is a commentary upon the difficulties in this field of research that the pioneer work of Ehrlich and Bertheim in 1907 still remains the outstanding example of the application of chemotherapeutic principles. That the laboratory worker will steadily add to the products available for the physician is certain, and there is no doubt that in many directions laboratory products will produce results not otherwise attainable. Nevertheless, the isolation of an active principle does not mean the death of the original vegetable or biological product. Tincture of nux vomica, tincture of digitalis or extract of ergot will have their place in medicine and may well produce physiological effects which cannot be obtained by their isolated active principles.

Educational Topics and Events

Cambridge.—The Central Committee for Agricultural Research Organizations has appointed H. Hunter, of St. Catharine's College, to be director of the Plant Breeding Institute in succession to Sir R. H. Biffen.

The director of the Solar Physics Observatory has made the following appointments: W. Moss, to be first senior observer, J. C. Dobbie, of Trinity College, to be second senior observer, E. G. Williams, of Trinity College, to be first junior observer.

Oxford.—Dr. H. M. N. H. Irving, of Queen's College, has been appointed tutor in natural science at St. Edmund Hall—a new appointment.

Mr. Alec Naylor Dakin, formerly Lady Elizabeth Hastings Scholar of Queen's College, has been elected to the Lady Wallis Budge Fellowship in Egyptology at University College. Mr. Dakin was educated at Heath School, Halifax, and was placed in the first class in Classical Honour Moderations and in the second class in the Final Honour School of *Literæ Humaniores*.

The Right Hon. W. G. A. Ormsby-Gore has been elected to an honorary fellowship at New College. Mr. Ormsby-Gore's work when Under-Secretary of State for the Colonies in a former administration, as well as his archæological writings, which have achieved a wide success, and his work in the preservation of ancient monuments while acting as Chief Commissioner of His Majesty's Office of Works, thus receive well-deserved academic recognition.

Sheffield.—The following appointments have been made: Dr. R. Rado, to be assistant lecturer in mathematics; Mr. T. L. Morgan, to be assistant lecturer in civil engineering; Dr. W. A. Kirkby, to be lecturer in fuel technology.

THE formal opening of the thirty-fifth session of the Sir John Cass Technical Institute took place on the evening of October 6, when an address was delivered by Bishop Paget to those assembled in the Great Hall, which forms a part of the recently erected extension of the Institute. The chairman of the Governors, the Rev. J. F. Marr, who presided, remarked that during the past two sessions, in which the additional accommodation provided by the extension has been in use, the volume of work has increased 15 per cent. This continued expansion is creating a new demand for additional laboratory accommodation for chemistry and biology, and also for lecture rooms for chemistry and physics capable of seating more than 70 students. The policy of fostering research has been followed consistently throughout the history of the Institute and during the past session 35 students were engaged in this type of work. In discussing the financial help which the Institute has received, Mr. Marr referred particularly to the generous support of several of the important oil companies in connexion with the courses in petroleum technology. New developments of the present session include advanced courses in botany of final degree standard and post-graduate courses in biochemistry and chemical engineering. An extension of the course in bacteriology will give additional facilities for post-graduate work. The Principal, Mr. Geo. Patchin, said that, of the 62 students successful at London post-matriculation examinations, 1 obtained the degree of Ph.D., 10 the degree of M.Sc., 5 the B.Sc. degree with first class honours, 6 the B.Sc. degree with second class honours, 15 the pass degree and 1 the B.Sc. Engineering (Metallurgy) degree with first class honours.

Science News a Century Ago

Caroline Herschel and Sir John Herschel

ON October 20, 1836, Caroline Herschel, then eighty-six years of age, wrote from Hanover to Sir John Herschel at the Cape. In the course of her letter she said: "I have four complete years of the 'Astronom. Nachrichten' ready bound for you. . . . I wished to give you the number of the paper (but cannot find it again) where Bessel speaks of Saturn's satellites, but my eyes are so dim and I am too unwell for doing anything. I will therefore only say he has seen the 6th but not the 7th, the ring being in the way. In No. 293 two of Bessel's assistants, Beer and Mädler, say a great deal about the observations of your father, but that goes for nothing. I will only say in general that he did in one season more than any one else could have done, and would have resumed the *hunt* the next fifteen years if nothing had interfered. And the Georgium Sidus was followed as long as anything could be obtained from that planet, and it will yet be some twenty years before he will be in that favourable situation in the ecliptic where he was at the time the satellites were discovered. . . ."

Warwickshire Natural History and Archæological Society

ACCORDING to the *Analyst* (5, 303), the first quarterly meeting of the members of the above society was held at Warwick on October 22, 1826, Sir H. Dryden, Bart., being in the chair. After some preliminary remarks by the chairman, the gathering was addressed by Dean Buckland, who is reported as saying that "the walls of Warwick Castle, the walls of the town, and the walls of the cathedral, were composed of strata till recently unknown to geologists. He saw them twenty years ago, but he did not know what was their composition, but still in his travels he had borne in mind the remains of the animals contained in the strata, in the hope that the time might come when the darkness in which these fragments were eclipsed would be dissipated; and when he should be able to make some important discovery to the scientific world. It was a matter of gratification to him that within the last two hours that darkness *had* dissipated; and he was now able to say that in Warwick—under their feet—and on Guys'-cliff there were the remains of many extinct species and genera of animals, whose names were as yet unuttered in England. . . . He ventured to say with as much confidence as if endowed with the spirit of prophecy, for he knew from geological inspection, and from example added to example, that under this town, Leamington and the surrounding neighbourhood, were the remains of thousands of Elephants, of Rhinoceroses, of Tigers, of Buffaloes, and a variety of other animals which he could enumerate."

Ehrenberg's Microscopical Discoveries

IN its column of "Miscellanea", the *Athenæum* of October 22, 1836, said: "M. Alexandre Brongniart writes from Berlin that a discovery has been made by M. Ehrenberg of a very interesting nature. It is, that the homogeneous rocks, which are not very hard, but friable, easily split, entirely composed of silex, and known under the name of Tripoli, or the Polierschiefer of Werner, are entirely composed of perfectly recognizable skeletons of infusory animals, of the family Bacillaria. . . . These remains having perfectly retained their forms, the siliceous carcases of these infusoriæ are to be seen very clearly in the microscope, and may be easily compared to the living animals as observed and delineated by M. Ehrenberg. In many instances there are no appreciable differences. The species are determined by the form, and more surely by the number of chambers or transversal lines which divide these minute bodies. M. Ehrenberg has been able to count them, by aid of the microscope, and has recognized the same number of divisions in the living and the fossil species."

Spontaneous Combustion

THE *Medico-Chirurgical Review* of October 1836 gives the following account of a case of spontaneous combustion reported in the French Press to have taken place at Aunay in the Department of Avalon: "A very fat woman, aged 74 years, addicted to drinking brandy at 27 degrees, lived alone, and one evening returned home as usual, but, as she did not appear among her neighbours the next morning, they knocked at her door. No answer being returned to repeated demands, they summoned the mayor, who forced the door and exposed a horrible spectacle, accompanied by an extraordinary smell. Near the chimney lay a heap of something burnt to cinders, at the end of which was a head, a neck, the upper part of a body, and one arm. At the other end were some of the lower parts, and one leg still retaining a very clean shoe and stocking. No other traces of fire were to be seen, except a blue flame which played along the surface of a long train of grease, or serous liquor, which had been produced by combustion of the body. The mayor found it impossible to extinguish this flame, and summoned all the authorities; and, from the state of the apartment and comparison of circumstances, it was concluded among them that previous to going to bed, for which she had evidently been making preparations, the woman had been trying to ignite some embers with her breath. The fire communicating with the body by means of the breath, combustion probably took place, and would appear to confirm an opinion entertained by several learned men, that that which is called spontaneous combustion of the human frame never takes place without the presence of some ignited body near the person predisposed to combustion."

Societies and Academies

Paris

Academy of Sciences, September 21 (*C.R.*, 203, 549–572).

Jacques de Lapparent: The generating media of montmorillonite and of sepiolite. Deposits of montmorillonite should be classed as pyroclastic rocks, arising from the devitrification of a magnesian glass. Sepiolite can be produced under analogous conditions.

Douchan Avsec: The experimental verification of the fact, predicted by Lord Rayleigh's theory, of the existence of the stable preconvective regime and on the mechanism of the appearance of convective currents in a gaseous layer, heated uniformly from below.

Roger Tournay: The existence of zinc metaborate. The author has been unable to obtain the zinc metaborate, ZnB_2O_4, of De Carli. The devitrification of the equimolecular mixture always gives two layers, one of which is formed by the borate $2B_2O_3,3ZnO$.

Marcel Prettre: The influence of a chemically inert gas on the velocity of the chain reaction of mixtures of normal pentane and oxygen. Study of the influence of the addition of nitrogen on the oxidation and inflammation between 250° C. and 350° C. of mixtures of normal pentane and oxygen.

Pierre Trunel: The electric moments of some fatty diamines.

André Vialard-Goudou: The oxidation of some organic substances by perchloric acid. From the experiments described it is concluded that the attack of organic materials by perchloric acid is due to the direct action of the acid itself and not to that of its decomposition products.

Joseph Biechler: The organic tricyanomelamines and their relations with the polymerized dicyanimides.

Raymond Guillemet: The aphis of wheat and the effect of their attacks.

Copenhagen

Royal Danish Academy of Sciences and Letters, January 24.

Niels Bohr: Properties and constitution of atomic nuclei. The fundamental discoveries of recent years regarding the transmutation of atomic nuclei, have exhibited the extraordinary facility with which nuclei react with each other as soon as direct contact is established. This circumstance may be brought into intimate connexion with the general properties of nuclei, when it discloses a characteristic difference between the problems of the ordinary atomic constitution and the structure of nuclei.

February 7.

L. S. Fridericia: Influence of a vitamin deficiency on the rate of growth of the incisors of rats.

February 21.

Harald Bohr: A theorem concerning stable motions in the plane.

Elis Stromgren: Ole Römer's meridian observations and the so-called Mayer formula for the correction of the observed time of transit for instrumental errors. Most of our knowledge of Ole Römer's work as a reformer of astronomy is derived from the work "Basis Astronomiæ", edited by Romer's pupil Peder Horrebow in 1735. During recent years, with the aid of Dr. Ræder, a series of chapters of this historically important work has been translated into Danish. These translations have been published in *Nordisk Astronomisk Tidsskrift* and partly also in German in *Die Sterne*. The work is being continued, and the next issue of the *Tidsskrift* will contain an exposition of the question of Romer's meridian observations and of the so-called Mayer formula, which, as has been previously proved by the aid of the Romerian "Adversaria" edited by the Royal Danish Academy, is in reality due to Ole Römer and not to Tobias Mayer.

March 6.

Øjvind Winge: Investigations on linkage in *Pisum*. An attempt is made to map the genes of *Pisum*, on the basis of crossing-experiments involving 17 genes, and the experiments of other investigators. In all, 37 genes are considered. They are provisionally arranged in eight linkage groups, while the chromosome number is only 7. The inheritance of seed weight has been studied. It is found probable that the genes for seed weight generally act upon the linear size of the seed (third root of its weight). Instances of dominance for high as well as for low seed size are also demonstrated. The genes I (yellow cotyledon) and *Pl* (dark hilum) show linkage to genes for seed size.

Knud Jessen: Some new archæological datings in Danish pollen diagrams. Some archæological finds from the passage grave period of the younger stone age and from the Celtic iron age on the Danish isles of Langeland and Als afford an opportunity of fixing the age partly of Zone VIII in the pollen diagrams and partly of a phase in the immigration history of the beech in the southern part of Denmark.

Tokyo

Imperial Academy, July 13 (*Proc.*, 12, 179–204).

T. Nakayama: Note on the sum and intersection of two ideals in an algebra.

M. Moriya: Division algebras over a $\mathfrak{p}$-ad manifold of an infinite algebraic manifold.

M Hasegawa: A statistical study of the type of diurnal variations of terrestrial magnetism on quiet days.

Y. Ōshima: Chemical studies on the tannin substance of Formosan tea leaves. Two crystalline catechins, an amorphous tannin and gallic acid have been isolated and their constitutions determined.

T. Yoshida: The reaction between ammonia and carbon dioxide. The reaction $2NH_3 + CO_2 = CO(NH_2)(ONH_4)$ proceeds only in the presence of water It is a consecutive reaction of the second order, involving the formation of the intermediate complex $NH_3.H_2O$, and has a negative temperature coefficient.

C. Moriya: Notes on the germicidal properties of the soil flat-worm *Rhabditis pellio* Schneider.

K. Kikuchi: A new species of *Diaptomus* from Formosa.

S. Okuda: Description of a new non-motile polychæte, *Thoracophelia ezoensis* n.sp.

S. Hirayama: Germination of pollen obtained from mosaic tobacco plants. Mosaic virus is found to be without effect on the germination.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, October 19

UNIVERSITY OF LEEDS, at 5.30.—Prof. N. V. Sidgwick, F.R.S.: "Resonance in Organic Chemistry".*

Tuesday, October 20

EUGENICS SOCIETY (at the Linnean Society), at 5.15.—Eliot Slater: "The Inheritance of Mental Disorder".*

Thursday, October 22

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—H. T. Young: Presidential Address.

Friday, October 23

INSTITUTION OF MECHANICAL ENGINEERS, at 7.—Sir Nigel Gresley: Presidential Address.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS, at 6.—Annual General Meeting. Prof. C. J. Hawkes: Presidential Address.

Official Publications Received

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh, Session 1935–1936. Vol. 56, Part 2, No. 12: The Brackish-water Lochs of North Uist. By Dr. Edith A. T. Nicol. Pp. 169–195. 2*s.* 3*d.* Vol. 56, Part 2, No. 13: Cytological Studies on the Reproductive Organs—Chromosome Behaviour in the Male Grey Squirrel (*Sciurus carolinensis leucotus*). By Dr. P. C. Koller. Pp. 196–209. 1*s.* 3*d.* (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [189

Imperial College of Science and Technology: Department of Aeronautics. Pamphlet, Session 1936–37. Pp. 6. (London: Imperial College of Science and Technology.) [219

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 39: A Contribution to Knowledge of the Irish Fungi. By Dr. P. O'Connor. Pp. 381–417. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 3*s.* [219

The Iron and Steel Institute. (Special Report No. 15): Second Report of the Steel Castings Research Committee; being a Report by a Joint Committee of the Iron and Steel Institute and the British Iron and Steel Federation to the Iron and Steel Industrial Research Council. Pp. vii+117+38 plates. (London: Iron and Steel Institute.) [219

Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1935. Pp. x+232. (London: H.M. Stationery Office.) 3*s.* 6*d.* net. [229

Forestry Commission. Utilization Series, No. 3: Report on the Demand for Timber in Wood-Turning in Great Britain. Pp. v+53+4 plates. (London: H.M. Stationery Office.) 1*s.* 3*d.* net. [229

Imperial Agricultural Bureaux. Seventh Annual Report of the Executive Council, 1935–1936. Pp. 102. (London: H.M. Stationery Office.) 5*s.* net. [239

Other Countries

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 101: Report of the Proceedings of the Special Scientific Meetings held in May 1936 at Copenhagen. 1ère partie. What Physiological Problems are of Interest to the Marine Biologist in his Studies of the Most Important Species of Fish? Pp. 14. 1.00 kr. 2ème partie: The Measurement of Submarine Light and its relationship to Biological Phenomena. Pp. 64. 3.00 kr. 3ème partie. Comparative Studies of the Fluctuations in the Stocks of Fish in the Seas of North and West Europe. Pp. 90. 4.00 kr. (Copenhague: Andr. Fred. Høst et fils.) [189

Tanganyika Territory: Department of Agriculture. Annual Report, 1935. Pp. 148. (Dar es Salaam: Government Printer.) 4*s.* [219

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 141: On the Relation between the Performance and the Loudness of Sound of an Airscrew. By Jûichi Obata, Sandi Kawada, Yahei Yosida and Umeziro Yosida. Pp. 341–366. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) 35 sen. [219

Society of Biological Chemists, India. Biochemical and Allied Research in India in 1935. Pp. 130. (Bangalore: Indian Institute of Science.) 2 rupees, 3*s.* [219

Royal Agricultural Society. Summarised translation of Bulletin No. 19: The Importance of Phosphoric Acid Supply for Egyptian Crops as illustrated by the Results of the Bahtim Permanent Experiments and Others. By Ahmed Mahmoud. Pp. 86. Bulletin No. 23: The Influence of Size and Weight of Seed upon the course of Subsequent Growth and upon Yield of Wheat. By Dr. M. A. Fikry. Pp. 54+27 plates. (Cairo: Royal Agricultural Society.) [219

Memoirs of the Geological Survey of India. Palæontologia Indica, New Series, Vol. 22, Memoir No. 2: Fossil Mollusca from Southern Persia (Iran) and Bahrein Island. By L. R. Cox. Pp. v+69+8 plates. (Calcutta: Geological Survey of India.) 5.8 rupees; 9*s.* [219

Field Museum of Natural History. Botany Leaflet 18: Common Mushrooms. By Leon L. Pray. Pp. 68. (Chicago: Field Museum of Natural History.) 50 cents. [219

Osiris. Vol. 2, Part 6: La première phase de l'évolution de la théorie des quanta. Par L. Rosenfeld. Pp. 149–196. Vol. 2, Part 7: Scope and Development of Indian Astronomy. By Sukumar Ranjan Das. Pp. 197–219. Vol. 2, Part 8: An Alchemical Manuscript by Arnaldus de Bruxella. By W. J. Wilson. Pp. 220–405. Vol. 2, Part 9: The Unity and Diversity of the Mediterranean World. By Dr. George Sarton. Pp. 406–463. (Bruges: The Saint Catherine Press, Ltd.) [219

Det Norske Videnskaps-Akademi i Oslo. Astrophysica Norvegica. Vol. 2, No. 2: Schwingungen und Wellenbewegungen in einer Atmosphäre mit nach oben abnehmender Temperatur. Von H. Solberg. Pp. 123–172. Vol. 2, No. 3: On the Theory of Rotating Stars, I. By S. Rosseland. Pp. 173–191. (Oslo: Jacob Dybwad.) [219

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 756: Surface Water Supply of the United States, 1934. Part 1: North Atlantic Slope Basins. Pp. x+383. 45 cents. Water-Supply Paper 757: Surface Water Supply of the United States, 1934. Part 2: South Atlantic Slope and Eastern Gulf of Mexico Basins. Pp. vii+216. 25 cents. Water-Supply Paper 758: Surface Water Supply of the United States, 1934. Part 3: Ohio River Basin. Pp. x+387. 50 cents. Water-Supply Paper 767: Surface Water Supply of the United States, 1934. Part 12: North Pacific Slope Basins. A: Pacific Slope Basins in Washington and Upper Columbia River Basins. Pp. vi+172. 20 cents. (Washington, D.C.: Government Printing Office.) [219

U.S. Department of the Interior: Geological Survey. Bulletin 847–D: Phosphate Rock near Maxville, Philipsburg and Avon, Montana. By J. T. Pardee. (Contributions to Economic Geology, 1934–36.) Pp. ii+175–188+plates 28–34. 20 cents. Bulletin 852: The Book Cliffs Coal Field in Emery and Grand Counties, Utah. By D. Jerome Fisher. Pp. iv+104+15 plates. 75 cents. Bulletin 863: Geology of the Salt Valley Anticline and Adjacent Areas, Grand County, Utah. By C. H. Dane. Pp. v+184+21 plates. 1 dollar. Bulletin 867: Geology of the Coastal Plain of South Carolina. By C. Wythe Cooke. Pp. v+196+18 plates. 60 cents. (Washington, D.C.: Government Printing Office.) [219

Report and Balance Sheet of the National Botanic Gardens of South Africa, Kirstenbosch, Newlands, Cape (and the Karoo Garden, Whitehill, near Matjesfontain) for the Year ending 31st December 1935. Pp. 32. (Kirstenbosch: National Botanic Gardens.) [229

Union of South Africa: Department of Mines. Geological Series, Bulletin No. 7: Some Magnetometric and Gravimetric Surveys in the Transvaal. By O. Weiss, D. J. Simpson and G. L. Paver. Pp. 27+9 plates. (Pretoria: Government Printer.) 2*s.* [229

Royal Agricultural Society, Egypt. Bulletin No. 26 of Technical Section and No. 4 of Royal Agricultural Society, Imperial Chemical Industries, Ltd., and I. G. Farbenindustrie Aktiengesellschaft Joint Agricultural Research Scheme: Experiments in Egypt on the Interaction of Factors in Crop Growth. 4: Nitrogenous and Phosphatic Manuring of Cotton and their relation to Variety and Spacing. By Frank Crowther, Adolf Tomforde and Ahmed Mahmoud. Pp. 46. (Cairo: Royal Agricultural Society.) [229

R. Osservatorio Astrofisico di Catania. Annuario 1935. Pp. 60+10 plates. (Catania: R. Osservatorio Astrofisico.) [229

University of Illinois: Engineering Experiment Station. Bulletin No. 283: A Study of the Reactions of various Inorganic and Organic Salts in Preventing Scale in Steam Boilers. By Prof. Frederick G. Straub. Pp. 118. 1 dollar. Bulletin No. 284: Oxidation and Loss of Weight of Clay Bodies during Firing. By William R. Morgan. Pp. 42. 50 cents. Bulletin No. 285: Possible Recovery of Coal from Waste at Illinois Mines. By Prof. Cloyde M. Smith and Prof. David R. Mitchell. Pp. 44. 50 cents. Bulletin No. 286: Analysis of Flow in Networks of Conduits or Conductors. By Prof. Hardy Cross. Pp. 32. 35 cents. Circular No. 26: Papers presented at the First Annual Conference on Air Conditioning, held at the University of Illinois, May 4 and 5, 1936. Pp. 154. 50 cents. Reprint No. 6: Electro-Organic Chemical Preparations. By Sherlock Swann, Jr. Pp. 385–440. 35 cents. Reprint No. 7: Papers presented at the Second Annual Short Course in Coal Utilization, held at the University of Illinois, June 11, 12 and 13, 1936. Pp. 163. 1 dollar. Reprint No. 8: Second Progress Report of the Joint Investigation of Fissures in Railroad Rails. By Herbert F. Moore. Pp. 15. 15 cents. (Urbana, Ill.: University of Illinois.) [259

Journal of the Federated Malay States Museums. Vol. 8: An Expedition to Korinchi Peak, Sumatra (1914). Part 1. Edited by H. M. Pendlebury. Pp. 31+15 plates. (Kuala Lumpur: Selangor Museum.) [289

Forestry Pamphlet No. 4: Notes on the More Important Timber Trees of Trinidad and Tobago. Pp. 17+25 plates. (Trinidad: Government Printing Office.) 12 cents. [289

International Institute of Agriculture. Bibliography of Tropical Agriculture, 1935. Pp. vii+256. (Rome: International Institute of Agriculture.) 10 lire. [289

Government of India: Department of Industries and Labour. Irrigation in India: Review for 1934–35. Pp. 47. (Delhi: Manager of Publications.) 1.8 rupees, 2*s.* 6*d.* [309

Catalogues

Science in the XIXth Century: The Beginnings of Modern Physics, Electricity, Telephone, Telegraph, Wireless; Chemical Systems and Spectrum Analysis; Development of Transport and Industry, Photography; Evolution; Advance in Medicine. (List No. 22.) Pp. 40. (London: E. P. Goldschmidt and Co., Ltd.)

Dunns Seed Wheats. Pp. 24. (Salisbury: Dunns Farm Seeds, Ltd.)

Petrological Microscopes. (Section 'C'.) Pp. 20. (London: James Swift and Son, Ltd.)

Priced Catalogue of B.D.H. Laboratory Chemicals. Pp. 200. The 'Carbosorb' Brand of Soda Lime and Soda Asbestos. Pp. 4. (London: The British Drug Houses, Ltd.)

Dulau's Catalogue of Botanical Books. (No. 249.) Pp. 40. (London: Dulau and Co., Ltd.)

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The Social Mission of Science

NOTHING has been more striking in the recent meetings of the British Association at Blackpool than the general indignation at the prostitution of the results of scientific inquiry for purposes of warfare, and the concern at the spread of political systems which reduce science itself and other of the richest elements in our intellectual heritage to servitude.

The opening address on cultural and social values of science (see NATURE, October 3, p. 594) with its emphatic repudiation of the inhumanity and insane misuse of science in the extension of aerial warfare to the destruction of cities and the killing and maiming of women and children by poison gas, incendiary bombs and high explosives, against which the only real defence is by retaliation, found echoes in the presidential address to Section G (Engineering) as in that of Prof. Philip to Section B (Chemistry). Sir Daniel Hall, speaking on science and social organization, uttered a grim warning that while of old every autocracy ended in a revolution, the chances of its successful overthrow in the face of guns and gas to-day are very different. Moreover, control by force is being reinforced by a subtler technique of subduing minds until the population is content to be slaves.

Prof. H. J. Fleure, in a further address on the science of man and the problems of to-day, urged the claims of science and intellectual freedom against aggressive and reactionary doctrines, nationalist and others, which are put forward to-day, and, like Dr. J. S. Huxley, strongly criticized the pretensions which attempt to erect fanatical racial hatred to the dignity of a science. Equally, Lord Horder emphasized the death which the totalitarian systems brought to the scientific spirit and the dangers which attend the sacrifice of individual freedom.

On many of the great issues of the modern world, the Blackpool meeting has made it plain where scientific workers in Great Britain stand. That they have not been unmindful of the responsibility to which the recent report of the University Grants Committee referred, is a hopeful sign; and it is well to remember that many of the addresses could scarcely have been delivered in some other European countries without disastrous consequences to the speakers. Even Sir Henry Dale's plea for support of tropical medical research more commensurate with our territorial responsibilities, for example, would almost certainly have been suppressed, in other circumstances, as detracting from the idea that the State can do no wrong.

It may be said, of course, that denunciation and demonstration are not enough, and in some of the speeches efforts were made to point out definite lines of advance. Scientific workers as such, however, can have no final power over policy, national or international; and without disparaging the need for practical proposals and definite organization, in which others besides scientific workers can participate, to prevent the infamous use of scientific work, it is well to remember that science has a spiritual message which her followers must give regardless of whether others heed its warnings or not.

This message of science also found welcome expression in discussions at the British Association meetings. The influence of science upon material progress and human comfort is much more commonly understood than its effect upon the human mind. To-day it is difficult to realize the liberation of life and intellect brought about by the works of Copernicus, Galileo and other pioneers of experimental philosophy. The principles of self-determination and self-government now accepted as democratic rights are indeed social effects of the independence of scientific inquiry involved in the new philosophy. The freedom of thought and action possessed by progressive peoples are direct consequences of the work of Galileo and other founders of experimental science.

Accordingly, it is well that scientific workers should take up the challenge which modern autocracies offer, not only to science itself but also to all that is best in man's heritage of culture. It is not for nothing that one after another of the speakers who followed Sir Richard Gregory in the discussion on cultural and social values of science deplored the decline of democracy and enlightened outlook. The whole discussion demonstrated the deep and wide respect still to be found for liberal culture, and the strength of the support which could be secured for positive action by a successful co-ordination of those connected with all cultural activities. In another discussion, on the strain of modern life, Lord Horder even more explicitly asserted his faith in the individual and in the enormous potentialities of the human spirit, maintaining that a rebirth of this spirit in British political life would be one of the best medicines our strained lives could have administered to them.

When individual freedom had been sacrificed, Lord Horder saw little chance of achieving the control through which alone he believed salvation could come to the human race. Chief among the remedies for the ill-effect of the strain of modern life he placed science, and especially science directed toward the study and development of the mind and spirit of men. So, too, Prof. Fleure pleaded for the scientific study of mankind as essential if society is to advance. Disregard of its teachings is one cause of the dislocation and disturbance which are baffling us all. Like Sir Daniel Hall, he also entered a fine plea for freedom of conscience and self-control in action on scientific grounds as the life-breath of policy and science. We cannot restrict scientific thought and imagination to defined spheres: sooner or later it must intrude everywhere.

The true aim of science is the enrichment of life, and the specific value of an education based on science is that it will encourage, if not create, a habit of acting on reason rather than emotion. Moreover, such an education could destroy the dangerous delusions which loyalties of party, country and religion are apt to foster, and teach people from their earliest years that men and women, however diverse as individuals, are collectively very much alike, and for this purpose a scientific education is more effective than a purely literary education. Science taught, not as an aid to a vocation but as part of the training of a modern citizen, may develop a habit of mind as ethical as that usually only associated with the study of what are called the humanities.

Apart from this, the cultural claims of science, as Prof. L. Hogben has pointed out, rest on the social fact that the use and measure of science intimately affects the everyday life of every citizen in a modern community. Education for citizenship, in fact, demands a knowledge of how science is misused, of the ways in which we fail to make the fullest use of science for our social well-being, and some vision of what human life could be if we planned our resources intelligently.

The cultural and spiritual claims of science need such emphasis if scientific workers are ever to make the full constructive contribution to the solution of the world problems of to-day which lies within their power. It is well, therefore, that such emphatic warnings should be uttered against the mass movements which now threaten the finest elements in the national life of almost every country. Without criticism the very life of society is stifled, and descent to the community of soldier and worker is rapid. Only as we can enlist the citizen in the constructive task of using wisely the new powers which science has placed at our disposal can we hope to preserve what is best in the world's heritage of culture, let alone to add to it.

This is the task of science in the education of the citizen. Before a new world-wide social order can be built up worthy of the limitless powers which the advance of science has put into the hands of men, the general community and its leaders must be persuaded that acquaintanceship with scientific forces is an essential condition of enlightened government. Without an adequate scientific background, it is impossible to evolve a social and political system in which progressive knowledge is used for the wisest and best purposes.

Even though some scientific workers may regard it as of little use to protest against the use of scientific knowledge in implements of war, they should not be unmindful of the necessity for science first to deliver her spiritual message regardless of whether it is heeded or not, and for her followers to seek to achieve the educational work which is an essential condition of transition to a better order. The misgivings expressed at Blackpool find support from such wide quarters as at Washington, in Mr. Cordell Hull's address to the delegates at the World Power Conference, in meetings of chemists at Bangalore, among scientific workers at the University of Cape Town, Cambridge and elsewhere; and they indicate that scientific workers are becoming ready to study these questions intensively, and either to develop an organization through which an effective common policy is possible or secure a re-orientation of existing organizations that would be equally effective. Nowhere is this feeling stronger than in Great Britain and the Dominions Overseas and in the United States of America, and the revived interest in the effect of science on society, as well as the quickened concern displayed at the British Association meetings at the use of science in the growing preparations for war, embolden the hope that a *rapprochement* for some such purpose as this between the British Association and the American Association for the Advancement of Science may not be impossible or impracticable.

The Rise of Man

Man makes Himself

By V. Gordon Childe. (The Library of Science and Culture.) Pp. xii+275. (London: Watts and Co., 1936.) 7*s*. 6*d*. net.

PROF. GORDON CHILDE has a sense of perspective in time, which has been developed to a degree exceptional even among archæologists, who juggle with millennia; and he is little more restricted in space, for he ranges from the north of Scotland to the Valley of the Indus with a familiarity which few may emulate. He is, therefore, in a position to recommend with confidence the study of archæology as an antidote to those modern pessimists, who are disposed to doubt the soundness of the foundations upon which the belief in 'progress', inherited from the late nineteenth century, takes its stand. Neither 'age', nor century, he argues, and equally no single area marked out by geographical or national limitations, can afford material adequate for such a judgment. The impartial inquirer must survey all time, and take the whole world as his province, before he ventures to pronounce upon the trend of events in present-day civilization.

However, even if the scope of inquiry in any estimate of modern development be extended to the broadest limits possible, the impartial point of view of a scientific investigator demands an objective standard by which 'progress' may be measured. As is well known, the judgment of the historian is apt to be coloured by his ideals—or prejudices; and essays in formulating an objective test, such as "an increased command over the material resources of Nature", are liable to be called into question. Prof. Childe offers as his objective standard the evolutionary principle of "survival of the fittest", which has the obvious merit that it links the study of man with biology and palæontology, and at the same time, as interpreted by him, bridges the awkward gap between physical and cultural, which has proved a stumbling block in much theorizing. Recognizing the ambiguity, or rather lack of content, in "the fittest", he interprets his criterion of progress as an increased capacity to enable members of the species to survive. In other words, the effect of any real advance in human development, physical or cultural, is shown in a consequent increase in population, as in the sharp rise in the population curve characteristic of the years which followed the Industrial Revolution of the early nineteenth century.

In the demonstration of the content of 'progress' which follows as a necessary corollary to his test of advance in the development of man, Prof. Childe shows that prehistory affords evidence of the occurrence of a succession of revolutions comparable to the Industrial Revolution, and of no less importance in the history of civilization. Some, indeed, almost certainly must have produced more far-reaching consequences than anything of which we know in recorded history. Here he elaborates suggestions which he put forward recently in his presidential address to the Prehistoric Society. He then pointed out that while the divisions of prehistory, the Stone, Bronze and Iron Ages, have lost the general and absolute chronological significance once attached to them, and as dates must now be regarded as applying only within restricted areas and under definite limitations, they are still significant as indicating certain crucial economic changes, which affect the whole character of the civilization of the time. In "Man makes Himself", this conception is worked out in some detail. Prof. Childe shows how the domestication of animals and plants initiated the neolithic economy and the growth of the village community, while the introduction of metals necessitated an increased specialization in prehistoric industry and commercial intercourse, which paved the way for the growth of an urban civilization, and thus ultimately of the great national and imperial organizations of the Ancient East.

An outline of the argument which forms the thread of Prof. Childe's book does less than justice to his vivid interpretation of archæological evidence as a growth of civilization and a network of interrelated cultural developments. His incidental reflections are both inspiring and delectable. In this connexion may be mentioned a timely caveat against attributing ideas and concepts to prehistoric man, which cannot be inferred directly from the archæological evidence, but rest on the analogy of primitive peoples of like culture. Prof. Childe does not believe that the Australians, for example, stopped thinking for perhaps thousands of years. May it not be, however, that a people who had attained a state of stable equilibrium in material culture, as apparently had the Australian aborigines, had also attained the limit of development in idea in that environment at an equally early stage. There is evidence of such an early arrest among certain peoples of North America. The problem needs further examination. At present the evidence is too scant for final judgment; but Prof. Childe's warning is none the less valid.

In his more strictly professional work, Prof. Childe has shown himself a master of closely reasoned archæological argument. He now gives proof that he is equally at ease in exposition on a large scale and in general terms. His professional colleagues will find his book a brilliant and stimulating study, while to the layman it will serve as a lucid interpretation of an intricate subject-matter. With Prof. Childe as tutor, none could question the value of archæological studies as an academic discipline, or as a practical guide to an understanding of the course of events in the life and development of man.

History of Science and Mathematics

(1) The Study of the History of Science
By Dr. George Sarton. Pp. v+75.
(2) The Study of the History of Mathematics
By Dr. George Sarton. Pp. v+113.
(Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1936.) 1.50 dollars each.

THESE volumes represent the substance of two inaugural lectures, (1) on the establishment of a seminary of the History of Science at Harvard University, (2) preliminary to a course of lectures on the history of mathematics. Apart from appendixes, they cover 52 and 38 pages respectively. It is observed that the history of science as an independent subject is a comparatively new study, and that, although some historical efforts were made so early as the fourth century B.C. by Aristotle's pupil, Eudemus of Rhodes, and were continued by later Greeks, while there have come down to us from the Middle Ages and modern times a whole series of writings in Arabic, Latin and other languages which might be catalogued under the heading "History of Science", nevertheless the first scholar to conceive of that subject as an independent discipline was Auguste Comte (1798–1857), and the first scholar who deserves perhaps more than any other to be called the father of the study was Paul Tannery (1843–1904). Even Tannery could write, so late as 1904, that the history of science is "nothing but an individual conception", by which he meant that it was not yet represented by a series of standard works, constituting the tradition of a definite and independent subject.

Tannery may not have been acquainted with William Whewell's "History of the Inductive Sciences from the earliest to the present times" (3 vols., 1837). This was, however, a collection of special histories, vol. 1 dealing with Greek physics, Greek astronomy, medieval physics, and astronomy from Copernicus to Kepler; vol. 2 with the history of mechanics, physical astronomy, acoustics, optics, "thermotics" and "atmology"; vol. 3 with other branches of physics, chemistry, natural history, physiology, comparative anatomy, and geology; but these histories were not brought into relation with one another so as to constitute one picture illustrating "l'évolution de l'humanité", or the progress of mankind. At the present time, what is being aimed at is rather a complete history of 'scientific thought', with the histories of the particular sciences thrown in, as it were. So far, apparently only one modern and complete treatise of this kind exists: Friedrich Dannemann, "Die Naturwissenschaften in ihrer Entwicklung und in ihrem Zusammenhange" (4 vols., second edition, Leipzig, 1920–23). Others have been begun, two of which should be mentioned: Federigo Enriques and G. de Santillana, "Storia del pensiero scientifico", vol. 1, Milano, 1932, and "Histoire des sciences" by Pierre Brunet and Aldo Mieli (of the Académie Internationale d'histoire des Sciences), vol. 1, Paris, 1935. It is claimed that the latter work will be unique in its kind; the first volume contains 1224 pages and covers the whole of antiquity and the beginning of the Middle Ages [see NATURE, October 10, p. 630].

Dr. Sarton's volume on the study of the history of science discusses generally the nature of the qualifications required by the scholar who would write a competent history of science, and the alternative points of view from which it might be written, involving different arrangements of matter; he adds warnings as to the pitfalls of various kinds against which the writer must guard himself. For example, the date of a discovery may be different from that of its publication: it may have been communicated earlier by word of mouth to a society or a circle of friends; the date given in the colophon to an old printed book has occasionally been shown to be wrong; even the particulars as to date of death or age on tombstones have sometimes been found to be inaccurate; the historian must verify everything.

The historian of science must have some acquaintance with the whole field of advancing knowledge. "One of the most pernicious types of error to which a false or shaky knowledge of living science frequently leads is the reading of modern conceptions such as atomic ideas, energy, evolution, into ancient texts." To appreciate a scientific text fairly, it is not enough to know how much of it is true from our more advanced point of view; we must find out how much of it was considered true or would appear plausible at the time of its composition, what led up to it, what was its influence; in short, it must be placed "as exactly as possible within the complicated network of our traditions".

A difficulty arises as to the relative amount of space to be given to different periods. Dr. Sarton observes that the tendency with some scientific workers is to divide the past not into periods of equal length, but into periods of equal productivity. On that basis, "the ancient times and the Middle Ages are entirely sacrificed to our more immediate past, when the slow gestation of centuries and millenaries was suddenly followed by an amazing outburst of discoveries".

The difficulty in the allocation of space is illustrated by the case of mathematics. Cantor's great history of mathematics was in four large volumes approximately equal in size and extending to about 4,000 pages in all. The first volume covered the period from the beginnings to A.D. 1200, the second A.D. 1200–1668, the third A.D. 1668–1758, and the fourth (which had to be written by a group of specialists under Cantor's direction) A.D. 1759–99. The growth of mathematics during the nineteenth and twentieth centuries has been so enormous that a history on the same scale could scarcely be contemplated. The late Prof. Cajori calculated that a history of nineteenth century mathematics (alone) on that scale would need some fourteen or fifteen additional volumes. The remedy lies in an alteration of the scale. "As only a fraction of the ancient mathematical writings have escaped destruction, any fragment, however insignificant, is very valuable, while for modern mathematics our task must be, on the contrary, to eliminate the great majority of the available writings and consider only a few". A general history in reasonable compass is that of Gino Loria, "Storia delle matematiche", in three volumes (1929), the first of which covers the period up to the Renaissance, the second the sixteenth and seventeenth, and the third the eighteenth and nineteenth, centuries; the last volume contains a good general account of modern mathematics.

As a practicable way of diffusing a knowledge of the history of modern mathematics, Dr. Sarton suggests that it should be the duty of instructors teaching special subjects to explain their history. He illustrates this idea by the theory of elliptic functions. If the teacher, in tracing the development of the subject, introduced the main creators of it, Fagnano, Euler, Lagrange, Legendre, Gauss, Abel, Jacobi, Clebsch, Kronecker, Halphen, and if he did this part of his task well enough, his audience would become familiar with some of the leading mathematicians of the last century. Similarly with other subjects taught in the universities to advanced students.

The volumes before us conclude with classified bibliographies for the history of science and the history of mathematics respectively, covering 16 pages in the first case and 25 in the second, besides notices of the greatest mathematicians of the nineteenth and twentieth centuries to the number of 118, with references to the best available biographies, editions of their collected works and editions of their correspondence in each case. These appendixes should prove extraordinarily useful.

T. L. H.

Biography of Coffee

The Saga of Coffee:
the Biography of an Economic Product. By H. E. Jacob. Translated by Eden and Cedar Paul. Pp. 384 + 27 plates. (London: George Allen and Unwin, Ltd., 1935.) 15*s.* net.

COFFEE has had much to contend with since its use as a stimulant was first made known to the world, and this biography of coffee deals in a very readable way with its vicissitudes during the last four to five hundred years, and with its influence on the development of western civilization.

The author first conceived the idea of writing the economic history of this product after seeing the bonfires of coffee at Santos which have been inaugurated by the Brazilian Government to meet the menace of serious over-production. It has been stated that 600,000 bags of coffee are destroyed every month in this manner.

How coffee-drinking and coffee houses were objected to by religious, political and medical bodies, how they were opposed by the ordinary taverns and the interests of the wine and beer trades, and how they were taxed for revenue purposes make fascinating reading. So also does the influence of coffee-production on colonial expansion in the tropics by the Western nations—the Netherlands in the East Indies, France in the West Indies, Portugal in Brazil, and, later, Great Britain in Ceylon.

The author, writing of the competition of tea and its popularity in Britain, makes a serious error in attributing this to the British conquests in India in the early part of the eighteenth century. No tea was produced in India until a century later, and only then were attempts made to grow it there because the East India Company feared trouble in China, which was the only source of supply. The first tea from India was sent to Great Britain in about 1840. At the period mentioned by the author the Dutch held the monopoly for spices and coffee in the East, and the British—who were there only as traders—were forced to bestow their attention on other commodities, of which tea from China was one of the most important.

Emulsions: Theory and Practice

The Theory of Emulsions and their Technical Treatment
By Dr. William Clayton. Third edition. Pp. ix + 458. (London: J. and A. Churchill, Ltd., 1935.) 25*s.*

DR. CLAYTON'S book on "Emulsions" has been transformed completely since the first edition was issued in 1923. Indeed, an inspection of the references shows that a very large proportion of the contents of the present volume is of later date than the second edition issued in 1928. The present volume may therefore be considered in most of its aspects as if it were a new publication.

The earlier chapters are naturally devoted to the fundamental principles of surface-phenomena, including air-liquid and liquid-liquid interfaces, which play so large a part in the production and stabilization of emulsions. Since water-in-oil emulsions are not formed, and stable emulsions of pure oil-in-water are limited to particles of the order of 10^{-6} cm. and to a maximum concentration of 1 in 10,000, the formation of emulsions depends on the presence of an emulsifying agent. These were formerly hydrophilic colloid such as gelatine; but in more recent years sulphates and sulphonates and sulphinates of known structure, and bases such as triethanolamine, $N(CH_2.CH_2.OH)_3$, have been used extensively.

Properties and theories of emulsions occupy two considerable and well-illustrated chapters, in which the recently defined property of 'thixotropy' plays an appropriate part; and inversion of phases is discussed in a chapter on dual emulsions. The problem of emulsification forms the subject of two chapters, concluding with a substantial section on the important process of 'homogenizing' milk and cream; but the converse process of de-emulsification is discussed in a separate chapter in which the majority of the references are of recent date, and an appendix is devoted to the separation of technical emulsions, with special reference to crude oil-field emulsions.

The practical character of the book is maintained throughout the new edition and is one of its most valuable features. Thus whipped cream is discussed in Chapter ii, and churning and separated milk in Chapter xii, whilst the whole of Chapter viii is devoted to biological investigations of milk, etc. Chapter ix is similarly devoted to miscellaneous emulsions, including emulsified bitumen as a road dressing, emulsified oils and fats as leather dressings, margarine and salad dressings as edible emulsions, with brief references to the delustring of rayon, the sizing of paper, and the preparation of agricultural sprays.

Author and subject indexes are provided, but the latter fails to guide the reader to clear definitions of terms such as cybotaxis, dineric interface and thixotropy, which may be cited as cases where it would be of real value to quote the first usage of names which are relatively new in the literature. The new edition is of obvious merit and is likely to prove indispensable even to those who already possess one of the earlier issues.

Animal Life in the Forth Area

A Vertebrate Fauna of Forth
By Leonora Jeffrey Rintoul and Evelyn V. Baxter.
Pp. lv + 397 + 16 plates. (Edinburgh and London: Oliver and Boyd, 1935.) 25*s*. net.

HALF a century ago, Harvie-Brown projected a great co-operative work on the vertebrate fauna of Scotland, each volume to deal with one of the zoo-geographical divisions delimited by the principal watersheds and other natural boundaries. The greater part of the scheme was accomplished, with valuable results, but some gaps remained: one of these has now been filled, through the successful undertaking by Misses Rintoul and Baxter of the task which William Evans did not live to complete. Considering the great disparity in time, the unity of the series is chiefly important on the historical side, and as a contemporary account the new book must stand on its own merits. It can well do so.

This volume on "Forth" is, indeed, of value from much more than a local point of view. It deals with a highly interesting region, which constitutes almost a cross-section of Scotland at the junction of Lowlands and Highlands, and includes a wide variety of country. The region consists of the drainage area of the River Forth, and of all the lesser streams that flow into its great estuary between St. Abbs Head and Fife Ness. On the map it appears roughly Y-shaped, two long arms enclosing the Firth of Forth and a shorter stem following the valley to its head. On the east it has its island outposts such as the Bass Rock, and on the west the land rises above 3,800 feet at the summit of Stobinian. The whole of three counties and large parts of five others are included, with fragments of three more.

There is thus a great diversity of environment, from the waters of the firth with their seals and gannets to the high mountains with their blue-hares and eagles. There is, too, the added interest attached to a transitional zone: it approaches, for example, the northern limit of the garden-warbler and includes the most southern point in the range of the Scottish ptarmigan. Birds, of course, bulk more largely in the book than all the other vertebrates together: the fishes are rightly dealt with quite briefly, as the purely marine forms cannot be very usefully discussed on this regional basis. The major interest is therefore inevitably for the ornithologist.

The two experienced naturalists who have written the book are well equipped for the purpose. They have lived all their lives in the area, giving much time to study of its fauna, and they have already made numerous and notable contributions to the subject. During the last ten years, moreover, they have systematically worked the area with the special object in view, visiting all parts at every season. The statements as to present status and distribution are therefore based to a remarkable extent on first-hand observation —although the help of others has also been freely used—and are definite, comprehensive and up to date. As was to be expected, the authors are particularly informative regarding migratory movements of the birds: in a special chapter they deal generally with this topic, and throughout the avifaunal section are to be found the abundant results of their well-known work on the Isle of May.

As it fortunately happens, there is also available a wealth of information relating to earlier times, and the published sources of this have been diligently and critically examined. It has thus been possible to present some picture of the effects which changes in the environment have wrought upon animal life in the area: a special chapter is devoted to this aspect, and there are also numerous references in the main body of the work which bring out points of much interest.

The modern standard for regional faunistic studies is a high one; but Miss Rintoul and Miss Baxter have produced a volume which can take its place among the very best of its kind. A. L. T.

The Systematic Identification of Organic Compounds:

a Laboratory Manual. By Prof. Ralph L. Shriner and Prof. Reynold C. Fuson. Pp. ix+195. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 11*s*. net.

INTEREST in organic identification work in the University of Illinois was first aroused by Prof. C. G. Derick in 1908, and the course was developed by Prof. O. Kamm, whose book on the subject, published in 1922, is widely known. The present volume is based on a one-semester course of two three-hour laboratory periods a week, now in force at the University of Illinois for students who have had a year of organic chemistry.

By means of a systematic examination of its solubility relationships, the unknown organic compound is relegated to one of nine solubility classes. Classification reagents are then introduced, and the search is narrowed to members of a few homologous series. Physical constants are next noted, and suitable derivatives are prepared. The subject is handled on these lines in a clear and up-to-date manner, and the book contains full practical directions, and many tables of physical constants. A later chapter deals with the separation of mixtures.

The authors have provided a useful manual for a type of work in which "the student's faculty for careful observation, his ability to make correct deductions from his observations, and his originality in planning his work are at a premium". It is clear that this sort of training provides excellent experience for those preparing for research work in organic chemistry.

Industrial Electronics

By F. H. Gulliksen and E. H. Vedder. Pp. xiv+245. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1935.) 17*s*. 6*d*. net.

IF the reader is not full of wrath when he discovers, by diligent search or by stumbling over a single sentence on page 41, that this book denies communication engineering a place in industry ("This type of equipment is used primarily for communication purposes, which is outside the scope of this book"), he will like it; its English is in general well above the level of the unhappy example which has intruded itself here. Even without its applications in the communications industry, "industrial electronics" is a wide subject of very general appeal. The engineer will find the book interesting and valuable, not merely for the large amount of detailed information which it provides on applications already effected, but also because it is stimulatingly suggestive of new applications and developments yet to be made. The authors have succeeded in compressing a great deal of information into a relatively small compass, but the compression has been carried too far; clarity and ease of reading have been sacrificed. Fig. 85, p. 67, will suffice as an example of loss of clarity which might have been avoided by adding three lines of text.

Among the applications outlined are light-sensitive controlling, indicating and recording devices (such as door controllers, smoke indicators, colour matchers), timing devices for welders, rectifiers and inverters, etc. A final and valuable section of the book deals with electronic regulators, including anti-hunting circuits, speed and voltage regulators, etc.

The book is well worth reading; its very defects stimulate thought.

Der Schwammspinner (*Porthetria dispar* L.) in Euroasien, Afrika und Neuengland

Von Dr. Karl E. Schedl. (Monographien zur angewandten Entomologie, herausgegeben von Prof. Dr. K. Escherich, Nr. 12.) Pp. iv+242. (Berlin: Paul Parey, 1936.) 16 gold marks.

THE main idea, underlying the production of the monographic series to which this memoir belongs, is to provide the latest and fullest scientific information with respect to specific subjects of economic importance. The purely scientific and economic aspects of entomology now intergrade so much that Dr. Schedl's contribution, like its predecessors, contains matter of interest to workers in both these fields. Its subject is the insect known in English as the gypsy moth which, although now extinct in Great Britain, is a pest of forest and shade trees more or less all through the South Palæarctic region to Japan. Its entry and spread in North America, and the prolonged campaign for its control on that continent by biological means, have often been recounted. In the present memoir a very complete account will be found of the biology, influence of environment, distribution, natural enemies and methods of control of this familiar insect. There is also a useful summary of Goldschmidt's famous work on sex determination, which has brought the name of gypsy moth to the notice of many biologists. The reader will, therefore, find little to complain of on the score of completeness of information, while the long list of references given will satisfy any crave to delve further into the subject. The work is well up to the standard of other contributions in its series and needs no further commendation.

A. D. I.

Die Blatt-Minen Mittel- und Nord-Europas:

Bestimmungs-Tabellen aller von Insekten-Larven der verschiedenen Ordnungen erzeugten Minen. Von Prof. Dr. Martin Hering. Lief. 2: Brunella—Filipendula. Pp. 113–224+2 plates. (Neubrandenburg: Gustav Heller; 's-Gravenhage: W. Junk, 1936.)

THE attention of entomologists and botanists is directed to "Die Blatt-Minen Mittel- und Nord-Europas" (including England) edited by the well-known authority, Dr. Martin Hering. It is to be completed in 5–6 Lieferungen, each being issued at a subscription price of 12 gold marks, and the publishers state that the work will be completed by the middle of 1937. The whole monograph will comprise about 700 pp. with 500 text-figures and 7 plates. The part to hand (Lieferung 2) is arranged alphabetically under plant genera: it consists of diagnostic tables of all known leaf-miners affecting each genus referred to. The work is evidently designed to facilitate easy reference and will cover the chief aspects of its subject.

Correlation of the Coal Measures

THERE are two quite different aspects of Coal Measure correlation. In the first place, there is the desirability of dividing the thousands of feet of Coal Measure strata into zones or other subdivisions, which can be recognized in different coalfields and can be used in the comparison of sequences in different areas; in the second place, there is the demand of the mining engineer for criteria which will make it possible for him in a given area to identify individual coal seams or other rock beds. The broad zoning has its economic uses in the exploration of undeveloped areas in known coalfields and in the interpretation of deep borings into concealed coalfields. In these preliminary stages, it is sufficient to know what part of the Coal Measures has been reached, but as mining operations proceed, especially in areas where seams are much disturbed and faulted, there is need for much more precise information than can be gained from a study of zones which may themselves be hundreds of feet thick.

For many years, the methods of correlation of the Coal Measures lagged behind those used in other formations. When nearly every other system had been divided into palæontological zones, the Carboniferous rocks were still unzoned, and even then zonal methods were applied to the Lower Carboniferous before much progress was made with the Upper. Meanwhile, however, much success attended the work of geologists who used lithological characters and matched sequences with reference to the distribution of coals, and such workers as Wheelton Hind and Stobbs found valuable datum planes in the marine bands which mark temporary but widespread incursions of the sea into the area where Coal Measures were deposited.

The advances in Coal Measure correlation which have taken place in the past ten years were summarized in a discussion in Section C (Geology) of the British Association during the recent Blackpool meeting; geologists certainly can no longer be charged with neglecting the study of correlation in the rocks which are of most economic importance. It has to be emphasized, however, that the needs of the mining engineer can only be met by a scheme of correlation much more detailed than those developed in almost any other formation, and while zonal classifications of the Coal Measures are now available, efforts are being made to develop methods which will facilitate the identification of individual seams.

The most important fossils for the zoning of the Coal Measures are the plants and those lamellibranchs (*Carbonicola, Anthracomya* and *Naiadites*) which are now believed to have lived in 'non-marine' (if not wholly freshwater) conditions; while the marine bands form useful reference planes, they are too few and their fossils too restricted to afford a general basis for zoning. The non-marine shells have provided six major zones; these are now recognized in practically every coalfield in Britain, and a similar sequence is known on the Continent in coalfields so far afield as the Donetz basin. The precise limits of some of the zones are rather indefinite, but they appear to afford a reasonably secure basis for correlation. Several of the zones can be subdivided: Dr. W. B. Wright has used a number of sub-zones in working out the structure of the Lancashire coalfield, and Dr. J. Weir and Mr. D. Leitch have found that certain of these can be recognized in the Scottish coalfields.

In limited areas, these 'mussel' shells are often sufficiently characteristic of the roof of a seam to be an infallible means of identification. Some mussel bands have long been used in this way: in the highly disturbed anthracite area of South Wales, recognition of the worked seams by means of these faunas is now an established practice. The nomenclature of these excessively variable shells presents a difficult problem, but the closeness of correlation is greater than can be expressed by lists of specific names. Mr. S. G. Clift demonstrated this for horizons in Nottinghamshire and Scotland.

Detailed zoning by means of fossil plants is a still more recent feature of Coal Measure correlation in Great Britain, although on the Continent plant-zones were being used some years ago. The palæobotanical work of Kidston and others, however, laid the foundation of an accurate nomenclature of the plants, and by collecting systematically from an established sequence in South Wales, Dr. Emily Dix has recently been able to subdivide the Coal Measures into zones which appear to be traceable over the whole of Britain. The results of this plant correlation in all the areas yet investigated substantiate the results based on the Lamellibranchs; as plants are usually abundant in those places where shells are rare, these two methods may often be regarded as complementary.

One striking result of the closer correlation of the sequences in various coalfields has been the recognition of the wide distribution of some characteristic bands. The great extent of certain marine bands (the equivalent of the Mansfield

Marine Bed is known in practically every coalfield from Scotland to South Wales and Somerset) proves that occasionally very wide areas were submerged; the remarkable frequency with which thick coals occur at comparable horizons in different coalfields (as at the base of the *Similis-Pulchra* Zone) also suggests a comparative uniformity of conditions at certain stages in Coal Measure times. For some years, there had been a tendency to assume that the basins in which the Coal Measures were deposited were restricted in extent and more or less coincident with the existing coalfields: it was thus thought that the freshwater shells could not be used for correlation since they were only of local occurrence. Their wide distribution and the similarity of their sequences in different countries indicate at least a free communication between the areas.

Work on the spores of the coals has likewise tended to reveal the wide lateral extent of characteristic features. The classic investigation by Dr. L. Slater and others of the distribution of megaspores in the Silkstone and Better Bed coals of Yorkshire and the Arley of Lancashire, which confirmed the correlation of the Better Bed with the Arley, already put forward by Dr. D. A. Wray on stratigraphical grounds, clearly showed the value of these methods, and lent further support to the view that the main coals of these two coalfields were formerly continuous.

More recently, Dr. A. Raistrick has developed with remarkable success a technique for the examination of the microspore content of seams. He has applied this method to the coals of Northumberland and Durham, many of which appear to have a characteristic microspore content which persists over wide areas. He has recently been investigating the difficulties which are introduced by changes in the structure of the seams and in the chemical and physical properties of the coals. The various methods of using spores (both megaspores and microspores) in correlation, and the problems which arise in that work, are also being explored by the Government Department responsible for fuel research (Mr. J. J. Walker and Dr. J. O'N. Millott gave an account of this work).

There can be little doubt that these methods will be of immense importance in the identification of seams, especially in the Lower and Middle Coal Measures, where the floral changes are most pronounced. In the highest Coal Measures, as Mr. G. A. Kellaway showed, the microspore content of successive seams is much less varied, and these methods of correlation present greater difficulties. They are likely, however, to be of great use in the parts of the Coal Measures which are most worked. They will probably supplement rather than replace the use of the plants and shells, from which conclusions can generally be reached so much more rapidly.

A. E. TRUEMAN.

Bracken as a Weed

THE Brake Fern or Bracken (*Pteridium aquilinum*) is an ancient plant of world-wide distribution in temperate and even tropical parts. Although a plant favouring the less dense woodlands and deeper soils, it may invade and dominate grass or heather even on shallow soils where the winters are not too severe or the summers too dry. This characteristic has made it a serious agricultural pest not only in Britain but also in Australia and New Zealand.

During the past forty or fifty years, the spread of bracken, especially in Scotland and Wales, has been so excessive that in many cases the available grazing land has been reduced by one half or more. This is not the only loss, however, for sheep which have been struck by the maggot fly (*Lucilia sericata*) take cover in dense bracken (which they normally avoid) and die there, although many could have been saved if treated in time. These carcasses are the breeding ground for more maggots. From the farmer's point of view, bracken (i) reduces the total grazing available and the number of sheep the ground should carry, (ii) leads to loss of sheep each of a value of 20*s*.–30*s*. or more, and (iii) adds to the costs of management, as in the absence of bracken a shepherd and his dogs can work a greater area of sheep-run.

The spread of bracken is due to many causes: (*a*) mild winters, (*b*) discontinuance of its use for thatching, litter, and as a source of potash for soap and manure, etc., (*c*) spore distribution, (*d*) depopulation of rural areas, and (*e*) reduction of cattle and horse grazing. Horses and cattle do not eat bracken extensively—it possesses a cumulative poison in their case—but heavy animals tramping and grazing amidst the fronds damage it and encourage grass. Pigs are the only animals which eat it; they dig up the subterranean stems or rhizomes.

In a moderately dense patch of bracken there will be 40 tons of rhizome and about 10 tons of fronds to the acre. The huge amount of material built up each year is used for replenishing the depleted rhizomes, the formation of new buds for future rhizomes and fronds, for the production of spores and for the elongation of the perennating rhizome—its chief method of spreading. This may grow as much as a yard each year. In this way a 1/40 acre bracken plant could become an acre in extent in 34 years, or 24 such plants could invade 1,000 sq. yd. in a year.

Unfortunately, bracken possesses few natural insect and fungoid enemies, and none of these materially damages it when it is growing in congenial sites. The one effective measure of control is continuous destruction of the fronds, so that the rhizome is exhausted in forming new fronds. The best time is when the frond is almost completely unfolded (mid-June to early July). A second and even a third removal of the fronds may be necessary for the first two years; thereafter the plant is much weakened and a single cut per year for a further two to five years should exterminate it.

Until recently, fronds have been destroyed by the scythe or by the sickle at a rate of 0·5–3 acres per day, at a cost of 3*s*.–8*s*. per cut per acre, and this on land probably worth only a shilling or two per acre. Now various machines have been produced, and this year the Department of Agriculture for Scotland has granted half the purchase price of machines (spread over three years) for areas satisfactorily cut with the Collins' power bracken cutter or the Glaslyn bracken cutter. The former can cut more than an acre an hour and the latter about an acre an hour, thus reducing the cost to approximately 1*s*. 6*d*.–2*s*. 6*d*. per acre. This season other promising machines have been produced: (*a*) the Denny hand scythe, (*b*) for horses or tractors, the Crossley thistle cutter and the Holt bracken breaker, and (*c*) the Allan and the Gordon motor machines. Reports of a demonstration of these and the two former machines appeared in the *North British Agriturist* and the *Scottish Farmer* of September 3 and 5, 1936, respectively*, and results of their use over extensive areas will be awaited with interest.

The employment of chemical sprays and powders applied by autogiro, tractor, horse-sprayer or hand, has so far proved to be costly and clumsy compared with the cutting methods, and often the resulting growth of herbage is less satisfactory.

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* *The North British Agriculturist*, 88, No. 37, 855 (1936). *The Scottish Farmer*, 44, No. 2277 (1936).

Developments in Electroplating

WITH the ever-growing demand for materials possessing new and more varied combinations of properties, it is seldom that any one of the commoner metals has all the properties desired for special applications. Suitable mechanical strength may be offset by susceptibility to corrosion, suitable density by insufficient hardness, amenability to mechanical processing by unsatisfactory appearance. The use of alloys of two or more metals affords one important method of escape from these limitations, especially since a small addition of an alloying element often produces profound alterations of properties. On the other hand, since it is frequently only the surface properties which particularly need modification, an alternative method is to cover the surface with a suitable coating. Thus, the metal may be coated with various enamels, paints, or lacquers; or with a thin layer of a different metal which may be applied by direct immersion in the molten metal—as in the production of tin-plate or galvanized iron—by electrodeposition from a solution of a salt of the metal, or by other means.

The two ways of using a metal to modify the properties of another—as an alloying element and as a coating—have both been extensively exploited, but their fields of application have seldom overlapped. Thus the range of utility of steel has been enormously extended by the use of coatings of tin, zinc and cadmium, but no alloys of these metals with steel have found application. Nickel has been used in both ways in relation to steel, but the applications of the respective products have been notably different. Indeed, chromium seems to be the only metal employed both for alloying with steel and as a coating on steel in order to produce the same type of result, namely, a tarnish-resisting surface.

These were among the matters discussed by Mr. D. J. Macnaughtan in introducing a symposium on electroplating before Section B (Chemistry) of the British Association at the recent meeting in Blackpool. The other papers presented were "The Development of Control in Electrodeposition Processes", by Mr. A. W. Hothersall; "Electrodeposited Coatings as Corrosion Preventives", by Dr. S. Wernick; "Non-tarnishable Finishes", by Mr. E. A. Ollard; "Advances in Industrial Electroplating", by Mr. C. F. J. Francis-Carter; and "The Future of Electrodeposition", by Dr. H. J. T. Ellingham. The whole group of papers afforded a survey of the development of electroplating practice, and directed attention to the striking advances which have been made in recent years. The achievements of modern electroplating were effectively illustrated by means of an exhibition specially arranged in conjunction with the meeting by the Electrodepositors' Technical Society.

In the more restricted sense of the term, electroplating connotes the electrodeposition of a thin, adherent coating of a metal over the surface of a metallic object in order to provide a decorative finish, to protect the underlying metal against corrosion, tarnish or wear, or to achieve a combination of these effects. The use of the term is often extended, however, to include a number of cognate electrolytic processes such as : the electrodeposition of relatively thick and very strongly adherent layers of metal for 'building up' worn or undersized machine parts ; the production of adherent oxide coatings on aluminium and its alloys by anodic treatment (anodizing) ; and the electrodeposition of non-adherent layers of metal which, on detachment from the surface on which they are formed, faithfully reproduce details of surface structure (as in the production of electrotypes and gramophone matrices) or the complete shape of an object (electroforming).

Although electroplating became a commercial process nearly a century ago, developments during the last twenty years have been so important as to change completely the scope and status of the industry. The list of metals electrodeposited in plating practice has been extended by the important addition of chromium and, quite recently, of rhodium ; and now comprises zinc, cadmium, tin, lead, iron, cobalt, nickel, chromium, copper, silver, gold, palladium, platinum and rhodium. The anodizing of aluminium and its alloys has been introduced ; and progress has been made in the electrodeposition of two metals simultaneously, so as to produce alloy coatings such as copper-zinc, copper-tin and zinc-cadmium.

Apart from the introduction of new metals and new processes, there has been also an all-round improvement in the quality and reliability of electrodeposited coatings, and an enormous expansion of the range and scale of their applications. Electroplating is now practised as one of the regular series of operations involved in the manufacture of a large proportion of metal articles of industrial and domestic utility.

For the protection against corrosion of a wide range of iron and steel articles and fittings, electroplating with zinc or cadmium has become an important commercial process. Electrodeposited coatings of tin and, in special circumstances, of lead are also being used for this purpose ; and as a result of the new methods employed in rolling mills, whereby steel sheet is produced in the form of a continuous strip, electrodeposition of tin is now becoming a practicable alternative to 'hot-dipping' in the large-scale manufacture of tin plate. Although the particular difficulties which beset the electrodeposition of adherent metal coatings on aluminium have been partly overcome, it is fortunate that, by anodic treatment of this metal and some of its alloys in suitable electrolytes, it is possible to bring about a considerable thickening of the oxide film which normally covers the surface, and thus effectively protect the underlying metal against corrosion. Since, moreover, the resulting oxide layer is a good insulator, is resistant to wear and readily takes up dyes—thus furnishing various decorative effects—it is not surprising that this anodizing process has rapidly found a wide range of applications.

The enormous expansion in the scale of nickel-plating during the last twenty years—it is estimated that an area of about 250 million square feet is now deposited annually—must be partly attributed to the development of chromium-plating. While very thin coatings of chromium on steel are liable to be too porous to afford much protection against corrosion, and thicker deposits are likely to crack, a highly satisfactory tarnish-resisting surface is produced by first coating the steel with a sound nickel deposit and then covering this with a 'flash' of chromium. In this two-stage process, which has been very widely adopted, it is most important that the nickel 'undercoat' shall be firmly adherent, uniform and non-porous ; and the thorough investigation of the factors which determine these properties has led to outstanding improvement in the quality and reliability of electrodeposited nickel coatings. The now widespread use of chromium as a non-tarnishing finish on base metals may be paralleled by the similar application of rhodium on the precious metals. Thus an extremely thin flash of this hard and highly resistant metal on silverware furnishes a lustrous surface, barely distinguishable in appearance from that of silver itself—but which does not require periodic cleaning.

In all these new developments important parts have been played by the metallurgist, the physicist, and especially the chemist. As a result of careful study of the functions of various ingredients in plating baths, considerable simplification of the older 'formulæ' has been effected, and it has become possible to exercise a much more exact control over conditions of operation, and hence over the character and properties of the deposit. The study of the influence of the pH value of solutions, especially in the deposition of nickel, has been important in securing adherent deposits free from pin-holes. Investigation of the factors which determine the 'throwing-power' of plating baths has led to the development of solutions which yield deposits of almost uniform thickness over the whole surface of an object of complicated shape. Examination of the effects of various kinds of 'addition agents'—especially colloids and other substances of high molecular weight—in the solution, has resulted in the production of smooth, coherent coatings from baths which otherwise yield coarsely crystalline, irregular or spongy deposits ; and is now leading to the direct production of coatings so lustrous as not to need polishing—a matter of some importance when the size or shape of the article or the nature of the deposit renders the polishing process difficult and costly, or where a particularly smooth surface is a necessary condition for the success of a subsequent process, such as the deposition of chromium on electrodeposited nickel.

The introduction of quantitative tests for such properties of the coating as hardness, porosity, internal stress and adhesion, has enabled these properties to be correlated with the conditions of deposition and hence to be brought under control. Microscopical examination of etched surfaces and sections has done much to indicate the size, shape and general arrangement of the crystallites of which the deposit is built up, and even to detect the presence of non-metallic matter, such as oxides, which may enter the deposit, probably in the colloidal state, and profoundly affect its properties. Such problems are now being further investigated by X-ray and electron diffraction methods.

Although the thickness which an electrodeposit should attain in order to fulfil its purpose depends not only on the nature of the metal deposited but also on the character of the basis metal and the conditions of service to which it is to be subjected, the following values (expressed in thousandths of an inch) give a general indication of the thicknesses of various metal coatings used in ordinary practice : lead, 3 ; nickel and silver, 1 ; zinc, 0·5 ; cadmium, 0·3–0·5 ; tin, 0·2–0·5 ; oxide film on anodized aluminium, 0·04 ; chromium (over nickel), 0·02 ; gold, platinum, palladium, rhodium, less than 0·01. These figures may be compared with 0·023 for the wave-length of sodium light and 0·0001 for the thickness of the air-formed 'passive' film on chromium, expressed in the same units.

The introduction of scientific control at every stage of electroplating processes, including the very important preliminary cleaning operations required to free the surface of the basis metal from traces of oxide, grease or other impurities which would prevent perfect adhesion of the coating, has raised the general standard of quality and reliability of plating to a remarkable extent, and given users confidence in its value for a wide range of new industrial purposes. The resulting increase in demand has stimulated the development of mass production methods for plating articles in automatic plants. The articles to be plated are carried at a regulated rate by conveyor chains through a succession of tanks and chambers in which the operations of cleaning, washing, plating, rinsing and drying are conducted in their proper sequence and each for its appropriate time. Although the modern type of automatic plating plant dates back only to 1929, twenty-seven such plants are now working in Great Britain. They operate on the deposition of pure metals such as zinc, cadmium, tin, nickel, chromium, copper and silver ; of alloys such as copper-tin, copper-zinc and zinc-cadmium ; and where no intermediate polishing is needed, successive deposits such as nickel and silver or copper and nickel may be produced in proper sequence ; or finishing processes such as 'oxidizing' or chemical colouring may be carried out at the conclusion of a plating operation. Such plants are often of very large capacity. Thus, whereas a few years ago a 500 gallon plating tank would have been considered very large, 3,000–5,000 gallon tanks are now common, and the largest plant now operated in Great Britain—a nickel plating plant—has a tank capacity of 12,000 gallons, which represents about 60 tons of solution containing about 13½ tons of nickel sulphate.

Improved control of the electrodeposition process has also led to notable developments in fields somewhat outside that of standard electroplating practice, such as the deposition of hard, wear-resistant facings on press tools, printing cylinders, gauges, etc. ; the building up of worn machine parts ; and the production of seamless metal tubing by depositing a thick, non-adherent coating of metal on a mandrel rotating in a plating bath. Cylindrical shells of copper deposited in this way may be slit up to form sheet, with mechanical properties superior to that of ordinary rolled sheet. By successive deposition of two metals, for example, copper and nickel, 'bi-metallic' sheet may also be produced.

With a continuance of the close co-operation which has now been established between the research laboratory and the plating shop, there is every reason to believe that all the lines of development referred to above will be extended. Additional metals will no doubt be introduced into plating practice, in some cases probably by the use of non-aqueous solutions ; and the whole field of alloy deposition is only just beginning to be explored systematically. Methods of control of existing processes will be still further improved, and new developments in various other industries will undoubtedly open up a variety of new and hitherto unsuspected applications of electroplating.

London University Degrees: a Faraday Letter

At the recent celebrations of the centenary of the University of London, the Royal Institution presented to the University a letter written by Faraday on August 10, 1859, to the Rev. John Barlow, F.R.S. The special appropriateness of the gift for the occasion lay in the reference the letter contains to that pioneering activity of the University, the institution of degrees in science. With the movement to accord full recognition to science as an object of academic study Faraday was, it is scarcely necessary to say, in complete sympathy. He was indeed actively concerned in the measures taken, for he was a member of the Senate of the University at the time, a circumstance which adds point to his comments. As this and other points in the letter may be of interest to readers of NATURE, it is printed below.

Hampton Court Green
10 Aug. 1859

My dear Barlow

It was very kind of Mrs. Barlow to write to my wife, and I think that a letter from me to you, is hardly the fit way to acknowledge it :—yet as I write to you you must say something fit for us, with our kindest remembrances, and I expect my wife will write soon. We are exceedingly glad to hear that your journey has been good—your company a happy one—& your present life healthy & joyous. Before I forget remember me to Mr. Esmead—I cannot tell whether I have been at Spa, or have any friends there ; if there are such I dare say you will find them out. We are jogging on or rather we are *not* jogging on :—for on Monday last the workmen ceased to come, the builders strike being on. As far as I can learn, both Masters & Men enter *quietly* into it ; so that though it seems as if it might come to an end in a few days, it may perhaps go on for some time & cause great distress and trouble. We must just wait.

I am not able to give Mrs. Barlow's message to Tyndall, for I think he started last Monday Morning for Chamounie, and I have not seen him since Saturday. Frankland goes with him. He spoke of taking the higher optics for his next course of lectures, and I agreed with him in the propriety (if he saw occasion) of spending £20 on apparatus fitted for the course and for investigation. I do not suppose that he will come across any clear good optical *rock salt*, but we find great difficulty in raising it from the mines in England. Indeed it is rather an impossibility than a difficulty.

As I have been out here with only runs into town I really know very little of what is going on there :—and what I learn I forget. The Senate of the University accepted and approved of the Report of the Committee for Scientific degrees, so that that will go forward (if the Government approve) and will come into work next year. It seems to give much satisfaction to all who have seen it, though the subject is beset with difficulties :—for when the depth & breadth of Science came to be considered, and an estimate was made of how much a man ought to know to obtain a right to a degree in it, the amount in words seemed to be so enormous as to make one hesitate in demanding it from the student :—and though in the D.S. one could divide the matter and claim eminence in one branch of Science, rather than good general knowledge in all—still in the B.S. which is a progressive degree a more extended though a more superficial acquaintance seemed to be required. In fact the matter is so new & there is so little that can serve as previous experience in the founding and arranging these degrees, that one must leave the whole endeavour to shape itself as the practice & experience accumulates.

We have had very hot weather but it is & has been cooler for a few days— The Thames has very rarely been seen so low in water here, as it is now. In London its bad condition seems to increase ; or else my nose accustomed to a better odour here feels it more. The harvest all round us is nearly in ; being very early ; but they tell me the corn is not so heavy as was to be desired. Want of rain has kept it small.

Ever My dear Barlow
Very truly yours
M. Faraday

Dear Mr. Barlow

My right hand Jane being absent in Scotland I am afraid my husband has promised more for me than I can perform so Mrs. Barlow will kindly take Mr. Faraday's letter as an answer with my best remembrances

Sincerely yours
S. Faraday

The letter is, first of all, an admirable example of the simplicity and directness of its author's style as a letter writer. It is written from the house on Hampton Court Green which had, only in the previous year, been placed at Faraday's disposal as a summer residence by Her Majesty the Queen—on the Prince Consort's suggestion it is said. The workmen spoken of were engaged that summer on alterations at the Royal Institution, and their strike evidently went on for many weeks, for it was reported in November that the work had been much delayed by it. The Rev. John Barlow, to whom the letter is addressed, and who was abroad on holiday with his wife, was at the time nearing the end of a long period of office as secretary of the Royal Institution. The correspondence which is preserved shows that out of their association in the business of the Institution there had grown up, between the Faradays and the Barlows, a close and affectionate friendship.

John Tyndall, whose lectures and activities in Switzerland are mentioned, had been Faraday's junior colleague since his appointment to the professorship of natural philosophy in 1853, and had long since been admitted to the intimate circle of the home at Albemarle Street. That Tyndall's search for rocksalt of optical quality was ultimately successful is evident from the valuable collection of prisms, lenses and rough blocks of the mineral, formerly his property and used in his researches, now in the possession of the Royal Institution. A large block was presented to him by the King of Würtemburg in 1867.

The letter contains one of Faraday's not infrequent references to his loss of memory—and a complaint on a different matter, the insanitary condition of the River Thames, a favourite topic, his strictures on which had provoked, a few years earlier, a cartoon in *Punch* of Prof. Faraday, holding his nose, rebuking Father Thames from the side of a steamboat.

The postscript is in Mrs. Faraday's handwriting, and the reference is to their niece Jane Barnard, who lived with them at the Royal Institution.

T. M.

Obituary

Prof. H. L. Le Chatelier, For. Mem. R.S.

The death of Henry Louis Le Chatelier, which occurred at Miribel-les-Échelles on September 17, removes one of the great pioneers in the physical chemistry of the last quarter of the nineteenth century; he was born in Paris on October 8, 1850. His father, Louis Le Chatelier, who died in 1873, was a man of high technical abilities and scientific talents; in 1842, when France possessed only six hundred kilometres of railroads, he was put in charge of railway development and became largely responsible for the construction of the present French railway network. Louis also played a great part in the perfection of the locomotive, in the improvement of coal mining and utilization, in the manufacture of open hearth steel and of aluminium and in the organization of the Bordeaux pine forests.

The intense application of scientific methods to practical ends which marked the career of the father, gave direction to the life-work of the son. Henry Le Chatelier was essentially a scientific man of great talents and resource but most of his work seemed to aim at some technical application; the tendency of his mind was well shown in a money gift which he made to the Académie des Sciences in 1922 with a condition that the income should be given to "persons possessed of such scientific aptitude and facilities for work as would enable them to carry out essentially scientific work involving precise measurements which would be sooner or later applicable to industry". The same interests were manifested in the frequent occasions on which he exhorted his countrymen to apply scientific methods to the improvement of industrial practice; the work of F. W. Taylor in the United States on scientific management first obtained publicity in France through Le Chatelier's writings.

Le Chatelier was educated at the Collège Rollin, the École Polytechnique and the École des Mines; he taught at the latter school and at the Collège de France and in 1907 succeeded Moissan as professor at the Sorbonne. As the fundamental importance of his work became universally recognized, honours came in rapid succession. He was a Grand Officer of the Légion d'Honneur and was elected to the Chemistry Section of the Académie des Sciences in 1907; he became a foreign member of the Royal Society in 1913 and received the Davy Medal in 1916. He was made a foreign member of the Chemical Society in 1908 and an honorary member of the Institute of Metals in 1913; an associate member of the Académie Royale de Belgique in 1913, a foreign member of the Accademia dei Lincei in 1918, and an *Ehrenmitglied* of the German Chemical Society in 1931. He was a Président d'Honneur of the French Chemical Society and probably its senior member, having been elected in 1878.

Le Chatelier early devoted himself to the study of the thermal changes which accompany chemical reactions and dissociations, following in this Berthelot and his teacher Sainte-Claire Deville; his work on this subject is monumental and he contributed much to the application of thermodynamics to chemical reactions. His experimental work was characterized by a delicacy previously unknown and was accompanied by mathematical analysis of a searching character; thus, he was able to predict that calcium carbonate should be appreciably dissociated by water vapour at the ordinary temperature and to show experimentally that the prediction is correct. His great generalization now known as the principle of mobile equilibrium dates from 1884 and states that "toute transformation infiniment petite d'un système en équilibre chimique qui est produite par la variation d'un seul des facteurs de l'équilibre s'éffectue dans un sens tel qu'elle tende a produire une variation en sens inverse du facteur considéré". He introduced great improvements in the methods of determining heats of reactions, specific heats of gases at high temperatures, explosion pressures and in the optical measurement of high temperatures. He made the thermoelement an efficient instrument for the determination of high temperatures in face of the criticisms of Regnault, who thought that the use of such an appliance involved sources of error which could not be eliminated; he was the first to use the platinum–platinum-rhodium thermoelement in thermochemical practice. Le Chatelier established a number of principles connected with the second law of thermodynamics which now form part of our classical knowledge of gas reactions; in this connexion he took out a patent for the synthesis of ammonia which anticipated the Haber process, now so widely used.

Le Chatelier extended the work of Vicat, a friend of his grandfather, on hydraulic cements and was the first to apply petrological methods to the study of this subject; he thus identified several components of Portland cement, and his researches in this connexion still form the framework of our knowledge of cements and mortars. He was a pioneer in the application of heat dilatation, electrical conductivity and etching methods to the study of metals and their alloys.

In this brief notice it is impossible to give any adequate account of the vast field covered by Le Chatelier in the course of his original work; some mention should be made, however, of his literary activities. In 1899 he published a French translation of the papers of Willard Gibbs, with the work of whom his own was so closely interwoven, and he founded the *Revue de Métallurgie* in 1904. He published a series of lectures on carbon in 1908 and, with the collaboration of his daughter, Madame Jean Royer, produced in 1925 a book of more general appeal entitled "Science et Industrie". These two books reveal Le Chatelier as he was known to his friends—a profound and original thinker and a high-minded and patriotic Frenchman with a deep sense of humour. His reminiscences of his old friends were many and usually combined wisdom and jest. Thus he recalled that Sainte-Claire Deville was a discursive lecturer who furnished his students with little likely to be of service in the approaching examinations. He likened the chemical affinity between sulphuric acid and potash to that existing between a dog and a bone; the dog has an affinity for the bone but it may be equally claimed that the bone has an affinity for the dog and the two mutually absorb each other to form one single entity. The only difference lies in the fact that the dog has personal feelings which are absent in the bone; but how can one say which is the more noble, the acid or the alkali? In such a manner Sainte-Claire Deville expressed his antipathy for so-called scientific theories in which empty words often stand for non-existent ideas, the term reciprocal affinity serving merely as a vague mode of recalling an experimental fact.

Le Chatelier was a man of fine presence and of courtly manner; he was a brilliant talker and, although advancing years brought deafness, his personal charm always remained. With his death we lose one of the great figures of the scientific France of last century.

WM. J. POPE.

Mr. Sherard O. Cowper-Coles

THE name of Sherard Cowper-Coles is closely linked to the progress which has been made in numerous branches of electrodeposition work during the last half-century. Born in 1867, his first patent was brought out while he was still a minor, although this had no connexion with electrodeposition; thereafter, there has scarcely been a year when his name has not appeared in the index to the *Patent Journal*.

Cowper-Coles's life was largely devoted to work in electrodeposition problems, his speciality being processes of electro-forming and applications of electrolysis which were rather outside the sphere of electroplating. If processes which are connected with the decoration and protection of metal surfaces interested him less, it is nevertheless a curious fact that what may possibly be considered his most important contribution from the industrial point of view was a method of protecting steel which is very widely practised to-day, and to which he gave his name—sherardizing. This process consists in the production of a zinc coating on ferrous articles, not by electrolysis but by cementation; later, it was progressively improved and now finds considerable application.

Among the many problems which interested Cowper-Coles were the electrodeposition of rubber, deposition on glass, sound recording, needle sharpening, production of white lead by electrolysis, transparent paper, sound-proof ventilation, while he also carried out some work on the smoke abatement problem.

For many years, Cowper-Coles worked in a private laboratory, which he built at Sunbury-on-Thames. Here, favoured visitors would be shown over a most fascinating and unique collection comprising examples of almost every aspect of applied electrodeposition, from electrolytic copper gramophone records to electrodeposited iron tubes of giant size. Most of these exhibits had been produced by Cowper-Coles during his lifetime, and some of them were shown at the Electrodeposition Exhibition held last year by the Electrodepositors' Technical Society at the Science Museum.

During the latter part of his life, Cowper-Coles devoted his efforts to the production of sheets by direct electrodeposition processes. He had a considerable financial as well as scientific genius, and a number of companies were formed to exploit his processes. He published a large number of papers in the proceedings of numerous societies and institutions. A man of considerable personal charm of manner, his courtliness was reminiscent of an age long passed. The niche which he filled in the world of electrodeposition was truly unique.

S. WERNICK.

We regret to announce the following deaths:

Sir George Hampson, Bt., formerly assistant keeper in the Natural History Museum, known for his work in entomology, on October 15, aged seventy-six years.

Prof. Alexander Larmor, formerly McCrea professor of natural philosophy in the Magee University College, Londonderry, on October 12.

Prof. Pietro R. Pirotta, formerly professor of botany in the University of Rome, on August 4, aged eighty-three years.

News and Views

Lord Nuffield and the University of Oxford

On October 16, it was announced that Lord Nuffield had offered to the University of Oxford the magnificent sum of £1,250,000 for the development of a post-graduate medical school with a staff of full-time professors. This is the greatest benefaction ever made by an Englishman in his lifetime to a specific public object, and the biggest sum a university in Britain has received since Mr. Carnegie's gift of two million pounds to the Scottish universities thirty-five years ago. Until recently, Oxford's small but good medical school did not engage itself much either in teaching or research beyond the subjects of the second professional examination. The men who had reached this stage were encouraged to continue their work at one of the big training hospitals in London or other large city, and to return to Oxford only to take examinations. In 1927, however, the new school of pathology was built and endowed by gifts from Sir William Dunn and Mr. Theodore Williams, and, more recently, Lord Nuffield made available for medical research the Nuffield Institute by buying the Radcliffe Observatory buildings and surrounding land and endowing it with £16,000. It is now proposed greatly to extend these beginnings so that the comparatively small city of Oxford may have the kind of medical school which in Great Britain has been considered feasible only in a large university city. The main purpose of this, however, will be research, not teaching. Disease is to be studied over the widest possible front; the clinical training of medical students will be incidental and definitely subsidiary.

In his letter to the Vice-Chancellor of the University announcing the gift, Lord Nuffield briefly outlined what he had in mind. He would like clinical departments in medicine, in surgery and in obstetrics, and a department of anæsthetics, to be established immediately. Each of these would be under the direction of a new university full-time professor. They and their principal assistants would be so remunerated that their energies could be wholly given to their work in the hospitals and at the University and not, in part, distracted by private practice. The new posts would be open to any qualified practitioner whether a graduate of Oxford or not. Young research students proposing to work under the supervision of seniors on clinical problems would be encouraged. The body entrusted with the execution of the scheme will include representatives of the University, of Lord Nuffield and of the two large hospitals—the Radcliffe Infirmary and the Wingfield-Morris Orthopædic Hospital—which will be mostly concerned. These and the Oxford Eye Hospital contain approximately seven hundred beds and serve a district extending in some directions nearly thirty miles from the city, which contains a quarter of a million people. Much of the credit for advising on the objects to which the benefaction will be directed is due to the regius professor of medicine, Sir Farquhar Buzzard, and it is a matter of satisfaction in Oxford that the new scheme will be begun under his guidance. Not content with this great benefaction for medical studies, Lord Nuffield has also given £100,000 to the University to help its endowments generally. The University is at present deeply committed financially for the building of the great Bodleian extension, and until that building is paid for, money for the extension of the scientific departments cannot be so readily available as otherwise. This gift, accordingly, makes more hopeful, although indirectly, the provision of two new science laboratories which are badly needed—a new University department of physical chemistry, and the replacement of the Clarendon Laboratory for physics.

Belluno Earthquake of October 18

At about 4 a.m. (3 a.m., G.M.T.) on October 18, a destructive earthquake occurred in northern Venetia and caused considerable loss of life and damage to property. The centre seems to have been close to Sacile, which lies about thirty-seven miles north of Venice and twenty miles south-east of Belluno. The area of damage is not less than forty miles in length and includes Belluno, where nearly all the old buildings were injured, Borgato Zago and Conegliano. The shock is said to have lasted twenty seconds and was felt at Milan, 166 miles to the west of Sacile, so that the disturbed area may contain about ninety thousand square miles. On June 29, 1873, there was a similarly destructive earthquake in the Belluno district, which was carefully studied by Höfer, Bittner and others. According to these investigators, the epicentre lay about two miles to the east or south-east of Belluno. Höfer assigned the origin of the earthquake to movements along two faults, one directed nearly north-east and south-east, and the other east, from the epicentre. He estimated the depth of the focus at 7·91 km., or very nearly five miles. It would thus seem that, in the recent earthquake, the centre was displaced some miles to the south-east to a point on, or not far from, the north-easterly fault marked out by Hofer.

Science in South Africa

In his presidential address to the South African Association for the Advancement of Science on October 5, at Johannesburg, H.E. the Right Hon. the Earl of Clarendon, Governor-General of the Union of South Africa, after referring to the part which applied science has played in the transformation of Johannesburg during the last fifty years, discussed particularly the part which the work of the man of science plays in everyday domestic, social and business life. The work which the Association is doing to bring home to the ordinary man the great debt which he owes to the scientific worker entitles it to the support not only of scientific men but also of the general public, and Lord Clarendon suggested that this is one of the most important aspects of the Association's work. Referring to the efforts of the scientific worker in the matter of health, nutrition and disease, he pointed out that much as we already owe to the discoveries of science, much more could be done if the requisite funds were available. Essentially the eradication of malaria, nagana, East Coast fever, tuberculosis in cattle is a matter of funds, lack of which prevents the carrying out of measures already known to be effective.

ACCORDINGLY Lord Clarendon argued that the support and fostering of scientific research should not be limited by national frontiers. The best utilization of national wealth involves the utilization of discoveries made elsewhere. Many scientific problems have been solved by international co-operation, and while the influence and guidance of politicians and financiers may still be necessary, we can also look forward to a brighter future in which a large proportion of the troubles of the world will be treated as scientific problems and dealt with on this basis by international congresses of men of science. In furthering this ideal, the diffusion of a knowledge of science and of the world's debt to scientific investigation is of vital importance. In a reference to the place in science of the amateur, Lord Clarendon suggested, contrary to the usual belief in scientific circles, that specialization has so handicapped the work of the amateur, at any rate in the physical sciences, that his contribution is now becoming insignificant, that the growth of leisure would greatly increase the number of amateur workers, particularly in the conception of leisure as "the opportunity to work hard at things which really interest one".

Research and Finance

A MEMORANDUM on the development and finance of the Department of Scientific and Industrial Research was discussed in a leading article of NATURE of July 11 last. The view appears to prevail that this memorandum embodies the considered views of the Parliamentary Science Committee; but this is not so. The history of the memorandum is as follows. Some three years ago the British Science Guild and the Association of Scientific Workers appointed a joint committee to explore this question. Considerable material was gathered, and certain progress was made. Eventually the two bodies referred the subject to the Parliamentary Science Committee in 1935, together with the results of their labours. Obviously it was desirable that this material should be collated, brought up to date, and even amplified. This was done by a distinguished scientific worker at Cambridge. His preliminary draft was circulated to the executive of the Parliamentary Science Committee last March. Before proceeding to consider the memorandum in detail, the executive deemed it expedient to refer it to the councils of its constituent bodies and to the individual members of its own general and executive committees to secure their considered views in writing. This has proved to be a leisurely process, as some councils meet at infrequent intervals —and not at all during high summer! A considerable volume of constructive and polemical criticism has been received; and an amended memorandum is now being prepared at Cambridge incorporating many of the suggestions received. It appears, therefore, that the Parliamentary Science Committee has not yet settled down to work, as a deliberative body, on this memorandum. In a sense, the committee may be said to have given it a 'first reading', and committed it to a select committee for consideration before proceeding to the 'second reading' and subsequent stages. The 'Parliamentary draftsman' has to finish his labours before the Parliamentary Science Committee can claim any credit for accepting the result of his public-spirited labours—or for rejecting the memorandum on 'third reading'.

Plant Organisms in Permanently Frozen Subsoil

SOME rather sensational newspaper reports on the discovery, by Russian scientific workers, that organisms which had remained frozen for thousands of years in Siberian soils can be revived (see NATURE, Sept. 26, p. 540), is now followed by an account on this work, carried out by P. Kapterev in the Amurland, at lat. 53° 58′ N. (*Comptes rendus, Academy of Sciences, Moscow*, 3, No. 3; 1936). The depth of the permanently frozen layer at that place has not been definitely determined, but is estimated at about 60 metres. The upper 2·5 metres of the soil may thaw during summer, and below that level the permanently frozen layer begins. This frozen subsoil is loamy and includes some peaty intermediate layers, which probably were formed at the bottoms of pools. Samples of peaty material taken at depths up to 4·25 metres, when placed in flasks with distilled water, invariably developed a fairly rich flora of algæ belonging to some twenty genera such as *Stigocleonium, Mougeotia, Oedogonium, Closterium, Cosmarium, Oscillatoria, Phormidium, Navicula, Gomphonema, Anabaena, Lyngbia, Chroococcus, Ulothrix, Chlamydomonas*, etc., as well as fungal hyphæ and green stems of a Hypnaceous moss. In one sample, a crustacean, *Chydorus Sphæricus* (Cladocera) has been found. The possibility that these organisms were introduced into subsoil by water percolating from upper layers is rejected, since the permanently frozen subsoil is practically impermeable to water. Nor can it be suggested that the cultures were infected accidentally, since it would be difficult to expect then a whole complex of organisms, which moreover varied with the depth of samples. It is considered, therefore, that the organisms actually came from the permanently frozen subsoil. The age of the layers from which the samples were taken is estimated as possibly from one to three thousand years. Carefully planned investigations of still deeper layers are being continued under the auspices of the Moscow Academy of Sciences.

Administrative Classification of Australian Aborigines

A NEW policy for the control of the aborigines under the jurisdiction of the Federal Government of the Commonwealth of Australia is announced by Mr. Paterson, Minister for the Interior (*The Times*, Oct. 4). These aborigines, that is, the inhabitants of the Northern Territories only, are estimated to number approximately 20,000 out of a total aboriginal population of 76,000, of whom 22,000 are half-castes. In future they will be classified in three divisions: (1) detribalized natives, such as those near Darwin and other northern towns; (2) tribes on or near pastoral stations and other white settlements; and (3) aborigines beyond civilized control. This classification corresponds broadly with the facts, and will involve no very drastic interference with existing conditions. At the same time, official recognition and acceptance of a very real distinction should facilitate discrimination and increase efficiency in administering and applying any ameliorative policy. The disposition of the aborigines proposed under the new regulations is that the completely detribalized aborigines should be educated to a white standard, with the view of training them to become economically and occupationally efficient. Areas are to be set aside at Darwin, on which they will be encouraged to abandon their nomadic habits and to settle in family houses, cultivating the soil and rearing domestic animals. Barracks, schools and recreational and sanitary facilities will be provided. Semi-detribalized natives will be settled in reserves, in which they will be enabled to live in native fashion; and *myalis*, aborigines completely under tribal institutions, will live in the inviolable reserves. The Australian aboriginal has shown himself singularly adaptable to the advantages of white civilization; but it will be interesting to watch how far this experiment in checking so deeply engrained a tribal habit as nomadism meets with success.

Public Lighting

IN his address at the opening meeting of the Illuminating Engineering Society on October 13, the president, Mr. Arthur Cunnington, referred to several questions of outstanding interest in connexion with lighting, such as the need for greater uniformity in conditions of supply of gas and electricity, the desirability of designing fittings that are easy to maintain as well as efficient, and the effect of surroundings on conditions of illumination. In this connexion, he suggested that if owners of buildings would make a practice of steam-cleaning the surfaces of buildings before the period of the Coronation, this would not only improve the appearance of the streets but would also greatly facilitate floodlighting. The concluding section of the address emphasized the value to large consumers of trained lighting engineers who could form an impartial opinion of the merit of different systems and appliances. The need for expert public lighting engineers in large towns and cities has recently been emphasized, but there are many other bodies such as Government departments, railways and docks and large industrial concerns which could benefit from their services.

Progress in Illumination

IN accordance with the usual practice of the Illuminating Engineering Society at its opening meeting, a report on progress prepared by the Technical Committee and summarizing advances in lighting and photometry during the past year was presented, and a series of exhibits was arranged. Among the most striking of these was a new form of small electric discharge lamp (80 watt and 125 watt), produced by leading manufacturers in Great Britain. This lamp, which resembles in size and shape an ordinary filament lamp, is the first of the kind capable of being applied (with only a choke in circuit) on circuits of 200–250 volts (A.C.) for domestic and office use. These lamps have an initial efficiency of 40 lumens per watt and an average efficiency of 30 lumens per watt during life. Of considerable interest also were the demonstrations of the effect of bulbs coated with fluorescent powder, whereby the natural spectrum of the light can be considerably improved, and of various stroboscopic effects. Other exhibits included a model illuminated aerodrome and a model stage, improved forms of catalytic methods of ignition for gas burners, and a method of studying the brightness of illuminated roadways by the aid of accurate photographs taken by artificial light.

The Microscope in Engineering and Industry

THIS was the subject chosen by Mr. A. E. Bingham for the address with which, as chairman, he opened the session of the Junior Institution of Engineers on October 9. After explaining the lens system of the modern instrument, he gave a résumé of its history and evolution to its present capacity for the production of photomicrographs of metallic surfaces with great clearness at high magnifications. In the majority of engineering investigations, the specimens under examination are opaque, and the difficulties of illumination and the most advantageous methods to use were discussed, as also were the preparation of metallic specimens and the making of photomicrographs. The petrological microscope, as used for the magnification of rock sections of less than one thousandth of an inch in thickness, and for their examination under polarized light, was also introduced. Many examples of the applications of microscopy were given, among them the examination and measurement of particles of abrasive powders, determination of the lengths of fibres used in the paper, artificial silk and other industries, checking the results of heat treatment of steel, hardness testing, and the examination of profiles of screws, wheel teeth, and small products by means of the profile projector.

Alcoholism and Psychiatry

THE seventeenth Norman Kerr Memorial Lecture before the Society for the Study of Inebriety was delivered by Dr. D. K. Henderson, professor of psychiatry at the University of Edinburgh and physician superintendent of the Royal Edinburgh Hospital for Mental Diseases, on October 13, the subject being alcoholism and psychiatry. At the outset, Dr. Henderson stated that though the admission rate to his hospital for cases of mental disorder due to alcoholism has been reduced from one half to one third of what it was twenty to thirty years ago, much more could be accomplished by more intense propaganda, educational campaigns and all manner of social influences. It is, however, by the methods and technique of psychiatry that the causation of alcoholism can best be elucidated and the best modes of treatment devised. It is essential, he declared, that alcoholism should be regarded as an illness or disease and not as a crime or misdemeanour, as is still done even to-day by some medical practitioners. Dr. Henderson then discussed alcoholism as a cause of homicide, assault, sex offences with adults or children and suicide, as well as the effect of parental alcoholism on the children and the relation of alcoholism to mental disease. In conclusion, he urged that the lunacy laws, which he said are archaic both in name and form, should be replaced by mental health laws applicable to all groups of nervous and mental disease.

Co-operation in Bibliography

THE movement for co-operation in bibliography has received an important impetus from the Bataafsche Petroleum Maatschappij. This company classifies, by means of the Decimal Classification, 150,000 references annually to literature in chemistry, physics, etc., and their applications. We learn from Dr. S. C. Bradford that, since March last, the firm has contributed copies of its non-secret references to the Science Library, for intercalation, with titles from other sources using the standard classification, in its Subject-Matter Index of 2¼ million references to scientific papers. This valuable contribution exemplifies the new spirit of co-operation in bibliography, which is surely achieving the production of a complete index to the records of discovery and invention. It is interesting to note, also, that Dr. Maximilian Pflücke, the editor of the *Chemisches Zentralblatt*, is collaborating in the production of the German edition of the Decimal Classification.

The Liverpool Biological Society

THE fiftieth anniversary of the Liverpool Biological Society is an event of more than local importance in that the large amount of original work by its members has wide significance, particularly through the foundations laid by one of its most prominent leaders, the late Sir William Herdman. Founded in 1886, the Liverpool Biological Society has since worked in close association with the Department of Zoology of the University of Liverpool, the Lancashire Sea Fisheries Laboratory and the Liverpool Marine Biological Committee which was started as a section of it, but some years ago, on the origin of the Department and chair of oceanography at the University, was absorbed in that. The *Transactions* of the Society have been issued annually and contain a wealth of original papers. The Society has always had distinguished presidents, some prominent past names being Profs. W. Mitchell Banks, Sir William Herdman, R. J. Harvey Gibson, Robert Newstead, P. G. H. Boswell, W. Dakin and J. Johnstone; the present holder of the office is Dr. R. J. Daniel. It was Sir William Herdman, in pre-War days, who succeeded in interesting city businessmen in the Society's activities, thereby increasing its financial support and enabling it to build up a valuable library. In 1924, the Liverpool Heredity Society amalgamated with it, following which special attention was given to this side of biological study. Although the Society's membership was 130 ten years ago, it now musters only about sixty, chiefly connected with the University. With its annual meeting in October, it meets, usually, at the University, every month during winter, with occasional summer excursions.

American Cultural Origins

THE latest addition to the excellent series of "Leaflets" describing the collections of the Field Museum of Natural History, Chicago ("Archaeology of South America". By Eric J. Thompson. Leaflet 33. Field Museum of Natural History, Chicago. Pp. 160, 12 pls., 18 text-figures and 1 map), is an introduction to, and description of, the cases in the museum covering the archæology of South America. An account of the culture of the separate and distinct geographical and cultural areas of the sub-continent is preceded, by way of introduction, by a concise review of current theory of American origins. The indigenous civilization of South America, when the pre-Inca and Inca peoples are taken into account, ranges from the greatest achievements in social organization and material development of the New World before Columbus to what is perhaps the most backward of any culture known among surviving primitive peoples—the culture of the Yahgans of Tierra del Fuego, a people who in their native state have not advanced so far as polishing stone.

THE Yahgans are taken, with reservations, as representing the culture of the earliest immigrants into the continent. The physical characters of the earlier arrivals probably were those of the Lagoa Santa skull type. Such innovations as basketry, bow and arrow and the domestic dog may, it is thought, have been brought in by the third wave of immigration, broad-headed peoples, also coming from Asia. The turning point in cultural development is the introduction of agriculture. Mr. Thompson is inclined to the view, now current, that the origins of the advanced American civilization must be sought in South rather than Central America; and he is disposed to hold that the domestication of plants, which took place about five to eight thousand years ago, began in eastern South America with the cultivation of manioc, rather than, as is generally assumed, in Central America with the development of maize from the wild grass Teocentli (*Euchlaena mexicana*). While Mr. Thompson rejects so low an estimate as two thousand years as the period of man's existence on the continent, he does not consider that a higher antiquity than twenty thousand years is probable.

Artificial Lakes in Africa

A REMARKABLE proposal for the formation of several great lakes in the interior of Africa in order to create cultivable land and stores of hydro-electric power is outlined in a report issued by Science Service, of Washington, D.C. The project emanates from H. Soergel, of Munich. A great dam two and a half miles long about 500 miles from the mouth of the Congo would turn the basin into an inland sea with an area of about 350,000 sq. miles. An outlet by the lower Congo would provide abundant water power or, alternatively, an outlet could be arranged to the north to create a second inland sea centring around Lake Chad, which would drain through existing wadis to the west, north-east and east by a "second Nile" to the Gulf of Gabes in the Mediterranean. This new river would provide irrigation water for vast areas in the French and Italian Sahara. A further suggestion is for a dam on the Zambezi River above Victoria Falls in order to create an inland sea over much of the Kalahari desert. Herr Soergel does not discuss the effect of evaporation on the projected Chad and Victoria Seas, both of which would lie in almost rainless regions.

Bee Control in Czechoslovakia

WE learn from the *Bee World* that Czechoslovakia is taking drastic steps in dealing with Acarine disease. The new law insists on treatment with the recognized British or Frow remedy of all colonies within 10 km. of an infested hive. Stocks found to be weak in mid-August are to be destroyed. The use of methyl salicylate is ordered during the spring up to honey flow, in all stocks discovered to be infested after over-wintering.

Indian Association for the Cultivation of Science

INDIAN physics, under the leadership of Sir C. V. Raman and Prof. M. N. Saha, has an established position; and it is interesting to read, in its report for 1935, a history of the Indian Association for the Cultivation of Science, an institution which has played a large, if not the dominant, part in bringing about this result. The Association was founded in 1870, and the laboratory, built in 1890, later became an active centre of research under the stimulating guidance of Raman, who was succeeded as Mahendralal Sircar professor by Dr. K. S. Krishnan. The financial and administrative arrangements have lately been re-organized and a material annual grant obtained from the Government of India, which accordingly has a voice in the management. The work of the past year covers a fairly wide range and includes studies of molecular structure, of magnetic effects and of optical phenomena. There is, therefore, every ground for anticipating the maintenance of full activity.

Anti-Rabic Treatment at Kasauli

IN the annual report of the Pasteur Institute of India, Kasauli, for 1934, the Director states that 1,471 Europeans and 15,380 Asiatics were treated at Kasauli and associated centres, a total increase of 913 compared with 1933. Of the treated cases, one death was reported among Europeans, and 90 among Asiatics, a mortality among the latter of 0·53 per cent, the lowest death-rate recorded during the last ten years. In addition, 671 courses of vaccine for the prophylactic treatment of animals were issued during the year. The vaccine employed is a carbolized 5 per cent Paris sheep vaccine.

Tuberculosis and Cattle

A FURTHER issue of the Register of Herds attested under the Tuberculosis (Attested Herds) Schemes, England and Wales and Scotland, has been published jointly by the Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1, and the Department of Agriculture for Scotland, Queen Street, Edinburgh, 2. It contains particulars of 117 herds in England and Wales and 144 herds in Scotland which had been attested up to July 31, 1936. Since the previous issue of the Register on March 31, 1936, 36 herds have been added in England and Wales and 56 in Scotland.

Parliamentary Science Committee

LAST April the Parliamentary Science Committee received the adhesion of the Association of British Zoologists. Recently it has had the gratification of the accession of another body devoted to biology, the Association of Applied Biologists. The Committee is already strong in support from bodies devoted to applied and mechanical science, and the strengthening of the biological support was much desired. The aggregate membership of the Committee's constituent bodies is now upwards of 100,000.

International Association for Testing Materials

THE Congress of the International Association for Testing Materials is to be held in London in April next. The subjects to be discussed are divided into four groups, A (Metals), B (Inorganic Materials), C (Organic Materials), and D (Subjects of General Importance), each of which is presided over by a distinguished worker from overseas. The last Congress for Testing Materials was held in 1931, and every effort is being made to ensure that the knowledge in this most important field will be brought completely up to date. The papers will be presented in the form of summaries, so that a vast amount of information will be made available in easily accessible form. Particulars of the Congress can be obtained from the honorary secretary, Mr. K. Headlam-Morley, at the offices of the British Committee, International Association for Testing Materials, 28 Victoria Street, London, S.W.1.

Announcements

THE Right Hon. Lord Balfour of Burleigh, and Prof. John Mellanby, Waynflete professor of physiology in the University of Oxford, have been appointed members of the Medical Research Council, in succession to the Most Hon. the Marquess of

Linlithgow, and Prof. E. D. Adrian, who retired in rotation on September 30. The appointment of Prof. Mellanby was made after consultation with the Medical Research Council and with the president of the Royal Society. Lord Balfour has been appointed to succeed Lord Linlithgow as chairman of the Medical Research Council.

A DINNER will be held at the Hyde Park Hotel, Knightsbridge, London, S.W.1, on November 24, at 7.30 for 8.0 p.m., when the president of the British Science Guild, the Right Hon. Lord Melchett, will preside. At the dinner, a presentation from supporters of the Guild will be made to Sir Richard Gregory, chairman of the Council of Management, in recognition of his services to science generally and to the British Science Guild in particular.

AT a meeting of the Advisory Council of the Imperial Institute on Mineral Resources, Sir Robert Hadfield, who is a member of the Council and has been interested in the mineral work of the Institute for many years past, announced that he wished to make a contribution of £1,000 to promote the compilation of mineral brochures by the Institute. The Director accepted this generous offer with gratitude on behalf of the Board of Governors. In making this offer, Sir Robert emphasized the importance of iron and ferro-alloy metals to the Empire, and expressed a hope that this importance would be recognized in the brochure programme of the Institute.

DR. OTTO KNOPF, professor of astronomy at Jena since 1923 and director of the Jena Observatory since 1900, celebrated his eightieth birthday on September 24, and Prof. Wladimir Köppen of Graz, formerly head of the naval observatory at Hamburg, was ninety years of age on September 25.

PROF. R. ZAUNICK, of Dresden, has been awarded the Sudhoff Medal by the German Society of the History of Medicine, Natural Science and Technique for his lecture on Karl Gustav Carus and his Dresden circle.

DR. WILLIAM HALLOCK PARK has retired from the chair of bacteriology and preventive medicine at the University of New York after thirty-eight years service on the staff of the College of Medicine. Dr. Park is the founder of the New York City Public Health Laboratories, on which he has served for forty-two years as director.

A SPECIAL institute for experimental physiology and therapeutics has been organized at the Pirogoff military hospital, Moscow, where researches will be made in physiology, physiochemistry and biochemistry.

DURING the first five months of this year the number of deaths from motor accidents in New York City fell to 9·3 per 100,000, which is the lowest figure hitherto reached in the towns in the United States. In New York State the number has fallen by 14 per cent, 829 persons having been killed in comparison with 965 during the same period in 1935.

THE thirty-fifth Congress of the Italian Society for the Progress of Science will be held at Tripoli on November 1–7 at the same time as the meeting of the Royal Italian Geographical Society, and will constitute the first Italian Scientific Congress of the Fascist Colonial Empire. The programme will include papers on hygiene and colonial pathology, with special reference to the sanitary, prophylactic and eugenic organization of the Italian colonies. Further information can be obtained from the Segretaria generale, Società Italiana per il progresso delle scienze, Via del Collegio 26, Rome.

THE *Proceedings and Transactions of the South London Entomological and Natural History Society* for 1935–36 form a record of a successful year's activities which close with the Society in a satisfactory financial condition. This publication, which appears annually, contains papers of both general and more specialized interest to naturalists, together with records of field meetings and of various congresses. The most extensive article is by Mr. Kenneth J. Hayward, and is an account of a collecting expedition along the Alto Parana, Argentina, illustrated by interesting photographs.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A chief technical instructor in the Government Trade School, Haifa—The Secretary (SIR/CA), Board of Education, Whitehall, S.W.1 (October 26).

Three technical officers, two assistants (Grade I), and one assistant (Grade II) in the Directorate of Technical Development, Air Ministry—The Secretary, Air Ministry (S.2.D./405), Adastral House, Kingsway, W.C.2 (October 30).

Assistants (Grades I and II) in the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (October 30).

A lecturer in pathology in the University and pathologist to the Queen's Hospital, Birmingham—The Secretary of the University (October 31).

A head of the Science Department, West Ham Municipal College—The Town Clerk (November 6).

A professor of applied chemistry in Andhra University—The High Commissioner for India (December 20).

A mechanical engineer, an architectural adviser and an assistant engineer to the Copper Development Association—The General Manager, Copper Development Association, Thames House, Millbank, London, S.W.1.

An assistant lecturer in education in University College, Exeter—The Registrar.

A professor of mathematics in University College, Southampton—The Registrar.

Civil engineering and architectural assistants in the drawing office of H.M. Dockyard, Portsmouth—The Civil Engineer-in-Chief, Admiralty, S.W.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 724.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Dentition of *Australopithecus* *

THE importance of *Australopithecus* as a possible near relative of man is such that it seems but right that the world should have the facts at the earliest moment after they are fully confirmed.

The Taungs ape is represented only by the skull of a six-year-old 'child'; and though some of its human-like characters are due in part to the infantile condition, there are a number of others that seem to show that it is more nearly related to man than to the chimpanzee. Of these, the most convincing is the structure of the milk molars, which agree closely with those of man and differ very greatly from those of the chimpanzee and gorilla. But owing to the superficial general resemblance of the skull to that of a young chimpanzee, many seem still to be inclined to regard the Taungs ape as a variety of chimpanzee.

The discovery at Sterkfontein of the adult skull of an allied species is thus of great importance. It will be some months naturally before a full account of the skull can be published as the bone is very friable, and development has to be done slowly, but as the upper dentition is now almost fully known, a preliminary account of it cannot fail to be of interest.

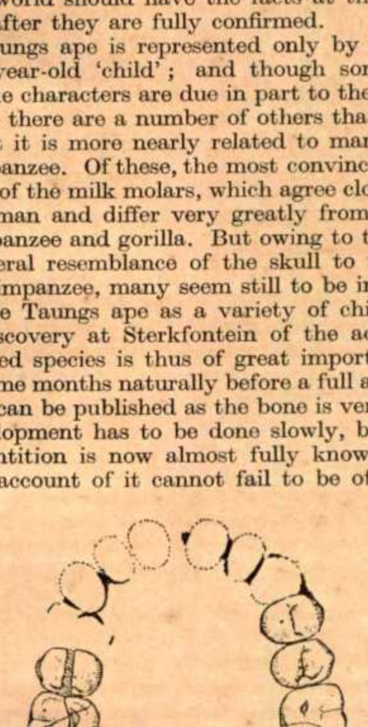

FIG. 1. The upper dental arch of *Australopithecus transvaalensis* Broom. As the maxillæ are detached, the exact relation of one to the other is uncertain. Three of the teeth of the right maxilla have been cracked and the fragments pushed apart during fossilization, but otherwise they are practically perfect. ⅔ natural size.

When I sent off the first notice of the discovery a few days after the find was made (see NATURE, Sept. 19, p. 486), only the upper part of the skull and the right maxilla were known. In the stone on the left side of the left orbit I later discovered the nearly perfect left maxilla, with both premolars and the 1st and 2nd molars in perfect condition and the sockets of the incisors and canine. The 3rd molar is probably also present but it cannot be displayed without destroying an important part of the skull.

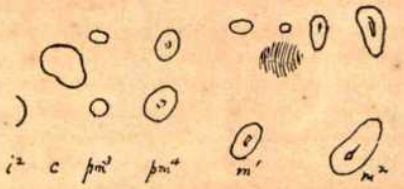

FIG. 2. Irregular section across the roots of some of the teeth of the right maxilla of *Australopithecus transvaalensis* Broom; the little shaded area between the roots of m^1 is part of the floor of the maxillary antrum. Note the remarkable degree to which the roots of the molars spread. Natural size.

The premolars and 1st molars are so remarkably human-like that there is scarcely a doubt that had they been found without the skull they would have been held by most to be human. They bear no close resemblance to the corresponding teeth in the chimpanzee. Each premolar has only two roots.

The canines are relatively small, and the incisors large. Perhaps the most striking character is the fact that the canine and the 2nd incisor are in contact as in man, and not with a gap between them as in living anthropoids.

It is unnecessary at present to discuss in detail the various features of the dentition, but Figs. 1 and 2 are sufficient to show that the Sterkfontein ape at least is not a chimpanzee, and that it approaches man in quite a number of characters.

R. BROOM.

Transvaal Museum,
Pretoria.
Sept. 29.

A New Upper Triassic Fossil Insect Bed in Queensland

SOME four years ago, two members of the staff of the Queensland Geological Survey, Messrs. Owen Jones and Denmead, picked up at Mount Crosby, some thirty miles inland from Brisbane, two finely preserved cockroach tegmina on pieces of dark brown shale. These were sent to me for description, and proved to belong to two new species of the genus *Triassoblatta*, originally described from the Rhaetic of Ipswich, Queensland (a locality about seven miles from Mount Crosby).

On my visit to Queensland in June 1936, members of the University of Queensland and of the Geological Survey, including Mr. Denmead, accompanied me to this locality. The original bed of shale, from which the cockroach tegmina came, was found without much difficulty. It appears to represent the mud deposit of the stream-bed of an ancient river which flowed sluggishly between high banks of older Brisbane Tuff. The age of the beds is definitely older than that of the Ipswich fossil insect beds, and may be placed with considerable certainty as Upper Triassic. The insect-bearing shales lie beneath a loose conglomerate, and are only about ten inches thick. Insect remains are abundant but mostly fragmentary, and are found in association with the following plants: *Schizoneura*, *Thinnfeldia*, *Baiera*, *Voltzia* and a Cycadophyte. The remains of the genus *Triassoblatta* include fore and hind wings, heads, pronota, thoracic and abdominal sclerites, all evidently having been separated by gentle maceration in the stream bed and fossilized separately. They total about half the whole number of fossil insects so far discovered.

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* Published by permission of the Trustees, Transvaal Museum, Pretoria.

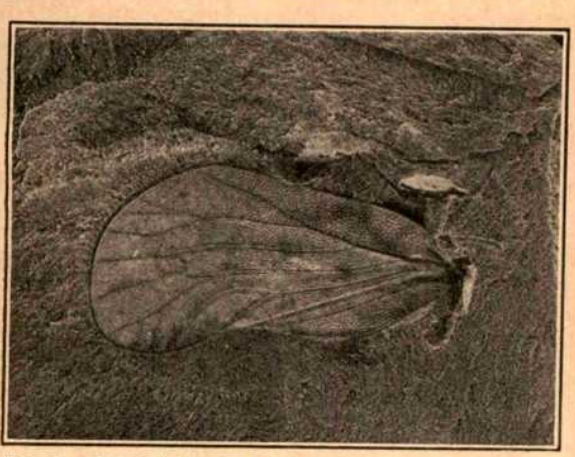

FIG. 1. Complete tegmen of a specialized Scytinopterid type (order Homoptera, division Auchinorrhyncha) in process of becoming a true Heteropterous type. Length 12 mm.; Upper Triassic of Mount Crosby, Queensland. Photo by Walter James.

The dominant order in families, genera and species is the Homoptera, with the following groups: Prosbolidæ, Scytinopteridæ, Fulgoroidea, Jassoidea and Psylloidea. The photograph (Fig. 1) shows the most remarkable of a number of perfectly preserved homopterous tegmina, in the shape of one which appears to be turning from a Scytinopterid type into a true Heteropteron. This is the first clear indication from palæontology of the probable mode of origin of the Heteroptera from the older Homoptera.

Next in importance are the Coleoptera, represented by elytra, heads and bodies. They are all small types, the largest being about 8 mm. in length (elytron), and the smallest only about 1 mm. long and therefore the tiniest fossil insect so far discovered. The Ipswich genus *Ademosyne* is well represented, but the beetle fauna is nothing like so abundant as at Ipswich.

Next in point of interest come the Trichoptera, with three entirely new types, two being perfect forewings. These are easily the oldest known Trichoptera, and represent almost perfectly the archetypic wing already postulated in my previous papers.

The older order Paratrichoptera is only represented by a single tiny wing, which could be classed as a Dipteron were it not for the form of its anal area.

A magnificent wing, practically perfect, introduces the true order Diptera as a member of this fauna. It has the general form of a Tipulid, with three-branched radial sector, but the anal area is of Tanyderid form, with only a single anal vein. As usual, the action of the water on this wing has caused considerable longitudinal rucking.

Some fine mecopterous types are present, including the genus *Mesochorista*, originally described from Ipswich, and a fine type ancestral to *Archipanorpa* and apparently also closely related to the Orthophlebiidæ of the Lias in the northern hemisphere.

True Neuroptera are represented by three new types, one being a perfect wing allied to the Berothidæ. Other orders, unfortunately so far only represented by fragmentary wings, are the Odonata and Orthoptera.

A total of more than two hundred specimens has now been obtained as a result of breaking up less than a cubic yard of shale. No less than fourteen specimens were found by splitting one small piece about four inches long by three inches wide and about an inch thick. Unfortunately, the amount of suitable material available is strictly limited, but the discovery promises to be one of the most interesting of recent years, and helps to fill the gap between the Upper Permian and the Rhætic.

A monograph on the above insect fauna is now in course of preparation.

R. J. TILLYARD.

Canberra, F.C.T.,
Australia.

The Gondwana Affinities of the Angara Flora in the Light of Geological Evidence

THE late Palæozoic flora of northern Russia and Siberia has long been known to include a certain element remarkable for its suspected affinities with the *Glossopteris* flora[1]. Prof. Zalessky, to whom much of our recent knowledge of the Angara flora is due, has been the chief exponent of the Gondwana affinities of the northern flora[2]. Prof. Halle believes (probably with some justice) that these affinities have been somewhat over-emphasized. But no one, so far as I know, has denied that some striking resemblances exist, and the view has been repeatedly expressed that there must have been some means of communication between the Gondwana and Angara continents.

The idea of a northward migration of plants from Gondwanaland is now forty years old, and has been advocated by many palæobotanists including Seward, Zalessky, Newell Arber, Grabau and myself[3]. In 1918, Zalessky suggested that either the two continents were once connected by an isthmus, or else some other means of intermigration, such as a dense group of islands, must have existed. Grabau[4] wrote: "It is possible that this northward migration of the Gondwana flora occurred during Carboniferous (pre-Permian) time, though so far as we know there were no direct land connections". The most obvious, if not the only, route seemed to me to be that through Kashmir[5], and I even suggested that possibly Kashmir was only a southern outpost of Angaraland. But data from the critical region between Kashmir and the known southern limit of the Angara flora were lacking, and are still awaited.

D. N. Wadia's brilliant work on the syntaxis of the north-west Himalaya[6] seemed at first to suggest that the marine barrier of the Himalayan geosyncline was too complete to allow migration of land plants to the northern continent. Nevertheless, the resemblance between some of the northern and southern types seemed to me too striking to be due to chance. I therefore wrote in a recent paper[7] as follows: "In the face of these considerations, Zalessky's hypothesis of a connecting isthmus or a chain of islands across the Tethys does seem bold, but then the Gondwana resemblances of the Angara flora, which, I believe, are undeniable though they may have been exaggerated, must be explained by an indirect route, still to be discovered."

Unfortunately for us palæobotanists, at a congress in Heerlen (September 11, 1935) when these matters were discussed in a geological atmosphere, we could not induce Mr. Wadia, who was present, to take part in the discussion. For had he done so, we would have learned, there and then, that he had already found this much-needed evidence of a means of communication with the north, during his recent field work in north-west Kashmir and Hazara[8]. According to Wadia, until as late as the end of the Middle Carboniferous, a continuous land bridge must have stretched from the Punjab as far as the Pamir plateau and possibly beyond. This is proved by the occurrence of a well-marked regional unconformity between the marine Dogra slates, which are probably of Cambrian age, and the overlying agglomeratic slate, regarded as not older than Upper Carboniferous. The long period of time from the Cambrian until at least the end of the Middle Carboniferous was therefore a land period* in this area. This land bridge, as stated, must have stretched at least as far as the Pamir plateau. What the conditions were farther north we shall only know from the work of our Russian colleagues: quite possibly the land bridge was unbroken as far as the northern continent.

Wadia further states that even during Upper Carboniferous and Permian times, the Kashmir portion of the Tethys must have been studded with an archipelago of volcanic islands, which may well have permitted some intercourse for land plants between India and the north. Proof of this is to be found in the presence of carbonaceous matter as well as recognizable impressions of Gondwana plants at six or seven localities in the Permo-Carboniferous tuffs so extensively developed in this region.

I confess that, not being a geologist, I had at first failed to appreciate the full implications of this work, although I had read it early in 1935. Mr. Wadia, in his turn, told me recently that he had not at first realized how important for palæobotanists was the evidence that he had found. Zalessky's idea of a possible archipelago in the Tethys, which may have served as stepping-stones for terrestrial forms of life migrating north, thus emerges as a prophetic utterance.

It remains to add that it is at Mr. Wadia's suggestion that I am writing the present note, which has been read by him. If conditions permit, we hope to present the whole evidence, from our respective points of view, before the International Geological Congress to be held in Moscow next year. On that occasion I also hope to be able to bring with me typical specimens of Indian Lower Gondwana plants for a direct comparison, now more urgent than ever, with the Gondwanoid members of the northern flora.

B. SAHNI.

University, Lucknow.
Aug. 8.

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* There is here a possibility of finding evidence of the Devonian flora, which has not so far been discovered in India.

[1] Amalitzky, *Trav. Soc. Imp. Nat. St. Pétersb.*, 28 (1897); *ibid.*, *Compt. rend.*, 132, 591 (1901), Zeiller, *Bull. Soc Bot. France*, 392 (1898); Schmalhausen, *Mém. Acad. Imp. Sci. St. Pétersb.*, 27, 4 (1879).

[2] Zalessky, *Mém. Com. Géol. N.S*, Livr., 174, 5–6 (1918)

[3] Seward, "Plant Life through the Ages", pp. 161, 252 (1933).

[4] Grabau, "Stratigraphy of China", Pt. 1, Palæozoic and Older, p. 407 (1923–24).

[5] Sahni, *Proc. 13th Ind Sci. Congr*, Pres. Addr. (Geol. Sec.) Bombay, pp. 239–240 (Jan. 1926).

[6] Wadia, *Rec. Geol. Surv. Ind.*, 65 (ii), 189 (1931).

[7] Sahni, *Current Science*, 4, 388 (1935).

[8] Wadia, *Rec Geol. Surv. Ind*, 68 (ii), 144 (1934)

Early Chinese Glass from Pre-Han to T'ang Times

IN a previous letter[1], Beck and Seligman described the analysis of a large ornamental glass "eye-bead" from the Han Chün graves near old Lo Yang, dating back to the second half of the third century B.C. or perhaps even earlier. This bead had the surprisingly high specific gravity of 3·57, and proved to be essentially a lead-barium silicate, with small amounts of soda, lime, alumina, etc. Prompted by this unexpected result, we have now extended our examination to a series of thirty-two specimens of Chinese glass, covering some twelve centuries, pre-Han and Han (*c.* 250 B.C., or earlier – A.D. 220) and T'ang (A.D. 618–907). Within these broad limits, there is little reasonable doubt as to the correct dating of the pre-Han and Han specimens. It is more difficult to be certain of the T'ang; perhaps all the specimens so attributed may be of this period, and some certainly are. As most of the specimens were of considerable value, only minute samples could be removed for analysis. The work was carried out spectrographically, and though accurately qualitative, no attempt was made to place it on more than an approximately quantitative basis.

While it is obviously not permissible to generalize too freely from such a limited number of specimens, a broad general fact emerges—namely, that in passing from pre-Han to T'ang times, Chinese glass tends to change from a lead-barium silicate type (so far unique) to a lead-soda-lime silicate type and to the more common soda-lime silicate type. The results may be grouped as follows:

(1) Twenty-three specimens of pre-Han and Han glass were examined, including eleven "eye-beads", more or less resembling the type originally described. Twenty belonged essentially to the system $PbO : BaO : SiO_2$, with small amounts of soda, lime, etc.; the lead was usually accompanied by tin and silver, and often by traces of bismuth and antimony. The specific gravity ranged from 3·25 to 5·25. The remaining three specimens contained no barium.

(2) Nine specimens of T'ang glass were examined. Seven were essentially soda-lime silicates, and two lead-soda-lime silicates. No barium was found, save a trace in three specimens.

An extended statement of the spectrographic analyses summarized in this preliminary note will be published by one of us (P. D. R.) in "Technical Studies in the Field of the Fine Arts", together with analyses of a number of intermediate specimens, which are less definitely dated but may be thought to range from the post-Han period to that of the Wei, say, third to sixth centuries A.D.

C. G. SELIGMAN.
P. D. RITCHIE.
H. C. BECK.

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[1] NATURE, 133, 982 (1934).

A Cosmic Ray Burst at a Depth equivalent to 800 m. of Water

WE have recently made measurements of cosmic ray intensities in the Simidu tunnel of the Government Railways of Japan. The measurements were carried out at different positions along its length of 9·7 km., in order to find the penetration of cosmic rays through various thicknesses of rocks, which consist mainly of diolite, the average density being probably 2·8. The measuring apparatus was the Neher electroscope[1] with which Dr. Millikan kindly supplied us. The ionization chamber of diameter 15 cm. was covered with 11 cm. of lead and was left at each place for about 24 hours. The vertical thickness of rocks varied from 1,230 m. to 120 m., corresponding to about 3,400 m. and 340 m. of water-equivalent respectively.

The results of the measurements are given in the accompanying table. The minimum thickness of rocks overhead was calculated from the contour lines of a map and is naturally not exact. The ionization values were calculated according to the constant of the instrument determined and communicated to us by Dr. Neher. They should be taken as relative values rather than absolute, because the difference in the surrounding conditions might have caused a minute change in the constant of the instrument.

Vertical thickness of rocks (m.)	120	175	220	325*	650	1230
Its water-equivalent (m.)	340	490	620	910	1800	3400
Minimum thickness of rocks (m.)	120	175	175	290	540	880
Its water-equivalent (m.)	340	490	490	810	1500	2500
Ions/cm.^{3}/sec./atm. (Cosmic rays + residual)	0·230 ± 0·001	0·223 ± 0 003	0·224 ± 0·003	0 222 ± 0·004	0·221 ± 0·002	0·220 ± 0 004

* A burst of about 10^7 ions was observed at this position.

Unfortunately, the residual ionization which Dr. Neher determined by going 70 m. underground is rather large (0·23 ions/cm.^{3}/sec./atm.) and the instrument is not suited for the present purpose. From the decrease of ionization with depth shown in the table we see the indication of the penetration of cosmic rays through much thicker layers of matter than has hitherto been observed[2]. The fluctuation of the ionization, however, is larger than the difference of ionization between the succeeding depths, and no definite inference in this regard can be made at present.

One conclusion, however, which we can draw from our results, is that the cosmic rays can definitely pass through more than 800 m. of water, and probably go much deeper. We observed, for example, a burst of the size of about 10^7 ions at a vertical depth of 325 m. (min. depth 290 m.), corresponding to a much greater penetration than has hitherto been directly observed. Both Kolhorster and Corlin[3] made measurements with an ionization chamber down to 800 m. water-equivalent underground. The cosmic ray intensity at this point was tentatively assumed to be zero. From the above results, however, we see that there still remains a very small part even at this depth.

Our measurements were made possible by the courtesy of the Bureau of Maintenance of the Japanese Government Railways, and our thanks are especially due to Mr. H. Asonuma and Dr. T. Watanabe of the Department of Railways, as well as Prof. M. Ishimoto of the Imperial University, Tokyo, for their interest in this work, and to Mr. Minamide and others at Minakami Station who offered us much assistance.

Y. NISHINA.
C. ISHII.

Cosmic Ray Sub-Committee of the
Foundation for the Promotion of
Scientific and Industrial Research
of Japan, Tokyo. Sept. 10.

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[1] Cf. R. A. Millikan and H. V. Neher, *Phys. Rev.*, **50**, 15 (1936).

[2] W. Kolhorster, *Sitz. Pr. Ak. Wiss.*, 689 (1933); NATURE, **132**, 407 (1933). A. Corlin, NATURE, **133**, 63 (1934), *Ann. Observatory Lund*, No 4, A, 95 (1934).

[3] loc. cit.

Radioactive Isotopes of Nickel and Copper

IT has been shown by Fermi and co-workers[1] and by Bjerge and Westcott[2] that the activity induced in zinc through neutron bombardment is due to an isotope of copper. Considering the well-known possibilities of the formation of active substances by a neutron bombardment, it is evident that the possibility of forming an active isotope of nickel is implied. Now, by means of an apparatus formerly described[3], the formation of active nickel from zinc irradiated with neutrons has been actually shown.

The experiments were carried out with metallic zinc powder. After activation, it was dissolved in nitric acid and a trace of cupric oxide and of nickel sulphate was added. The copper was precipitated from the acid solution by means of hydrogen sulphide. After filtration, ammonium chloride in excess was added to the filtrate, next dimethylglyoxime was added, and finally the acid solution was made alkaline by the addition of ammonium hydroxide. The red precipitate was ignited and placed in a counter in a manner formerly described[4]. The activity decayed with a period of nearly 100 minutes. McLennan and others[5] have found a period of 100 minutes produced by slow neutrons in metallic zinc. Perhaps this is the same activity as that mentioned here. Rotblat[6] and Naidu[7], however, found a period for nickel formed by means of neutron irradiation of nickel to be 3 hours. These results may indicate the possibility of the existence of two active isotopes of nickel—possibly $^{63}_{28}$Ni and $^{65}_{28}$Ni.

The period of the active copper has also been measured. The copper sulphide was dissolved in nitric acid and transformed to cupric oxide. The period of this product was measured and found to be 17 hours. This result is not in accord with the results of Fermi and of Bjerge and Westcott, who found 10 hours and 6 hours respectively. Special care was taken in the measurements during the first twenty hours to find, if possible, a shorter period, but the decay curves only gave the 17-hour period. Van Voorhis[8] has reported an activity produced in copper by deuteron bombardment, supposed to be due to an isotope $^{64}_{29}$Cu, with a period of 12·8 hours, emitting both positrons and electrons. It seems difficult at present to reconcile these observations, apparently giving four different decay periods for the same isotope. As the experimental method only allows detection of active products with fairly long periods, the 5-minute period of copper was not found.

The number of particles counted from the nickel is only one tenth of that from the same amount of copper.

Attempts to isolate active chlorine from irradiated potassium gave negative results. This may be due to the possibility that it is not $^{36}_{17}$Cl, but $^{38}_{17}$Cl which is the bearer of the chlorine activity already known.

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Sept. 22.

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[1] Fermi and others, *Proc. Roy. Soc*, A, **149**, 522 (1935).

[2] Bjerge and Westcott, NATURE, **134**, 286 (1934).

[3] Madsen, *Z. Phys.*, **101**, 72 (1936).

[4] Buch Andersen, *Z. Phys.*, **98**, 597 (1936).

[5] McLennan and others, NATURE, **135**, 505 (1935).

[6] Rotblat, NATURE, **136**, 515 (1935).

[7] Naidu, NATURE, **137**, 578 (1936).

[8] Van Voorhis, *Phys. Rev.*, **49**, 876 (1936).

Evidence for the Expulsion of Two Neutrons from Copper and Zinc by One Fast Neutron

COPPER and zinc were bombarded with neutrons from different sources. The results are represented in the following table:

Source of neutrons	Periods	
	Copper	Zinc
$^2H + ^2H$	6 m. (weak)	No activity
$^2H + ^2H + P$ $Be + ^2H + P$	6 m.	60 m
$Be + ^2H$	6 m. (weak)	No activity
$Li + ^2H$	10·5 ± 0·5 m.	6 m. 60 m.
$Li + ^2H + Ag + Cd$	10·5 ± 0·5 m.	6 m. 60 m.

P means that paraffin was used to slow down the neutrons. Ag + Cd means that a sheet of 0·2 mm. silver and one of 0·2 mm. cadmium were placed between source and bombarded material in order to stop slow neutrons.

The 6-minute period of copper most probably corresponds to the 5-minute period reported by Fermi and his collaborators[1]. The 10·5-minute period appears with the fast neutrons from ($Li + ^2H$) only. An initial activity of 1,200 impulses per minute was measured. An activity of about 11 minutes observed in cobalt bombarded with slow neutrons and in nickel with fast neutrons (which may be the same as the 20-minute period reported by Rotblat[2]) might lead to the assumption that an active cobalt isotope is produced here. We found, however, that this assumption is not justified.

The 60-minute period of zinc induced by slow neutrons probably corresponds to the 100-minute period reported by McLennan, Grimmet and Read[3], the 6-minute period to that reported by Fermi and his collaborators[1].

The same 60-minute period appears, however, with the fast neutrons from the ($Li + ^2H + Ag + Cd$) source, and not with those from the ($^2H + ^2H$) or ($Be + ^2H$) source, which excludes the possibility of ascribing this activity to the action of slow neutrons; it indicates that neutrons of considerable energy are essential here.

A chemical separation of the radioactive substances was attempted by Mr. R. W. P. de Vries. As to copper (10·5-minute period): cobalt and nickel precipitated in different ways were found to be inactive. Copper precipitated electrolytically was active. As to zinc (60-minute period obtained with fast neutrons): precipitated nickel was inactive. Copper showed a 6-minute and a 10–12 hour period, as was to be expected. Zinc precipitated electrolytically from the solution showed the 60-minute period. Both activities must therefore be ascribed to isotopes of the irradiated elements.

An investigation of the particles emitted by copper (10·5-minute period) by means of magnetic deflection *in vacuo* and a Geiger-Müller counter proved these to be positrons. A period of about 10 minutes was found for these deflected positrons. The intensity of the 60-minute period of zinc was too small to observe the deflected particles with certainty.

From these data we may infer that the following reactions take place with fast neutrons:

$$^{63}Cu + {}^1n \rightarrow {}^{62}Cu + 2\,{}^1n \qquad {}^{62}Cu \rightarrow {}^{62}Ni + e^+$$
$$^{66}Zn + {}^1n \rightarrow {}^{65}Zn + 2\,{}^1n \qquad {}^{65}Zn \rightarrow {}^{65}Cu + e^+$$

We found the same zinc isotope to be formed by capture of a slow neutron:

$$^{64}Zn + {}^1n \rightarrow {}^{65}Zn.$$

The possibility of the type of reaction described was discussed by Fermi[4] but up to the present it had not been observed with certainty (cf. L. Meitner and O. Hahn[5] and Johnson and Hamblin[6]).

Further details and a description of our apparatus will appear elsewhere.

F. A. HEYN.

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Sept. 30.

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[1] *Proc. Roy. Soc.*, A, 149, 522 (1935).
[2] NATURE, 136, 515 (1936).
[3] NATURE, 135, 505 (1935).
[4] *Proc. Roy. Soc.*, A, 146, 483 (1934).
[5] *Naturwiss.*, 24, 158 (1936).
[6] NATURE, 138, 504 (1936).

Thermal Properties of Helium, Hydrogen and Deuterium

IT has been shown by F. Simon[1] and F. London[2] that the abnormally large specific volume and compressibility of helium and hydrogen can be understood by considering the influence of the zero point motion. Clusius and Bartholomé[3] pointed out that this zero point motion is also responsible for the fact that the specific heat of hydrogen is nearly equal to that of deuterium. They remarked that it is no longer legitimate here to represent the potential energy as a quadratic function of the deviations of the particles from their equilibrium positions.

As at low temperatures only long heat waves, which are harmonic, contribute to the specific heat, and the frequencies of these waves are determined by the velocity of sound, the specific heat near the absolute zero can be calculated if the velocity of sound is known.

It is possible to derive a 'Schrödinger equation' for a crystal deformed by a long wave. The deformation energy, derived with the help of this equation, contains not only a change in the potential energy but also in the kinetic energy. An expression for θ is obtained in which the two effects are separated:

$$\theta^2 = \frac{1}{2\pi^2 l^2}\,\frac{h^2}{mk^2}\left[\frac{s}{2} + \frac{\pi^2 h^2}{2^8 m l^4}\right],$$

where m is the mass of the particle, s the second derivative of the molecular field at a lattice point and l is a length which is equal to or smaller than $a - \sigma$ (a is distance between nearest neighbours, σ is molecular diameter).

Taking $l = a - \sigma$, and omitting s (which means that the molecules are replaced by hard spheres) the following results are obtained:

	Mol vol.	σ	l	θ calc.	θ exp. (0° K.)
He	19·88	2·35	1·24	29 2	34·0 [4]
	19 32	,,	1·21	30·8	36·0 [4]
	18·35	,,	1·15	33·9	39·5 [4]
H_2	23·31	2·80	0·98	93·7	91 [5]
D_2	20·48	,,	0·83	65·7	89 [3]

The rather large deviation shown by deuterium may be due to the fact that it is not permissible to omit s in this case, and the value of l is only an upper limit.

Some conclusions about the thermal expansion can also be deduced by this formula. According to Debye's theory[6], the thermal expansion contains the factor $-\delta\theta/\delta V$. For increasing volume, s becomes negative and then becomes zero. At very small densities it may therefore give a positive contribution in $\delta\theta/\delta V$. So the thermal expansion might become negative for very small densities.

Although the formula only holds for crystals, this might still be an indication of how the negative expansion coefficient of 'liquid' helium II is to be explained.

A detailed account will be published in *Physica*. My thanks are due to Dr. A. Michels for stimulating discussions.

A. BIJL.

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Amsterdam.

[1] NATURE, **133**, 529 (1934); **138**, 244 (1936).
[2] *Proc. Roy. Soc.*, A, **153**, 576 (1936).
[3] *Z. phys. Chem.*, B, **30**, 237 (1935).
[4] W. H. Keesom and A. P. Keesom, *Physica*, **3**, 105 (1936).
[5] Simon und Lange, *Z. Phys.*, **15**, 307 (1923).
[6] "Vortrage uber kin. Theorie der Materie."

Electrification of a Roof during a Thunderstorm

A LETTER from my daughter in Jamaica refers to her house being affected electrically in a curious manner. She was sitting on the verandah during a thunderstorm when she heard "a funny sound like the buzzing of a bumble-bee", and saw that the verandah gutter was emitting sparks and smoke. Running to the kitchen to get a bucket of water, she found the legs of the stove, where they rested on the stone floor, spluttering sparks. She threw a bucket of water on them, and in doing so "got quite a bad shock and the bucket was torn out of my hands". On returning to the verandah, the gutter was still emitting sparks.

The explanation of this affair appears—from my knowledge of the house—to be as follows. The roof—its ridge about 25 ft. above the ground—is of galvanized iron, and is insulated from 'earth' except via the kitchen stove funnel. The guttering is fastened to wooden verandah pillars and normally is not in contact with the roof. The single down-pipe of the guttering leads to a water tank and presumably is earthed.

I imagine that what occurred is this: somehow the partially insulated roof became charged as one plate of a condenser, and the charge, being insufficient to break through the resistance to earth in one discharge, leaked away gradually via the weak contact of the stove legs with the floor and also via the small gap between the roof and the gutter. The shock my daughter got was obviously due to the thrown water forming another channel for discharge via the bucket and herself.

W. F. TYLER.

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S.W.1.
Sept. 24.

Points from Foregoing Letters

DR. BROOM has now prepared a description, with diagrams, of teeth belonging to the fossil skull, *Australopithecus transvaalensis*, described by him in NATURE of September 19, p. 486. It will be recalled that the skull was found at Sterkfontein, Transvaal, and is of presumably Upper Pleistocene age. The teeth differ from those of the chimpanzee and resemble those of man in many respects.

A photograph of a fossil wing-cover of an insect from the Upper Triassic of Queensland, showing transition from characters of the order Homoptera to those of Heteroptera, is submitted by Dr. R. J. Tillyard. The bed from which it was obtained is rich in insects; some two hundred specimens belonging to various orders (Homoptera, Coleoptera, Trichoptera, etc.) have been found in less than a cubic yard of shale.

A continuous land-bridge must have stretched in Permian to Middle Carboniferous times from the Gondwanaland (the Palæozoic continent which spanned the South Atlantic and Indian Oceans) northwards through the Punjab as far as the Pamir Plateau and possibly beyond. Commenting on the evidence for this view, supplied by the investigations of D. N. Wadia in the Himalaya, Prof. B. Sahni points out its importance to the old hypothesis of a land connexion between Gondwanaland in the south and Angaraland (which included a great part of eastern Siberia) in the north across the Thetis Sea (of which the Mediterranean is a remnant).

Chemical analysis of early Chinese glass indicates that in the period from pre-Han (before A.D. 220) to T'ang times (A.D. 618) Chinese glass tends to change from lead-barium silicate type to the more common soda-lime silicate type. The investigation was carried out spectrographically on minute samples by Prof. C. G. Seligman, Dr. P. D. Ritchie and H. C. Beck.

Dr. Y. Nishina and C. Ishii have recently made measurements of cosmic ray intensities in a railway tunnel under a vertical thickness of rock (diolite) varying from 1,230 m. to 120 m., water-equivalent about 3,400 m. and 340 m. respectively. At a vertical thickness of 325 m. (minimum thickness 290 m.) a burst of 10^7 ions was observed, which proves the presence of cosmic rays after passing through rock the absorption of which is equivalent to that of more than 800 m. of water.

The chemical identification of radioactive nickel, of nearly 100 minutes period, prepared by irradiation of zinc with neutrons, is described by Dr. C. B. Madsen. Radioactive copper was also obtained, with a period of 17 hours. Bombarding copper and zinc with neutrons, according to F. A. Heyn, leads to expulsion of other neutrons and formation of radioactive isotopes of the elements irradiated.

An equation for calculating specific heats at very low temperatures (near the absolute zero), if the velocity of sound is known, is given by A. Bijl. In the case of helium and hydrogen, the calculated values agree with those experimentally observed, but in the case of heavy hydrogen there is a wide discrepancy. This, the author considers, may be due to the fact that the simplifying assumption—that molecules behave like hard spheres—is not permissible in the case of heavy hydrogen.

Research Items

Physical Characters of the Cook Islanders

To a series of monographs on the physical characters of the native populations of Polynesia, Dr. H. L. Shapiro and Dr. P. H. Buck (Te Rangi Hiroa) have added a study of the Cook Islanders, based on material collected by Dr. Buck in 1926 and 1929 (*Mem. Bernice P. Bishop Museum*, 12, No. 1). The process of disintegration has not gone so far in Cook Islands as in other parts of Polynesia, and it is still possible to find there a representative example of true Polynesians. Although strictly speaking the Cook Islands are limited to six, three others, Manihiki, Rakahanga and Tongareva are included. Of the 913 individuals examined, a number were rejected as unsuitable, and the records here studied are derived from 804 individuals, of whom 551 are males and 253 females. Ten measurements and twenty observations were taken. The characteristic features show that the Cook Islanders are akin to other Polynesian groups. Tall, robust, and well developed, they show a typical tendency to brachycephaly, with a massive face and characteristic combination of broad bizygomatic diameters with high narrow foreheads. The nose is large and fleshy and the lips full. In complexion they are moderately brown-skinned with dark, straight, or wavy hair, which, though luxuriant on the head, is only sparsely developed on the body and face. The eyes are full and dark-brown, and the epicanthus is usually absent. The archipelagic uniformity which is characteristic of other parts of Polynesia, with one exception, is completely lacking here. The exception is the resemblance between Manihiki and Rakahanga. Certain characters, however, bind the islanders into a homogeneous group, while in others, such as nose height, face height, head length and span, the islanders are differentiated one from another. Two distinct types, however, can be established with several intergrades, the differences to be allotted to Central. Western and Maori strains.

Proficiency and Psychological Tests

REPORT No. 74 of the Industrial Health Research Board, by E. Farmer and E. G. Chambers, is a study of the prognostic value of some psychological tests. In all, 2,731 men from fourteen occupational groups were tested with a number of psychological tests, and the data were examined to see to what degree proficiency at the tests was related to proficiency at the different occupations. Statistical treatment of the results showed that the psychological tests given to adolescents did have prognostic value in the skilled groups, but that they were of no diagnostic value for proficiency in the unskilled groups. There was also no evidence to show that psychological tests can afford a measure of the factors involved in the proficiency of those already proficient. The report is extremely valuable, not only for its positive conclusions but also because it shows the very great complexity both of the processes involved in proficiency and in the interrelation of the various psychological functions. Vocational selection is an infinitely more difficult problem than some enthusiasts for testing realize.

Birds of Bay Islands, Spanish Honduras

"LAS ISLAS DE LA BAHIA" form a chain of islands in the Caribbean Sea, off the north coast of Honduras. They are little known, and have a very limited fauna, land shells being particularly scarce. James Bond has described the resident birds of the islands, 43 species or subspecies, five of the latter being new to science (*Proc. Acad. Nat. Sci. Philadelphia*, 88, 353; 1936). The resident bird fauna is fundamentally of Central American type, and the island chain must be looked upon as the tops of a submerged mountain range, which through isolation from the mainland have retained a number of Central American species. These relict forms have entirely or almost disappeared from Central America proper, but they appear, again as relicts, on islands off the coast of Yucatan.

Reproduction in the Chimpanzee

THERE are about twenty published records of the birth of chimpanzees in captivity, but in none of these cases has the whole process been described in the full detail which is given in a recent paper by J. H. Elder and R. M. Yerkes (*Proc. Roy. Soc.*, B, 120, 409; 1936). This paper reports fifteen births (one of them twins) which have occurred during the last six years in the Yale Laboratories of Primate Biology. Fertilization, pregnancy, parturition and the puerperium are fully described. Impregnation occurs about, or slightly after, the midpoint of the 35-day sexual cycle. The average duration of pregnancy was 236 days—about 30 days shorter than in man. Menstrual bleeding does not commonly recur after conception. Almost without exception, the chimpanzee female during pregnancy and nursing is much more gentle, friendly, dependable and easily handled than at other times.

Genetical Constitution of *Drosophila pseudo-obscura*

LIGHT is thrown on the relationships of species by a comparison of their mutations. Mr. H. P. Donald (*J. Genetics*, 33, No. 1) has investigated the forty-five known mutations of *Drosophila pseudo-obscura* in comparison with those of *D. melanogaster*, and gives revised linkage maps for its five pairs of chromosomes. A number of the mutants are similar to those of *D. melanogaster*; for example, the autosomal types bithorax, glass, stubble, pink, cross-veinless and jaunty, and the sex-linked mutations known as pointed (= beaded), yellow, scutellar, white, singed, vermilion and miniature. Linkage maps of the two species, connecting genes which are supposed to be homologous, indicate that various rearrangements of the genetic material have taken place, and that these have been intrachromosomal more frequently than interchromosomal. Considerable homology is indicated between corresponding chromosomes or whole arms of chromosomes in the two species. Despite a number of translocations involving changes in the positions of one or more genes, the loci involved appear to have retained largely the same phenotypic effects, variability and mutability as before.

Radioactive Elements in Plants

THE continued interest in the relation of radioactivity to plant growth focuses attention on the paucity of information available as to the presence of radioactive elements in plants. K. Kunasheva and B. Brunowsky, of the Biogeochemical Laboratory of the Academy of Sciences at Moscow, who have already published work dealing with the presence of elements of the thorium series in duckweed, have reported in a letter to the Editor the results of quantitative determinations of uranium in the same species. They find the uranium content to be $9 \cdot 5 \times 10^{-5}$ per cent. By the same method the radium content was found to be $2 \cdot 38 \times 10^{-11}$ per cent. On the basis of these figures, the ratio Ra : U for duckweed is calculated as $2 \cdot 7 \times 10^{-7}$, that is, within the limits of error in measurements, uranium is in equilibrium with radium. Details of the method and results of the measurements are to be published in a forthcoming issue of the *Proceedings of the Biogeochemical Laboratory of the Academy of Sciences*.

A New Genus of Mesembryanthemum

The late Dr. N. E. Brown left a manuscript note of six species of shrubby South African mesembryanthemums. He included these in a new genus, *Mestoklema* (Gr. *Mestos*, full, *klema*, a small branch), and full descriptions of the species appear in the *Gardeners' Chronicle* of August 29. *Mestoklema* is allied to the older genus *Delosperma*, but differs in its peculiar branched habit, the very small flowers, the persistent, hardened, subspinose cymes, and the closed cells of the capsule, which are provided with cell wings.

The South Sandwich Trench

To the north and east of the South Sandwich Islands in the South Atlantic on the edge of the Weddell Sea, the *Meteor*, and later *Discovery II*, took some unexpectedly deep soundings exceeding seven thousand metres. This area was further sounded in the most recent cruise of *Discovery II* and is provisionally mapped in a paper by Dr. N. A. Mackintosh on "The Third Commission of the R.S.S. Discovery II" in the *Geographical Journal* of October. The trench seems to extend in an arc about a hundred miles to the east of the line of volcanic peaks which constitute the group of South Sandwich Islands. On the north it ends in about lat. 55° S., and in its northern part it is widest and deepest, falling to below eight thousand metres. To the south it narrows to a cleft of more than seven thousand metres, less than ten miles wide in its deepest parts. This remarkable cleft has not yet been traced south of about lat. 61° S., where it seems to curve towards the west, south of the ridge joining the South Sandwich and South Orkney Islands.

'Polaroid'

DEMONSTRATIONS of some technical uses of the new polarizing material 'Polaroid' are being given by appointment with Messrs. Polaroid Products, Ltd., 39 Lombard Street, E.C.3 (Telephone, Mansion House 2997). This firm is the representative agent in Great Britain of the American manufacturers of the polarizing film described by Prof. A. F. C. Pollard in NATURE of August 22 (p. 311) and now named the International Polaroid Corporation, New Jersey, U.S.A., with its laboratories in Boston. The film, which formerly consisted of nitrocellulose, but now consists of the less inflammable cellulose acetate, contains sub-microscopic crystals of herapathite with their optic axes oriented in one direction parallel to one another, and is made in the two grades designated Types I and II. Type I is intended for use in optical systems and instruments, whereas Type II is intended for use over light sources when plane polarized illumination is required. Type I may be obtained clear or dyed in various colours. Type II is not optically clear, but polarizes light just as efficiently as Type I and is cemented to one side of glass sheet. Messrs. Polaroid Products, Ltd., supply Type I film, cemented between glass plates of optical quality sufficiently good for most purposes and mounted in bakelite rims with an aperture of 4 cm. Disks, ¼–4 in. diameter, and squares of the same dimensions, with the film cemented to one side of the glass only can also be supplied immediately. The American concern is now manufacturing film 2–2½ ft. wide, and, we are informed, will supply 'Polaroid' in production quantities in the near future. Amongst the technical applications of 'Polaroid' to be seen at the demonstration there is the elimination of glare by motor-car headlights, a very striking and beautiful stereoscopic cinema projection in natural colours, a large apertured stereoscope which can be viewed by several people at the same time, a strain viewer and some effects with colourless 'Cellophane' cut out to form pictures which in polarized light appear in a variety of interference colours. In addition, a lamp is arranged to give strong polarized illumination so that the texture of the skin may be examined by the aid of a 'Polaroid' screen.

A Fairthorne–Salt Mathematical Film

A CINEMA film to show the qualitative properties of the differential equation $\ddot{x} + x = 0$ has been produced by R. A. Fairthorne and B. G. D. Salt and can be obtained from the former at Kirk Michael, Hillfield Road, Farnborough, Hants. It shows two disks of variable radius, revolving at constant speed. The radius of one represents the acceleration $\ddot{x}$, so the length of a string unrolled from it represents the velocity $\dot{x}$. The radius of the second disk is equal to the length of this string, and so represents this velocity, and the length of a string unrolled from it represents the distance x. By arranging that the length of this second string, taken in a certain direction, is numerically equal to the radius of the first disk, we get the differential equation. This arrangement may be regarded as embodying the fundamental ideas of the differential analysers used by Dr. Bush at Massachusetts Institute of Technology or Prof. D. R. Hartree at the University of Manchester. The film can be obtained on 35 mm., 16 mm. or 9·5 mm. stock. The methods used can be extended to other differential equations, as was explained in a paper by Mr. Fairthorne read before the International Congress of Mathematics at Oslo last July.

ERRATUM.—In the summary prepared for NATURE of Dr. I. V. Newman's paper before the Linnean Society of New South Wales on the angiospermic carpel (NATURE, August 1, p. 209), the third conclusion, that "the legume is not a foliar structure", is incorrect. It should read "the evidence is compatible with the legume being a foliar structure".

The Second International Cancer Congress

THE Second International Cancer Congress, held at Brussels under the auspices of L'Union Internationale contre le Cancer, terminated on September 28. Between three and four hundred surgeons, physicians, radiologists and research workers, drawn from forty-seven different countries, were in attendance, and were welcomed by M. Lerat, president of the Congress; by M. Justin Godart, president of L'Union Internationale contre le Cancer; and by M. Vandervelde, (Belgian) Minister of Health, in the presence of H.M. The King of the Belgians.

Great Britain was officially represented by Dr. W. Cramer, Col. A. B. Smallman, Mr. Sampson Handley, Mr. J. J. Shaw, and Mr. Cecil Rowntree. There was also a large group of workers from the great research centres, which included Dr. W. E. Gye, Prof. E. L. Kennaway, Prof. J. W. Cook, Dr. R. D. Passey, Prof. Mathew Stewart, Dr. Dorothy Russell, Dr. P. D. Peacock, Dr. Donaldson, and Mr. Stanford Cade.

The Belgian Committee, to whom the organization of the Congress had been entrusted by the Union Internationale, by a wealth of private and public hospitality did much to establish a degree of intimacy between the nationals of so many diverse countries, and added greatly to the success of the Congress.

Among the more notable official occasions was a reception by the Prime Minister and Mme. van Zeeland held at the beautiful Musée Cinquantenaire; and a banquet at which speeches were made by representatives of Germany, France, Great Britain, Italy, Spain, Greece and Sweden expressing their appreciation of the great scientific and social success of the Congress. During the latter, one delegate felt that song was the only suitable medium with which to express his feelings, and brought down the house with his delightful rendering of "Qui ne sait boire, ne sait rien".

But perhaps the most interesting event—in any event so far as the delegates from the British Empire were concerned—was the reception on the last evening at the Fondation Universitaire, when the opportunity was taken to present to Profs. Kennaway and Cook the prize award of the Union Internationale. The allocation of this prize to the two English research workers was unanimously voted at a meeting of the Council of the Union. It consists of a sum of money and a quantity of radium, generously placed at the disposal of the Union Internationale by the Union Minière [see NATURE, Oct. 3, p. 579].

In addition to a large number of independent papers, thirty-five official reports were presented. All the different aspects of the cancer problem came under consideration, and the subjects ranged from the demonstration of micro-puncture of cells by ultra-violet rays, to the provision of hospital accommodation for incurable cancer patients.

For the presentation of the communications, six different sections had been created, and by skilful organization it had been arranged that papers relating to allied subjects were read in one section, and so far as possible at the same meeting. One of the most interesting meetings was a discussion on carcinogenesis, in which Profs. Kennaway and Cook spoke on chemical compounds as carcinogenic agents, and Dr. Gye on tumours transmissible with viruses. At a subsequent meeting, Prof. F. Pentimalli (Florence) submitted a report on the nature of the agent present in two filtrable fowl tumours. The hereditary factors in cancer were discussed by Dr. Clara Lynch (New York), Prof. Maud Slye (Chicago), Dr. L. Kreyberg (Oslo), Prof. Nadine Dobrovolskaia-Zavadskaia (Paris), Prof. R. Korteweg (Amsterdam), Dr. Wilhelmina Dunning (New York), and Prof. A. Hintze (Berlin).

Communications on the experimental investigation of cancer were submitted by Dr. P. R. Peacock (Glasgow), Prof. R. D. Passey (Leeds), Prof. J. McIntosh (London), Dr. O. Schürch (Winterthur), Prof. Oberndorfer (Istanboul), Dr. I. Berenblum (Leeds), and others. The interesting new subject of transplantable fibro-adenomata of rats and their transformation into sarcomata was discussed by Dr. Ch. Oberling (Paris), and Dr. J. Heiman (New York). Mr. Sampson Handley (London) presented his thesis on the etological importance of lymph stasis.

On the subject of the diagnosis of cancer, Dr. J. Ewing (New York) read a report on problems in histological diagnosis, whilst Prof. L. Hirszfeld (Warsaw), Prof. P. Rondoni (Milan) and Prof. P. Del Rio Hortega (who had specially travelled from Madrid to attend the Congress), discussed the serological and sero-cytological diagnosis of cancer. Dr. Dorothy Russell showed her instructive film demonstrating the tissue culture of gliomata.

The papers read in the section of radiotherapy by Prof. F. Carter Wood (New York), Prof. H. R. Schniz (Zurich), and Dr. L. Mallet (Paris) gave an indication of the progress made in this important branch of cancer therapy as a result of a better understanding of the mode of action of X-rays and radium. By a modification of the previous technique, Schinz has succeeded in obtaining in tumours of the mesopharynx, in which previously radiotherapy had been a failure, a remarkably high percentage of five-year-cures. Schinz also emphasized the importance of radiotherapy as a palliative measure in cancer. This aspect was dealt with in greater detail in the communication of Dr. Mallet. He has applied systematically tele-X-ray therapy to patients in advanced stages of cancer, by exposing large parts of the body at long distances. He showed by numerous illustrations that his method enables him to check the progress of the disease in advanced stages of cancer of the uterus and of the œsophagus, and also in metastases in bones and lungs. Mr. Stanford Cade gave an account of the results obtained by the Curie therapy in pharyngeal cancer.

In the Social Section, the importance of statistics as a scientific method for the investigation of the etiological factors of cancer in man was emphasized in reports by Dr. L. I. Dublin (New York), Dr. W. Cramer (London), and Dr. S. Peller (Jerusalem). Some of the American and German delegates, believing that a morbidity statistic would advance our knowledge, submitted a resolution that the compulsory notification of cancer is advisable from this point of view, and that the Union Internationale should appoint a committee to consider this question.

The incidence of cancer in different races was discussed by Prof. C. Bonne (Batavia), and M. J. A. des Ligneris (South Africa).

The thorny problem of the medical treatment of cancer was discussed in numerous communications. One of these methods which, described as a polyvalent hormonetherapy, had received a good deal of notice in the Continental press, was submitted to a devastating criticism; while the more serious attempts by Prof. E. Freund and Dr. Kaminer of Vienna, which were frankly admitted to be mainly of a palliative nature, were listened to with respectful scepticism.

The general feeling among the delegates was that definite progress has been made both in our understanding of the disease and in the methods of treatment; and that a continuation of this progress is assured. This feeling found expression in the conclusion submitted at the final meeting, in which it was stated, for the first time officially, that cancer is a disease which is not only curable, but also, within limits, preventable.

National Smoke Abatement Exhibition

DURING October, an exhibition and conference is being held under the auspices of the National Smoke Abatement Society in the Science Museum, South Kensington. The interesting Handbook (Pp. 78. Price 6*d*.) published by the Society, the offices of which are at 36 King Street, Manchester, contains twelve articles on various aspects, which are reinforced by another dozen addresses at the Conference held at the Science Museum on October 14–17. Dr. des Voeux, reviewing the smoke abatement movement, mentioned that an exhibition of appliances was held in 1885. Actually one was held still earlier, in November 1881, under most influential auspices and also in South Kensington (NATURE, 25, 219; 1882). The writer has been informed that the organizers were prosecuted for causing a smoke nuisance. Many would be interested to learn that a grate designed by Sir W. Siemens for burning coke and fitted with a gas burner for ignition was a prominent exhibit (NATURE, 23, 25; 1881). The promoters of the 1881 exhibition would have been surprised to learn that a problem which they understood would still await solution after half a century.

Technically, of course, a solution is possible, but the obstacle is a lack of will. Generally speaking, enthusiasts for smoke abatement lack power and influence commensurate with their knowledge and vision. They control neither politics nor finance. As a result it is rare, even now, to find in local government any party making atmospheric cleanliness a primary object of policy. Alteration may, however, come soon. It may be realized by property owners that upper floors of buildings in central urban areas might serve as attractive residential quarters if the air were freed from smoke. That realization might create an interest in smoke abatement in people now indifferent though suffering from the depreciation in value of urban property due to a flight to the suburbs. In one of the papers read, Mr. Noel Carrington blamed the decay of civic spirit in large cities for the lukewarm interest in the smoke nuisance. Those who do not live near their work are prone to be indifferent about the conditions there.

The present activity in rebuilding cities offers an unprecedented chance of replacing smoky by clean fuel appliances, but generally speaking the opportunity is neglected. The opportunity is recognized by public health officials—as shown in Dr. A. S. M. Macgregor's paper on the work of his department in Glasgow; but public opinion rarely gives adequate backing.

The development of flying has brought support to the movement from a new quarter. Flight-Lieut. H. M. Schofield's paper described with terse emphasis how aviation is hindered in Great Britain by atmospheric conditions.

There is no doubt that improvement has taken place in the matter of industrial smoke, but the advance is uneven. In many light industries, the spread in the use of gas and electricity has removed the need for boiler plants, and new factories are often smokeless. However, as H. G. Clinch described, there is often great difficulty in enforcing a high standard, and this is increased by the reluctance of employers to encourage and reward technical training among working stokers.

The heavy industries offer another problem, for generally they are protected by law from prosecution for unavoidable smoke. This exemption has generally deprived them of a strong incentive to seek to avoid smoke. As Mr. H. C. Armstrong said in his paper, Sheffield opinion held that their "steels could not be made without smoke". This was due to the recognized need for maintaining a reducing atmosphere in furnaces. That this could only be done by keeping smoking coal fires seemed so axiomatic as to need no investigation. Recent studies have largely destroyed the basis for this opinion, and new practices are developing in Sheffield and Rotherham, assisted by the development of the 'grid' conveying gas from the coke ovens to the steel works. Mr. Armstrong shows clearly that large technical and financial difficulties retard the rapid abolition of coal-fired furnaces, and that much depends on the availability of cheap gas. A definite amelioration can be looked for.

The same point follows from the examination of the problem of smoke in the clay industries by E. Rowden and A. T. Green. It must have puzzled many to understand why the makers of artistic ceramic ware should be content to live in the atmosphere of the Potteries. The firing of clayware is, however, beset with peculiar technical problems which often demand the use of intermittent kilns. When these are fired by coal, smoke production is inevitable, but efforts are being made to diminish this. Headway is being made with the use of town gas-fired kilns when possible, but cost of fuel is a limiting factor.

These industrial examples show the need for making gaseous fuel cheap if industrial smoke is to be reduced. At the moment, the case of the South Metropolitan Gas Co. has brought forward prominently the question of gas charges, and those interested in smoke abatement will welcome tariffs framed to encourage the displacement of raw coal, not only in the home, but also in industry.

Dr. M. Fishenden reviewed the problem of domestic fuel problems in an illuminating manner, and concluded that although any rapid cure is impossible, present trends to the use of gas, coke, electricity, anthracite should in time be effective.

Three papers dealt with the medical aspects of smoke abatement, two of them with tuberculosis. To-day when the improvement of physique is increasingly regarded as of national concern, it is time to expect that the State will act as though the reduction of atmospheric pollution were something of national importance. A paper by Sir Arthur Hill and Dr. C. R. Metcalfe, on the effect of such pollution upon plants at the Royal Botanic Gardens, Kew, illustrated the direct interest of a public department in the subject.

Only a few of the papers have been mentioned, but all merit study, and together form a very comprehensive survey of the problem as it stands to-day.

H. J. HODSMAN.

Pedology (Soil Science) at the British Association

THE assignment of pedology (or soil science as it is still, unfortunately, termed) to Section M (Agriculture) of the British Association is the natural outcome of its historical development from a branch of agricultural chemistry. But although, in its applied aspect, it has the closest and most vital connexion with agriculture, it is to be feared that it is not entirely at home in the agricultural section. Indeed, if the geologists could be persuaded to adopt it, pedology might more fittingly find a home in Section C. It is probably the exception rather than the rule for papers or discussions to be interesting, or even intelligible, to all attending members, even in the senior sections of the British Association. Section M, however, is expected to be more popular in its appeal, and it might be better in future years to introduce pedology in the form of joint meetings with other sections. Problems of applied pedology might still be assigned to Section M.

One session in Section M on September 14 at Blackpool was devoted to pedology. The president, Prof. J. Hendrick, devoted his address to a review of the development of soil studies in the twentieth century. He directed attention to the great change which has taken place in our outlook on soil science since the beginning of the century. At that time there were no British text-books on the subject, little was known of work in other countries, and the soil was regarded simply as a medium for the growth of crops. Since that time, our outlook has been widened both by the recognition of the soil as an object of study in itself and also by the extension of our interest to include not only British soils but also those of other lands. The study of soils is essentially international, and Prof. Hendrick traced the development of that active organization, the International Society of Soil Science, which held its third Congress in England last year. In the remainder of the address, the newer conceptions in pedology were briefly adumbrated. In conclusion, Prof. Hendrick dwelt on the applied aspect of the subject and its impact on society. Increased knowledge means the possibility of increased production and even over-production, problems for the economist and the social reformer. Yet, whilst malnutrition and under-nutrition exist, even in a prosperous country like Great Britain, the fear of over-production is not likely to restrain the soil investigator from pursuing that fundamental knowledge from which progress in practice ensues.

The remainder of the session was devoted to three different aspects of pedology. Prof. G. W. Robinson dealt with the problems and difficulties of soil classification. Pedology as an independent branch of inquiry being still comparatively youthful, the principles of soil classification have not yet been so clearly defined as in the older disciplines. Whilst there is general agreement in regarding the soil profile as the unit of study, it is not always easy to define its lower limit. Further, actual profiles are not always developed to climax. Apart from complications due to immaturity of development, human interference introduces a group of soil-forming factors which must be accorded their place in a scheme of classification. The importance of giving relevant and precise information about soil profiles was stressed. Much of the published descriptive material is almost valueless through irrelevance and lack of precision. Whilst the final elaboration of a world system of classification must await the accumulation of more information, it seems possible to distinguish three main groups, depending on the character of the leaching processes, namely, (1) completely leached soils; (2) incompletely leached soils; and (3) soils with impeded leaching.

The effect of human interference as a pedogenic factor was raised in the discussion, and it was agreed that the study of soil history is of great importance for the comprehension of contemporary soils.

Dr. R. K. Schofield dealt with the behaviour of soil moisture in the field. Given the importance of soil moisture for the growth of plants, and remembering that the interstitial space of soils is the reservoir not only of water but also of air, the importance of studying the moisture conditions of the soil in profile is evident. Ideally, it would be desirable to follow the moisture changes and movements in each horizon throughout the year. By frequent sampling, a certain amount of information may be obtained, and Dr. Schofield gave the results of observations on the classical Broadbalk field at Rothamsted, on a soil in Utah, and on a soil in the Sudan—the last two under the influence of irrigation.

One of the most striking advances in our knowledge of soil moisture has been the virtual abandonment of the 'capillary-tube hypothesis' and the recognition of the limited role of capillary action in determining water movements in soils. This was stressed in the ensuing discussion by Dr. B. A. Keen, who gave a striking instance of the way in which erroneous ideas of the influence of a deep water-table on surface moisture conditions can still enter into questions of compensation in public schemes for water supply.

Dr. A. B. Stewart dealt with a group of problems in applied pedology by describing the methods used in the advisory service at the Macaulay Institute, Aberdeen. The problems are attacked by three methods, namely, (*a*) field experiments, (*b*) pot experiments, and (*c*) laboratory examination. Since the last method is the cheapest and most convenient, a considerable amount of work has been devoted to correlating laboratory results with field and pot trials. The work is concerned chiefly with the investigation of deficiencies in lime, phosphate and potash. Field and pot experiments are generally in good agreement in the case of potash. In the case of phosphate, agreement is less satisfactory, and the necessity for taking the subsoil conditions into account is suggested. Laboratory methods are, to a large extent, arbitrary and empirical, but, with adequate interpretation, can serve as useful guides to the application of manures and fertilizers.

Soil problems were also dealt with in the session of the Forestry Sub-Section on September 10, where, arising out of an interesting series of papers on afforestation, an animated discussion took place on the possible disadvantages of purely coniferous planting. There was also a discussion on the position of British soils in a world system at a meeting of the British section of the International Society of Soil Science, held in connexion with the Blackpool meeting. G. W. R.

Work of the Government Laboratory

PRESENTING his first report as Government Chemist, Dr. J. J. Fox* refers to the considerable increase in volume and complexity of the work carried out in the Government Laboratory under the direction of his predecessor, Sir Robert Robertson, who held office from March 1921 until April 1936. During this period, the number of samples examined annually rose from about 300,000 to nearly 550,000, whilst the literature of chemistry has been enriched by many accounts of investigations arising out of fiscal and technical developments.

The subject matter of the report follows familiar lines, and provides ample material for satisfaction that the hand of the Government Chemist is on the pulse of so many activities affecting the health and revenues of the nation. Thus one paragraph commences with the words, "In order to ensure that no tea but that which is fit for human food shall pass into the country for human consumption . . .", and records the fact that of the 22,741 samples of imported tea examined during the year ended March 31, 1936, 100 samples, representing 311 packages, were found to contain foreign substances or to be unfit for human consumption. The increase in the number of samples was due principally to the necessity for re-examining nearly 10,000 samples after outbreaks of fire in the warehouses. It is of interest to note that damaged or condemned tea may be used, free of duty, for the manufacture of caffeine, after being suitably denatured with nauseous materials.

Tobacco smokers are informed that in order to maintain the moisture in tobacco and to improve its quality, glycerol or diethylene glycol is added by foreign manufacturers, but such additions are illegal in Great Britain, and the prohibition automatically extends to imported manufactured tobacco. Offal tobacco is used for manufacturing nicotine; now, however, an alkaloid, anabasine, from *Anabasis aphylla*, a weed growing in eastern Europe and northern Africa, is produced for use as a substitute for nicotine in insecticidal preparations. This fact has necessitated researches into methods for the detection of anabasine, and for distinguishing it from nicotine.

Beer is of interest in the Government Laboratory principally in its relation to the revenue, but we are informed in the report that of the 2,115 samples of beer and brewing materials examined, 23 were found to contain arsenic in slight excess of the limit recommended by the Royal Commission on Arsenical Poisoning, namely, the equivalent of one hundredth of a gram of arsenious oxide per pound in solid materials or per gallon in liquids.

Services are rendered to numerous Government departments and offices. Thus the Prison Commission for Scotland desired an opinion on soap; the Post Office on gum, gold thread and ink, among other things; the Mines Department on bath water; the Ministry of Labour on refuse dumps; the Home Office on seized drugs and on matters affecting the health of factory workers; the Ministry of Pensions on Stores supplied to hospitals; and the Board of Inland Revenue on stamps and documents.

Once again we reproduce comments on the composition of cheese and cream. In the paragraph on cheese we read: "The water ranged from 27·0 to 66·8 per cent; the proportion of fat varied from 7·9 to 40·4 per cent of the cheese. . . . As, however, there are no regulations relating to the marking of skimmed or partially skimmed cheese, no exception could be taken to any of the importations". Of tinned cream it is said: "The percentage of fat varied greatly. Two samples contained 50–52 per cent of fat, and the remainder [88] contained from 19–30 per cent. Since there is no standard for cream in this country, exception could not be taken to the samples in respect of low proportion of fat, even when the tins were labelled 'thick cream'". We remind ourselves, with Little Buttercup, that things are seldom what they seem, but we do not find the thought entirely satisfactory.

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* Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending 31st March, 1936; with Appendices. Pp. 46. (London: H.M. Stationery Office, 1936.) 9*d*. net

Progress of the Post Office

IN an address delivered to the meeting of the Portsmouth Brotherhood at Portsmouth on October 18, Mr. J. H. Brebner, the controller of press information for the General Post Office, gave a brief account of the history of the Post Office. He laid stress on the fact that in the early days, about 1800, the Post Office was considered more as an instrument for taxation than as an undertaking to be run for the benefit of the public.

In 1801 the Post Office was called on to make a contribution of £150,000 to the Exchequer. The Secretary of that date thought that this was an excellent opportunity to remedy what he considered a grave defect in its system of charging, namely, that the postage was the same whatever distance the letter was delivered, while obviously the charge should vary with the distance. He therefore fixed new rates proportional to the distance the letter travelled. In 1812, for example, the postage from London to Portsmouth was 8*d*. and from London to Thurso 5*s*. A consequence of these high rates was that the illegal conveyance of letters became general. To stop this, prosecutions were undertaken whenever evidence became available. Sometimes hundreds of prosecutions were proceeding simultaneously, and in one case in Scotland there were twelve hundred.

It is instructive to learn that owing to the increased long-distance telephone traffic, an extensive programme of underground cables costing £4,500,000 will be carried out this year. The traffic has increased so rapidly that to enable additional circuits to be provided in advance of the completion of the new cables, schemes are in hand for doubling the capacity of many of the existing four-wire trunk circuits by dividing them into two-wire circuits. Telephone lines more than 100 miles in length will be provided by means of a twelve-channel carrier system, from which twelve telephone circuits will be obtained. This compares with one circuit by normal methods. In this new system, at repeater stations, at every twenty miles, the power of the speech currents can be amplified 100,000 times. The first twelve-channel system will be brought into use between Bristol and Plymouth about the end of this year.

Those who think that radio communication has displaced submarine cables will be surprised to learn that arrangements have been made for the laying of two submarine cables of a new type between Great Britain and Holland, and for one new cable to Ireland. The two Anglo-Dutch cables will provide eleven circuits and the Anglo-Irish cable will provide eight circuits. It is anticipated that further circuits to meet the ever-increasing traffic will be obtained by the installation of additional terminal equipment at a later date.

In conclusion, Mr. Brebner said that the Post Office, by pursuing a policy of reducing the charges for its various services, has grown to be the largest employer of labour in the country. Its ever-increasing profits approximate thirteen millions annually; telephone calls last year were 1,800 million, showing an increase of 140 million over the preceding year. The remarkable progress of recent years is due to the recognition of the fact that the Post Office should work for the common weal. The results which have been achieved fully justify this policy.

Educational Topics and Events

CAMBRIDGE.—D. H. Valentine, of St. John's College, has been appointed curator of the Botanical Museum and Herbarium.

The degree of M.A. has been conferred on Dr. D. J. Bell, University lecturer in biochemistry.

At Trinity College, the following have been elected into fellowships: Dr. N. Feather, on appointment as assistant lecturer in natural sciences, M. H. L. Pryce, for research in mathematics, A. L. Hodgkin, for research in physiology, and T. T. Paterson, for research in geology.

GLASGOW.—Dr. J. W. McNee, University College, London, has been appointed regius professor of the practice of medicine.

The Rector, Sir Ian Colquhoun, is delivering his rectorial address in St. Andrew's Hall, Glasgow, on October 23, at 11 a.m., and a luncheon in his honour is being held in the Bute Hall of the University.

Prof. J. Graham Kerr, M.P., has presented to the Zoological Department of the University a very valuable collection comprising all his zoological manuscripts and the material on which the work was based, including a unique series of *Lepidosiren* and *Spirula*, Budgett's collections of *Protopterus*, and Minchin's slides and material illustrating his study of sponges. Many other collections of great historical interest are included, and will form a basis for many future investigations. In addition, the gift comprises a collection of more than seven thousand books and pamphlets together with various scientific apparatus, and a unique series of demonstration slides which had been accumulated during his long tenure of the chair at Glasgow. In accordance with Prof. Graham Kerr's wishes, the further study of the research material included in this gift is to be restricted to fully qualified investigators, and their work must be carried out in the Department of Zoology at the University.

Prof. F. O. Bower has presented a valuable Zeiss microscope, together with a very complete series of objectives, for the use of research students in the Department of Botany.

Mr. Lewis H. Littlejohn, of the Botany Department, has been awarded a Colonial agricultural research scholarship, and is spending one year at Cambridge and the second year in Trinidad.

NURSERY education problems were dealt with in two papers read before Section L of the British Association on September 11: one by Miss I. Jones on "Nursery Education in Lancashire" and one by Mrs. M. Wintringham on "Emergency Open-air Nurseries in the Distressed Areas". Both papers comment on the favourable influence nursery schools are capable of exerting not only on the children in them but also on the homes from which they come. Miss Jones described two successfully working examples of nursery education: one in "The Tannery School" comprising a full range of classes with children of ages 3–14 years, where older girls are serviceable in the nursery class, finding thus an outlet for mothering instincts, older boys cultivate and keep in order a school garden, and part of the playing field is available for use by toddlers; the other in "The Titan Works School", having only children up to the age of eleven; here conditions point to development into a 'home school' in which parents intimately co-operate with teachers in meeting the needs of the few nursery children. Mrs. Wintringham said of children who have been cared for in the open-air nurseries in distressed areas that "in all cases the teachers of the infant schools, where the children go afterwards, notice how much more alert they are, more independent and adventurous—willing to try" than the other infants. On the question of the effect on family life of "taking the children away from their mothers", she says there are many instances of little reforms and improvements in the personal habits and domestic life of the parents due to the nursery school training.

MR. E. I. LEWIS has issued a pamphlet, "Preparation for Business Careers" (W. Heffer and Sons, Cambridge. 1*s*. net), advocating a course of teaching during the last year of school life which should be a bridge between school and business. Mr. Lewis's ideas were originally presented in an address to a conference of public school masters. He appears to have in mind mainly boys receiving education of a public school or similar type. He does not attempt to deal, "for our present purposes with students in technical schools, colleges or universities. . . ." Mr. Lewis's suggested course aims at avoiding sectional-mindedness and at producing a view of business as a whole, its several parts working to one end. He realizes the present hampering quality of examinations, and sees that only by a new educational treatment can over-specialization be avoided. He makes points which are not new but are in constant need of emphasis. Classical masters, for example, extol the artistic conception of ancient peoples, but neglect their workmanship and their organizing genius. "Whoever would appraise Egyptian, Greek or Roman engineers might with profit consult their living successors". The treatment of subjects, chemistry for example, in vast detail at too early a stage imposes uneven development and imperils chances of promotion to administrative posts where scientific training is needed. No chemist should be content with an education based solely upon the branches of knowledge which directly meet his professional needs; he should enjoy a liberal education, from which flows broad interests, corrective of the narrowness that threatens men who follow professions shut off from the everyday affairs of their kind. With all of which no one who desires to see the scientific worker accorded his proper sphere in the administration of a scientific and industrial world will disagree. Mr. Lewis gives an outline of the subjects of the proposed "Bridge Course", which is the more stimulating since they will by no means find universal agreement.

Science News a Century Ago

Population of England and Wales

The Times of October 26, 1836, contained an article by T. R. Edmonds, author of "Life Tables", on the "Density of the English Population". "The rapid increase of the English population", he said, "during the last 30 or 40 years is one of the most decisive manifestations of our national prosperity. Whilst other European nations are increasing their food and population at the rate of 8 per cent. every ten years, the population of England is increasing at the rate of 16 per cent. every 10 years. The density of the English population is now much greater than that of any other European nation, with the exception of the Netherlands, which being the commercial depot of Germany, is not a fair comparison. In the different counties of England the variations in the density of the population are very considerable; in the manufacturing counties the density is nearly twice as great as in the agricultural counties. . . . In the year 1821, the mean density of the population of England and Wales was represented by 207 inhabitants to each square mile; in 1831 there were 240 to each square mile; and in 1841 there will be 278 inhabitants to each square mile. . . . The comparative densities of the population in the different counties of England is a subject of some importance to the nation and to capitalists. A given extent of territory may, with few exceptions, be presumed to be wealthy or productive in proportion to the density of the population." The article was accompanied by a table of the counties showing the area and the number of inhabitants per square mile; the latter ranging from 4,817 in Middlesex to 72 in Westmoreland.

Death of William Lax, F.R.S.

ON October 29, 1836, the death took place of the Rev. William Lax, the third Lowndean professor of astronomy at Cambridge. Born in 1761, Lax graduated in 1785 from Trinity College, Cambridge, as senior wrangler; he was a Smith's prizeman, and was afterwards elected a fellow of his college. In 1795, at the age of thirty-four years, he was chosen to succeed Dr. John Smith in the Lowndean chair of astronomy and geometry, and after several years spent in tuition was presented to the livings of Marsworth, Buckinghamshire, and St. Ippolyts in Hertfordshire. At the latter place he erected a small observatory, and it was there he died at the age of seventy-five years. Lax was elected a fellow of the Royal Society in 1796, and in 1799 and 1808 respectively he contributed memoirs to the Society on "A Method of Finding the Latitude of a place by means of the Altitude of the Sun", and "On a Method of examining the Divisions of Astronomical Instruments". His "Tables to be used with the Nautical Almanac" was published by the Board of Longitude in 1821. In Lax's time, the University of Cambridge possessed no observatory, and it was due to his successor, George Peacock (1791–1858), Dean of Ely, that one was erected.

The Brussels and Antwerp Railway

THE first railways to be planned in Belgium were those between Ostend and Liège and Antwerp and Valenciennes, and portions of these were opened in 1836. Referring to the railway line between Antwerp and Brussels, the *Athenæum* of October 29, 1836, said: "We learn from *Le Voleur* that this undertaking, which has been in operation only a few months, has already met with great success. The following is an account of the number of passengers who availed themselves of it in the first four months. In May 101,000; in June 98,000; in July 112,000; in August 117,000; total 428,000. . . . This result is extraordinary. The number exceeds that of the travellers by the Manchester and Liverpool Railway, which is upon the average only 80 per train whilst upon the above it is 200. The average price is 1 fr. per person, and the receipts for the four months in question are more than 430,000 frs., which gives an interest of 5 per cent. on the capital."

Societies and Academies

Paris

Academy of Sciences, September 28 (*C.R.*, 203, 573–592).

Edouard Chatton and Mlle. Berthe Biecheler: New evidence relating to the Coccidinia (parasitic Dinoflagellates). The sexuality of *Coccidinium Mesnili*.

Alberto Gonsàlez Domìnguez : A theorem of M. Glivenko.

Paul Montel : Univalence or local multivalence.

Marcel Servigne : The luminescence of solid substances produced by direct excitation in a Geissler tube. Under the experimental conditions described, the light phenomena observed could not have been caused by the action of gaseous ions ; they were due to ultra-violet rays.

René Dubrisay and Albert Saint-Maxen : Researches on the basic lead acetates.

Louis André Germann : Contribution to the study of the mechanism of the condensation between acetone and formaldehyde.

Henri Labbé and Frédéric Heim de Balsac : The presence of vitamin E in the embryo of cacao.

Cracow

Polish Academy of Science and Letters, July 6.

M. Centnerszwer and J. Szper : The electrolysis of some salts in anhydrous glycerol. With copper electrodes, the chlorides of copper, zinc and magnesium, electrolysed in glycerol, give cuprous chloride at the anode and glycerates of the metals at the cathode.

J. Suszko and F. Szelag : The steric inversion of the alkaloids, compounds of the type of the optically active carbinols. The total transformation of quinidine into epiquinidine.

K. Dziewonski and W. Dymek : A method of synthesis of compounds, diaryl derivatives of 2,4-diaminoquinoline.

St. Kreutz : Studies on the luminescence of some minerals. Description of the phenomena observed when fluorite, willemite and calcite are illuminated with a quartz lamp under varying temperature conditions.

W. Vorbrodt : An attempt to use concentrated hydrogen peroxide for the determination of the mineral contents of plant and animal materials. A list of materials is given for which the oxidation is sufficiently complete. The method is specially useful for the determination of phosphorus.

B. Skarzynski : The metabolism of the sterols in the egg of the fowl during its development.

J. S. Mikulski : (1) The influence of constant and alternating temperatures on the survival of some stages of development of *Tribolium confusum*. (2) The influence of constant and alternating temperatures on the variations of the rapidity of development in some stages of the embryogeny of *Tribolium confusum*.

H. Szarski : The anatomy and physiology of the digestive tube of worms of the Naïdin family.

Mme. Z. Opoczynska-Sembratowa : The anatomy and innervation of the heart of *Carausius morosus*.

Moscow

Academy of Sciences (*C.R.*, 3, No. 1 ; 1936).

A. Bermant : A theorem of P. Montel.

I. Kantorovič : Some classes of linear operations.

E. A. Šilov and Š. M. Solodušenkov : The velocity of hydrolysation of chlorine.

V. Rasumovskij : Correlations between the energetic saturation and the polarity of molecules.

I. A. Smorodincev and P. I. Pavlova : The chemical composition of eggs of *Taeinarhynchus saginatus* and of *Diphyllobothrium latum*.

L. V. Krištofovič : Brachiopoda from the Tertiary sediments of the western coast of Kamchatka.

L. G. Arutjunova : An investigation of chromosome morphology in the genus *Gossypium*.

K. I. Panin : Distribution of *Sardinops melanosticta*, Temm. and Schl., in the waters of eastern Kamchatka.

(*C.R.*, 3, No. 2 ; 1936).

W. Sierpinski : Functions of class 1.

A. Tichonov : Topological universal space.

N. Moisejev : A quantitative character of the qualitative theory of contiguity.

V. S. Lukjanova : The physical characteristics of mimicry in fish.

B. I. Svešnikov : Influence of the solvent on the kinetics of bimolecular reactions in solutions.

T. T. Demidenko and V. P. Popov : Colloidochemical characteristics of sugar beet as dependent on its conditions of growth.

L. N. Bereznegovskaja : Some peculiarities in the development of resistant forms of sunflower when attacked by *Orobanche cumana* Wallr., race *B*.

K. I. Pangalo : (1) The diversity of sex expression in plants as illustrated by the *Cucurbitaceae*. (2) Genes determining different sex types in plants as illustrated by the *Cucurbitaceae*.

K. S. Usenko : The distribution of Lower Sarmatian deposits on the north-western outskirts of the Donetz Basin.

A. I. Schmidtov : Survival of the spermatozoids of *Acipenser* spp. under different external conditions.

Rome

Royal National Academy of the Lincei (*Atti*, 3, 277–380 ; 1936).

G. Armellini : Erroneous objection against the cosmogonic hypothesis of Laplace.

G. Andreoli : Composition functions of the second kind, infinite functions of matrices.

R. Caccioppoli : Conformable representation of surfaces.

B. Manià : Navigation problem of Zermelo.

G. Sansone : Limitation of the integral $\int_{-1}^{1}|P_n(x)|^m dx$.

B. Segre : Varieties of Veronese with two indices (1).

L. Toscano : Permutable operators of the second order.

F. Tricomi : 'Density' of the continuum of points or of straight lines and 'density' of a correspondence.

C. Agostinelli : Motion generated by a plane liquid source imposed on a rigid rectilinear profile with formation of vortices.

B. Caldonazzo : A hydrodynamic problem relative to the arc of a circumference.

E. Volterra : Questions of linked elasticity (4). Geometrical significance of the linking.

G. Conti : Relations between the winter and summer temperatures at Rome.

M. Maggini : Rapid variations of colour of some stars.

J. R. Dunning, G. B. Pegram, G. A. Mitchell, G. Fink and E. Segrè : Velocity of slow neutrons. Group C neutrons have a velocity of about $2 \cdot 2 \times 10^5$ cm. per sec., which is of the order of magnitude of the velocity due to thermal agitation at the ordinary temperature.

F. Rasetti, E. Segrè, G. Fink, J. R. Dunning and G. B. Pegram : Law of absorption of slow neutrons.

G. Usiglio : A recent experiment considered as a confirmation of a new interpretation of refraction in conditions of total reflection.

G. C. Wick : Annihilation of positive electrons.

G. Piccardi : Spectrum of praseodymium oxide in the vapour state.

M. Benazzi : Physiological races of *Euplanaria gonocephala* differentiated by means of their different behaviour to scissiparity.

S. Ranzi : The hypophysis and gestation in selachians.

E. Biocca : Crystallization of the carboxyhæmoglobin of dried blood from various animal species, and a particular rule of medico-legal application.

E. Tria : Enzymatic activity and surface tension. Action of some surface active substances on pancreatic lipase.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Tuesday, October 27

Royal Horticultural Society, at 3.30.—Redcliffe N. Salaman : "The Potato in its Early Home and its Introduction into Europe" (Masters Memorial Lectures. Succeeding lecture on November 10).

Royal Anthropological Institute, at 9 p.m.—(in the Lecture Room, Royal Society, Burlington House, W.1). —Prof. E. Westermarck : "Methods in Social Anthropology" (Huxley Memorial Lecture).

Thursday, October 29

Chemical Society, at 8.—Prof. A. P. Laurie : "Mediæval Pigments and Mediums used in Painting".

University of Oxford—(in the Milner Hall, Rhodes House).—Dr. E. Hubble : "The Observational Approach to Cosmology" (Rhodes Memorial Lectures. Succeeding lectures on November 12 and 26).

Friday, October 30

Royal Astronomical Society, at 4.30.—Geophysical Discussion on : "The Gaseous Content of the Atmosphere at Various Altitudes" to be opened by Dr. F. A. Paneth.

School Nature Study Union, at 6.—Autumn Meeting to be held in the Conference Hall, County Hall, London, S.E.1.

Prof. David Katz : "Some Problems of Animal Psychology".

Institution of Chemical Engineers, at 6.30—(at the Institution of Civil Engineers, Great George Street, Westminster, S.W.1).—Prof. F. A. Lindemann, F.R.S. : "Research at the Lowest Temperatures and its Importance to Industry".*

Official Publications Received

Great Britain and Ireland

The Demand for Colonial Territories and Equality of Economic Opportunity. Pp. 32. (London : The Labour Party.) 4*d*. [289

The Rubber Growers' Association. Rubber and Agriculture Series, Bulletin No. 4 : The Care and Cleaning of Milking Machines. By Alexander Hay. Pp. ii+16. (London. Rubber Growers' Association.) [299

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 40 : A Comparison of some Dutch and Irish Potato Mosaic Viruses. By Paul A. Murphy and J. B. Loughnane. Pp. 419–430+plate 9. 1*s*. 6*d*. Vol. 21 (N.S.), No. 41. A Study of the Aurora or Yellow Mosaics of the Potato. By Phyllis E. M. Clinch, J. B. Loughnane and Paul A. Murphy. Pp 431–448+plates 10–12. 2*s*. 6*d*. (Dublin Hodges, Figgis and Co ; London : Williams and Norgate, Ltd.) [309

Rothamsted Experimental Station, Harpenden : Lawes Agricultural Trust. Report for 1935. Pp. 279. (Harpenden : Rothamsted Experimental Station.) 2*s*. 6*d* [110

The Royal Botanic Gardens, Kew. Twelve coloured Views. Pp 14 (London : H.M. Stationery Office.) 1*s*. 6*d*. net. [210

Iron and Steel Institute. Special Report No. 13 : Fourth Report of the Corrosion Committee : being a Report by a Joint Committee of the Iron and Steel Institute and the British Iron and Steel Federation to the Iron and Steel Industrial Research Council. Pp. xv+240+11 plates. (London : Iron and Steel Institute) [710

Other Countries

Trinidad and Tobago Progress Report on Exotics. Prepared for the British Empire Forestry Conference, South Africa, 1935, by R L Brooks. Pp. 4 Timber Supply, Consumption and Marketing in Trinidad and Tobago Prepared for the British Empire Forestry Conference, South Africa, 1935, by R L. Brooks. Pp 8. Forests and Forestry in Trinidad and Tobago A statement prepared for the British Empire Forestry Conference, South Africa, 1935, by R. L. Brooks. Pp. 26. (Trinidad : Government Printing Office.) [110

U.S. Department of Agriculture. Circular No. 237. Control of the Japanese Beetle on Fruit and Shade Trees. By W. E. Fleming and F. W. Metzger. Revised edition. Pp. 12. 5 cents. Farmers' Bulletin No. 1758 · Cover Crops for Soil Conservation. By Walter V. Kell and Roland McKee. Pp. ii+14. 5 cents. Technical Bulletin No. 524 : Silting of Reservoirs. By Henry M. Eakin. Pp. 142+16 plates. 40 cents (Washington, D.C. Government Printing Office.) [110

U.S. Department of Commerce : Coast and Geodetic Survey. Special Publication No 201. Earthquake Investigations in California, 1934–1935. Pp. ix+231. (Washington, D C. : Government Printing Office.) 35 cents. [110

Sveriges Geologiska Undersokning. Ser Ca, No. 24 : Norbergs Berggrund och Malmfyndigheter. Av Per Geijer. Pp. 16+26 plates. (Stockholm · Sveriges Geologiska Undersökning) 8 00 kr. [210

Crohamhurst Observatory. Observatory Paper No. 4 : Tables of Rainfalls in Queensland for the Years 1933, 1934, 1935. Pp. 16. Observatory Paper No. 5. Data from Australian Observations for the Period 1770–1853, with all available Rainfall Figures. Pp. 23. (Beerwah, Qd Crohamhurst Observatory.) [510

Bulletin of Indian Industrial Research. No. 1. Bibliography of Industrial Publications published in India from 1921. Pp. iii+257. (Delhi : Manager of Publications.) 4·6 rupees ; 7*s*. 3*d*. [510

Indian Central Cotton Committee · Technological Laboratory. Technological Bulletin, Series A, No. 33 · Technological Reports on Standard Indian Cottons, 1936 By Dr. Nazir Ahmad. Pp. iii+103. (Bombay : Indian Central Cotton Committee.) 1.8 rupees. [510

U.S. Department of Agriculture. Circular No. 390 : Flour-Mill Insects and their Control. By G. A. Dean, R. T. Cotton and G. B. Wagner. Pp. 34. (Washington, D.C. : Government Printing Office.) 5 cents. [510

Annual Report of Hydrographical Observations No. 7 : For the Year 1932. Pp. viii+196. (Husan : Fisheries Experiment Station.) [510

Memoirs of the Geological Survey of India. Palæontologia Indica, New Series, Vol. 22, Memoir No. 3. On Bajocian Ammonites and Belemnites from Eastern Persia (Iran). By Dr. L F. Spath. Pp. vi+21+1 plate. (Calcutta : Geological Survey of India.) 1.2 rupees ; 2*s*. [510

National Research Council. Transactions of the American Geophysical Union, Seventeenth Annual Meeting, April 30, May 1, 2, 1936, Washington, D.C, West Coast Meeting, January 31 and February 1, 1936, Pasadena, California. Part 1. Reports and Papers, Washington, D C., General Assembly and Sections of Geodesy, Seismology, Meteorology, Terrestrial Magnetism and Electricity, Oceanography and Volcanology. Pp. 260. 1.50 dollars. Part 2 : Reports and Papers, Section of Hydrology and Western Interstate Snow-Survey Conference. Pp. 261–563. 2 dollars. (Washington, D C. : National Academy of Sciences.) [510

University of Toronto Studies : Physics Series 1936. Discrete Spacetime : a Course of Five Lectures delivered in the McLennan Laboratory on January 7, 13, 20, 27, and February 1, 1936. By Dr. Ludwik Silberstein. Pp. 49. (Toronto : University of Toronto Press ; London : Oxford University Press.) 4*s*. 6*d* net. [910

Transactions of the San Diego Society of Natural History. Vol. 8, No. 19 : *Crotalus mitchellii*, the Speckled Rattlesnake. By Laurence M. Klauber. Pp. 149–184+plates 19–20. (San Diego, Calif. : San Diego Society of Natural History) [1010

Malayan Forest Records. No. 12 : Commercial Timbers of the Malay Peninsula. No. 1 : The Genus *Shorea*. By H. E. Desch, with Botanical Notes by C F. Symington. Pp. x+73+9 plates (Kuala Lumpur : Forest Department.) 1 dollar ; 2*s*. 6*d*. [1210

The Rubber Research Institute of Malaya. Annual Report 1935. Pp. 163+3 plates. (Kuala Lumpur : Rubber Research Institute.) 1 dollar. [1210

U.S. Department of Agriculture. Circular No. 392 : Diagnosing Bee Diseases in the Apiary. By C. E. Burnside and A. P. Sturtevant. Pp. 35. (Washington, D.C. : Government Printing Office.) 5 cents. [1210

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Taxation, Administration and Research in East Africa

IT has sometimes been questioned by purists in British constitutional practice whether it is advisable that the ministers of His Majesty's Government in charge of Departments of State should have personal experience of conditions in the affairs they are called upon to administer. Whichever way opinion may incline, it is patent that Mr. Ormsby-Gore's tenure of office will afford concrete material for judgment. His knowledge of conditions in the British dependencies is greater than that of any previous holder of the office of Colonial Secretary, and has been approached by none since the days of Joseph Chamberlain. Mr. Ormsby-Gore does not propose to allow his knowledge to lie fallow ; and already both in matters which have arisen under his jurisdiction and in those which he has inherited from his predecessor in office, it has enabled him to show a ready appreciation of the necessity for prompt action and a strong forward policy in native affairs in Africa to remedy or to forestall the dangers, to which he is fully alive, arising out of the dislocation threatening the welfare of African peoples in the present rapid development of economic and social circumstances.

Mr. Ormsby-Gore's dispatch to the Governor of Nyasaland dealing with the report of the Committee on emigrant labour from the Protectorate (see NATURE, 137, 921) is remarkable alike for its independence of judgment and its well-balanced assessment of the conflicting forces, which have to be taken into account in devising measures to meet the trend of circumstances threatening the future stability of the country and its peoples. He intimates that he shares to the full the anxiety of the members of the Committee, and that he agrees to the necessity for immediate steps to remedy a state of affairs, which seems to be bringing hardship and misery to many members of the native community. When he suggests, however, that less spectacular measures may serve the purpose of such of the remedial proposals of the Committee as he has been unable to accept in full, his reasons are in plain view. He goes on to point out that expenditure on a scale, which since 1930 has allocated more than £4,200,000 to the development of the Protectorate and to raising the standard of living of the native inhabitants, cannot continue.

The crux of the native situation in Nyasaland is undoubtedly the hut and poll tax. The Governor of the Protectorate, it is true, and as it appears from the dispatch of the Colonial Secretary, does not admit the contention of the Committee that taxation is the primary cause of the excessive emigration ; but Mr. Ormsby-Gore, while recognizing the influence of a higher standard of living, of the spirit of adventure and of the attraction of conditions of employment in neighbouring territories, holds that the hut and poll tax must be regarded as a most important factor in the present situation. It bears heavily, he maintains, on natives in those areas in which the opportunities of obtaining employment or of selling crops for export are scarce. In this more limited sense, there cannot be two opinions but that he is correct. He suggests, therefore, that taxation in such areas should be reduced immediately. At the same time, he expresses himself as not in favour of the drastic methods of control and restriction of movement advocated in the report of the Committee. To some, Mr. Ormsby-Gore may appear to have been over-cautious ; but in initiating changes among African peoples a certain restraint is no unwise policy.

It is interesting to note how closely in principle the suggestions of the Colonial Secretary addressed to the Governor of Nyasaland are in accord with the attitude of Sir Alan Pim when he touches upon native problems in his recent report on the financial position in Kenya*. Sir Alan Pim's previous experience of adverse conditions among the peoples of the Protectorates of South Africa affords assurance that his diagnosis of factors detrimental to the native population of Kenya may be accepted as well grounded. That this, at any rate, is the conclusion at which Mr. Ormsby-Gore has arrived is indicated by the fact that he has intimated to the Governor, Sir Joseph Byrne, that the recommendations of the report are generally acceptable and should be adopted as a whole.

Not only does Sir Alan Pim regard the system of registration and labour control with little favour, but he also holds taxation of the native, as at present constituted, to be one of the principal factors operating to the detriment of social and economic conditions among them. The case for and against the hut and poll tax, which is estimated to produce the sum of £540,000 in the current year, is stated in detail in this report. No more need be said here than that broadly the conclusion is that this form of taxation is a cause of poverty, is difficult to assess, difficult to collect, and a source of injustice.

Hut and poll taxes were imposed originally on the natives of Africa, as is well known and as has been recalled frequently in recent discussion, in great measure to spur the native to greater activity as a producer and to stimulate and ensure a larger and more steady flow of labour into European employment. This object has been attained at a cost of no little disintegration in native social and economic institutions. In accordance with the recommendations of this report, revision in Kenya is now under consideration.

Sir Alan Pim's recommendations for retrenchment in the finances of Kenya, while sufficiently drastic, though in the opinion of some disappointing in result, are sympathetic towards native claims for consideration. In regard to the medical service, for example, to which the native looks in an increasing degree, he points out that since the Great War a complete change in outlook has taken place, and enlargement rather than retrenchment must be anticipated, although he indicates the road to one possible economy in the development of the non-European sub-medical staff. At the same time, in the matter of scientific research he is by no means over-generous; and although he notes with some approval the desire of the Director of Medical Services to form an Institute of Medical Research for East Africa in Kenya, his general position is that what may be regarded as 'long-term' research must be met from outside sources. This will come as something of a setback to those who appreciate the urgency of inquiry on a much greater scale than as yet has seemed possible without official support on such matters as the nutrition, physical development and the mental capacities of the natives of East Africa, to mention one group only of questions needing investigation.

That there is a wide field for scientific research in matters directly affecting the life of both white settlers and natives in Kenya, and that it is largely untouched, has been deplored on many occasions. It is possible that the solution of the difficulties, financial and other, may lie along lines suggested in the report of this Commission. It is there pointed out that local research in agriculture, for example, might be associated with more advanced study in a centre at either the research institute at Amani in Tanganyika or at the centre for higher education at Makerere in Uganda. Such a solution would facilitate a scheme of co-operation as between the several Territories in East Africa, which might be made sufficiently wide to cover the whole field of appropriate research.

The possibilities of a scheme of co-ordinated and co-operative research in East Africa, in which responsibility for the various branches of inquiry would be distributed among the local governments, deserve to be explored further. Such a question may scarcely be considered to fall within the terms of reference of the newly appointed Commission, which is to proceed under the chairmanship of Lord De La Warr to Uganda early next year, for the purpose of inquiring into the constitution and working of the centre for higher education at Makerere and affiliated institutions, as well as to examine and report on their effect on the educational institutions and systems of the Territories affected (*The Times*, Oct. 20). At the same time, it is a matter upon which even a passing expression of opinion from the Commission, or better a suggestion as to a line of inquiry, would be of inestimable value as a stage towards specific action.

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* Report of the Commission appointed to enquire into and report on the Financial Position and System of Taxation of Kenya. (Colonial No. 116.) Pp. vii+282. (London: H.M. Stationery Office, 1936.) 9*s*.

High Court Procedure and the Cost of Patent Actions

At the recent meeting in Blackpool of the British Association, the president of Section G (Engineering), Prof. W. Cramp, gave an address on "The Engineer and the Nation" in which he referred to the difficulties in the way of an inventor who patents his invention and attempts to create a new industry. As an illustration of these difficulties, Prof. Cramp mentioned a patent action within his own experience which cost £30,000, more than half of which was spent in obtaining a judgment (reversed on appeal) from a judge who, he stated, admitted that "he could hardly understand a word about it". On this state of affairs Prof. Cramp expressed the opinion that "there is no hope for the Patentee in this country under such a clumsy ineffective system ; but to change it will be difficult. It will be necessary to break through the resistance of a thoroughly case-hardened Bar, and engineers know what that means. I believe that this Association is the only body with the necessary prestige and influence to produce the desired effect. I hope that this Section will urge the Council to take steps to bring about a reform that is so long overdue."

Reform of the patent system in Great Britain has been under consideration more than once during recent years, and the net result is that amended Rules of the Supreme Court are at the present moment being put into effect. This position has been reached by two stages. The first stage included the Departmental Committee on the Patents Acts, presided over by Sir Charles Sargant, and a discussion at the centenary meeting of the British Association in London in 1931. After the Departmental Committee had decided that the cost of patent actions was a subject outside its terms of reference, the subject was brought before the British Association at the centenary meeting. At that meeting, papers on "The Development of Invention" were read by nine representative authorities under the chairmanship of Sir James Swinburne, and the related subjects of High Court procedure and the cost of patent actions were carefully considered. There was general agreement that litigation over patents had become so slow and expensive that only the large corporations or companies and wealthy individuals could afford to go to law over patents, and that there was no satisfactory method of obtaining a decision of very numerous disputes arising on patented inventions. Various suggestions for reform were put forward, of which probably the most interesting was one advocating arbitration of the disputes under procedure similar to that adopted under the London Building Acts. The suggestion, briefly, was that the advisers to parties in a patent dispute should call in either a member of the Patent Bar or some other experienced person to act as a third adviser, and that the parties should agree to abide by any award of the three advisers, signed by at least two of them. This suggestion has not apparently been at all widely adopted.

In the second stage, High Court procedure was considered by the Business of Courts Committee, presided over by Lord Hanworth, and recommendations on the subject were made in the Final Report, 1936. The Committee examined suggestions in regard to rearrangements in the constitution of the Court including (*a*) proposals for the delegation of the hearing of minor patent actions to the Comptroller of Patents or some special officer in his department and (*b*) proposals for the appointment of a special High Court judge to deal with patent business ; and reported against each of these proposals. The Committee further expressed the opinion that the machinery for trial with assessors or with court experts was amply available under existing rules, and that there was not sufficient ground for forcing the machinery upon unwilling parties. In relation to this opinion it should be remembered that Section 31 (1) of the Patents and Designs Acts, 1907–1932, enacts that in an action or proceeding for infringement or revocation of a patent, the court may, if it think fit, and shall on the request of all of the parties to the proceedings, call in the aid of an assessor specially qualified, and try the case wholly or partially with his assistance.

The Business of Courts Committee also considered carefully the possibility of a reform of procedure in the High Court as at present constituted and found an almost universal agreement that it would be desirable, before patent actions come into court, that there should be some means adopted of crystallizing the issues, as well of law as of fact. The Committee recommended that the rules should be amended so as to enable the judge, (*a*) to order the parties to embody their scientific evidence in affidavits to be subject to cross-examination and to be exchanged before the hearing in court, and (*b*) to order the parties to exchange statements (to be signed by counsel), setting out all matters of fact and contentions of law (including contentions on the construction of documents), on which they intend to rely at the trial. These recommendations are now being put into practice by the rules of the Supreme Court (No. 3), 1936, some of the rules being operative from July 13 this year and the remainder from October 12.

In commenting on the patent case that cost £30,000 in the English courts, Prof. Cramp stated that "In France, thanks largely to Napoleon's short way with legal privilege the case given above, with an appeal, cost less than one-tenth of the hearing in the English courts. There, to the best of my recollection, the system is as follows. The court sits to determine if there is a case. Having decided in the affirmative three technical experts are appointed, one by each litigant and one by the judge. These three have access to all apparatus, experiments and documents. Each presents an independent report to the judge and on these the issue is decided." It is a fact that, apart from fees paid to some members of the French Bar who are also eminent politicians or senators, the fees of our Patent Bar are higher than those of the French Bar, and it is true that according to the present procedure in France, the evidence of the three experts is not subject to cross-examination in open court. Nevertheless, it would be unwise to infer from Prof. Cramp's statement that opinion in Great Britain is unanimously in favour of adopting the French procedure, and it is significant that, in the Bill at present before the French legislature, provision is made for cross-examination of the experts in open court, and that this system has already been adopted in the United States.

If any inference is to be drawn from this short statement of High Court procedure and the cost of patent actions, it may possibly be that Prof. Cramp's "case-hardened Bar" shows little indication of bending under the stress of the recent changes and not the slightest indication of breaking. The recent changes have established the present position, and it is unlikely that further changes will be adopted until the present position has been tested, unless they are generally acceptable. It is to be hoped, therefore, that, if the Council of the British Association decides to recommend any further change, it will be specified precisely and will be such as to receive the unanimous support of all the parties interested; otherwise it seems highly improbable that the recommendation will "break through the resistance of a thoroughly case-hardened Bar".

Astronomical Telescopes

Lunettes et télescopes:
théorie, conditions d'emploi, description, réglage. Par André Danjon et André Couder. Pp. xvi+715+14 plates. (Paris: Éditions de la *Revue d'Optique théorique et instrumentale*, 1935.) 100 francs.

THE collaboration of MM. Danjon and Couder has resulted in a notable addition to astronomical literature. The volume under review is the best and most complete book on telescopes that has been written, and it will undoubtedly remain for a long time the standard work on the subject. M. Danjon is the director of the Strasbourg Observatory and a practical astronomer with wide experience; M. Couder, one of the astronomers at the Paris Observatory, is a skilled optician, who made the 81-cm. mirror and other optical parts of the reflector at the Forcalquier (Basses-Alpes) station of the Paris Observatory. The excellent photographs that are being obtained with this instrument are a sufficient testimony to the high quality of its optics. The authors were therefore particularly well qualified for their task.

The volume is divided into five parts. The first part deals with the general theory and use of telescopes. The elementary geometrical theory is summarized, and the limitations of this theory caused by the diffraction of light are then considered. This leads naturally to the question of resolving power, which is discussed in relation to the resolving power of the eye in visual observations and to the resolving power of the photographic plate in photographic observations. The observation of point-sources (stars) and of bodies showing a sensible surface (planets, comets, nebulæ, etc.) are separately considered. Of particular value is a chapter on atmospheric agitation, its measurement and its effect on resolving power.

The careful study of the whole of this part is strongly recommended to amateur telescope users. It will remove many misconceptions and will help them to realize the limitations of their observations. One observer, for example, may describe a comet as having a bright tail but no nucleus; another may describe the same comet as having a nucleus but a scarcely perceptible tail. The two observations are not necessarily inconsistent, but are the result of using telescopes with different apertures and different magnifications. A common misconception is that under conditions of poor definition, it is advantageous to reduce the aperture. An image that is more agreeable to the eye is obtained, but the gain is purely illusory. There is no gain in resolving power and the advantage of the full aperture in the moments of better seeing is lost.

The second part contains a good discussion of the principal aberrations of an optical system, illustrated by numerical examples. The nature of the several aberrations is explained in a very clear manner and their order of magnitude is estimated, using only elementary mathematics. The drawings of focal and extra-focal images, affected by various aberrations, will be found useful in examining any particular telescope for the presence of these aberrations.

The third part is concerned with different types of reflecting and refracting telescopes, and with the design of object glasses and eyepieces. The Newtonian and Cassegrain forms of the reflecting telescope are first discussed; their aberrations are estimated and their limitations are emphasized. These may be termed the classical types of reflector. Alternative designs have been proposed, with the view of obtaining a larger field of good definition. The Schwarzschild, Chrétien, Couder and Schmidt types of reflecting telescope are described and discussed.

A general outline is given of the methods used by the optical computer to reduce aberrations by the combination of two lenses of different types of glass, and several of the principal types of objective are described in some detail. A chapter is devoted to the more common types of oculars and their aberrations.

In the fourth part are described various types of mountings and of miscellaneous auxiliary apparatus; methods of testing and adjusting telescopes; the manufacture of optical glass; the processes for silvering mirrors; the flexure of mirrors and the methods of mounting so as to minimize the effects of flexure; and thermal phenomena, causing variations of focal length and of surface figure. The whole of this part is full of practical information for the telescope user. The adjustment of the Newtonian and Cassegrain reflectors is explained. The testing of an objective for relative tilt of the components, for centring and for tilt of the objective as a whole is described in detail; the method of testing the squaring-on of the photographic plate is also described. A full account is given both of the Hartmann test and of the knife-edge test of Foucault. The method of computing the results of the Hartmann test to show the zonal aberrations and the astigmatic defect is illustrated by the actual figures for the Forcalquier mirror. The result of the Hartmann test is often summed up by a numerical figure, called the Hartmann criterion, which is the weighted mean of the angular aberrations, the weight for each zone being proportional to its distance from the axis. The Hartmann criterion depends upon the origin chosen for the longitudinal aberrations; the origin that gives the smallest value to the criterion is chosen, though this is not necessarily reached in the plane of the circle of least zonal aberration. Moreover, the authors point out that the criterion can only have a significance in relation to the theoretical resolving power of the objective, which depends on its diameter, and, further, that two objectives of the same diameter may have errors of different type and distribution, giving the same value of the criterion, although the images produced by one may be better than those given by the other. In short, though the test gives full information about the defects of figure, the criterion in itself is of relatively small importance.

It is of interest to note the authors' specification for a satisfactory objective: (1) The radius of the circle of least aberration must be comparable to that of the theoretical diffraction image and, in the mean, the reduced transverse aberrations must be smaller than unity; (2) the greatest defect of the surface from tautochronism must not exceed a quarter wave-length and for most of the surface it should be appreciably smaller.

The final part gives a historical account of the invention and evolution of the telescope. The invention of the telescope is often attributed to Hans Lipperhey, a spectacle-maker of Middelburg, in the year 1608. The authors assign the invention to Giambattista della Porta, of Murano near Venice, in the year 1580. Their account of the invention is fully documented, and it seems reasonably certain that, even if della Porta was not actually the inventor, Lipperhey ought not to receive the credit.

Every practical astronomer, amateur and professional, should read this book; many portions of it will be found to deserve careful study. I would urge all who can do so to purchase it; for so comprehensive a work, the price (with the present value of the franc) is very moderate. The expenditure will be found to be a good investment.

H. SPENCER JONES.

The Technique of Biography

(1) Edison, his Life, his Work, his Genius
By W. A. Simonds. Pp. 364 + 12 plates. (London: George Allen and Unwin, Ltd., 1935.) 10*s.* 6*d.* net.

(2) Partners in Progress
By Esse V. Hathaway. Pp. vii + 303 + 12 plates. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 15*s.* net.

(3) Outposts of Science:
a Journey to the Workshops of our Leading Men of Science. By B. Jaffe. Pp. xxvi + 547 + 32 plates. (New York: Simon and Schuster, Inc., 1935.) 3.75 dollars.

THE technique of biography has sometimes seemed to change rapidly in a changing world. The god-like and disembodied abstractions of one phase vanished before the painfully concrete and over-bodied victims of the 'de-bunker', now happily retiring from his brief tenure of the stage. But one aim of the biographer has never, in any worthy practice of the art, varied or failed. The merely superficial account of what a man did never was real biography; the mainspring of action, the 'why' rather than the 'what' and the 'how', must always be the centre of interest in any work of value. The three works before us are all mainly biographical in intent, and must be tested principally for depth of penetration. One of them passes the test triumphantly, the other two are, relatively, insignificant and superficial.

(1) Thomas Alva Edison has always been something of a puzzle to the student of science and technology in the industrial revolution. His career belonged to the 'log-cabin to White House' category, yet no account of his life seemed to recognize that his mainspring of action had not been identified. Every schoolboy was thrilled by the story of his violently episodic progress, his staccato and his sostenuto, his plunges from one subject to another, his living of laborious days and nights in the glamour of wizardry at Menlo Park. But why did he do this and thus, was the glamour real or artificial, was it a spontaneous and so to speak accidental growth, or was it as well engineered as the material products round which it grew? Mr. Simonds, in "Edison, his Life, his Work, his Genius", supplies new factual material and re-presents the old, but of the essence of the man, his genius in the real sense, we feel that we have learnt no more. The restless versatility, the dæmonic energy, are as vividly before us as ever, but why did the man do these things? Was he impelled by an altruistic desire to benefit his kind, was he in search of wealth and power for himself, was the need to "bat the other fellow"—a succession of other fellows—"in the eye" an important element in the good he undoubtedly did for humanity at large?

The questions remain unanswered; Mr. Simonds gives us a good record of fact, but despite the promise implied in his preface he never attempts analysis. He gives us reason to suppose that the first hypothesis is sound, he supplies some evidence for the others, but we suspect his own hypothesis to be merely that Edison did it all because he couldn't help it. We lay down the book with the same feeling of disappointment as with every other life of Edison.

(2) Miss Hathaway does no more for Edison in the score of pages she can spare for him in her verbal picture gallery of "Partners in Progress". The sitters are a well-chosen galaxy from the last twenty-five centuries, but if Mr. Simonds gives us his one sitter in plain black and white, Miss Hathaway presents hers in chromo-lithograph. We just don't believe that Hippocrates was as purple as he is painted; he was probably a grim forthright G.P. without time for rhetoric and romanticism, and he would almost certainly have shared our objection to Miss Hathaway's parsimony with predicates; he might have said with us that what he wanted was verb, not sap. As a cataloguer Miss Hathaway shows talent; her grouping of twenty-five biographies is logical if a trifle obvious. But she adds nothing of value to the already familiar; she pads out inordinately, and her style is maddening.

(3) These two authors might have been more welcome had they not arrived in the company of Bernard Jaffe. "Outposts of Science" is as definitely about people as are the other two works, but there is just enough vivid portraiture to make the *dramatis personæ* fully alive, mainly lovable, occasionally laughable, always humanly understandable. The real dramatic material is the spirit of investigation; the characters in this thrilling presentation of the search for truth are nicely subordinated to their work, their achievements, and partial failures. The major themes are, appropriately, the inner compulsion and the rules of the great game of research, a game in which individual motives are scarcely ever single, but in which single-mindedness is the common dominant.

Boswell's Johnson is as much Boswell as Johnson. Every biography is an autobiography. So in reading the five hundred pages from which the author has apparently excluded himself, we learn to hold in high regard the modest investigator of investigators who tells us in a dozen introductory pages how he made this fine book and what he learnt in the making of it. His four years labour was well spent, and he has done a greater and more difficult service than if he had devoted himself to the physical sciences in which he began his career. One feels that even the star at the eyepiece end of the Mount Wilson 60-inch, of which he tells us in these pages, could scarcely fail to be held by his unrolling of a great scenario.

It is perhaps in part an accident that to a physicist this physicist's account of biological research is more enthralling than his account of physical researches, but it is probably not an accident that the book opens with a chapter in which the story of *Drosophila* is told in a manner which makes this chapter on genetics the most fascinating part of a fascinating whole.

There are many good research workers, there are many good teachers, but there are distressingly few interpreters of Mr. Jaffe's calibre to carry on the vitally important task of explaining the aims, the methods, and the essential achievements of science to the intelligent public. We trust that he will continue his admirable work; he will do well indeed if he does as well as in his survey of the "Outposts of Science".

Biochemical Progress

Annual Review of Biochemistry
Edited by James Murray Luck. Vol. 5. Pp. ix+640. (Stanford University P.O., Calif.: Annual Review of Biochemistry, Ltd.; London: H. K. Lewis and Co., Ltd., 1936.) 5 dollars.

IT is true to say that these annual reports are now eagerly awaited. This year they appeared somewhat later, due it would appear largely to their international character, which is more than ever marked. As evidence of the spread of research institutions of the first class all over the geographical world, it is interesting to note reports from Pretoria, Honolulu, Leningrad, as well as from all parts of the United States and the older European centres. There are twenty-six different reports varying in length and in the ease with which they can be read by the general student who is not an expert in the particular field. In some sections the work is largely pioneer and is still to be correlated; in others a particular stage has been completed and a problem largely solved in preparation for the next step forward.

Gradually more light is being thrown on biological oxidations and reductions. For some of these it has long been known that a co-enzyme is an essential unit in a complex system of reaction components. It is now largely established that such compounds are composed of adenine, phosphoric acid and a sugar ribose, the point of attachment of which to the adenine has now been determined.

Ascorbic acid, the vitamin, is the subject of intense study. Three principal methods are now available for its synthesis, and a number of closely related analogues are available for the investigation of the correlation between constitution and physiological activity. There is evidence that ascorbic acid inhibits the action of certain enzymes unless iron is also present. Such enzymes would appear to contain —SS— compounds in their protein complex which have to be made into —SH compounds for the enzyme to become active. Addition of ferrous ions increases the specificity range of papain and enables the enzyme to hydrolyse peptone. A clue is being obtained which points to the existence of active groupings of elements in the enzymes.

Individual reports by the leading experts deal with the sugars, fats and proteins, either from the point of view of their structure or metabolism, and progress with the hormones and vitamins is fully chronicled; there are signs that the former are now becoming the more fashionable subjects of research. The progress made with the investigation of the structure of the œstrogenic compounds is remarkable and is leading to expansion in many directions as, for example, in regard to the factors involved in the secretion of milk for which lactogenic preparations, which appear to contain a chemical unity prolactin, have been made. Methods of assay of these substances are also having to be developed.

In addition to insulin, many of the hormones are now being manufactured on the commercial scale, so quick has been their application.

All the time, the animal and the plant world are being investigated for rare or new substances—

two new nitrogen-containing extractives have been found in the lower vertebrates, namely, a betaine, homarine, in lobster muscle, and a guanidine derivative, asterubin, in star-fish. More attention is being paid to bacteria, and there are reports on metabolism, soil microbiology and the biochemistry of the fungi.

We have refrained from listing the separate reports or their authors, but we would wish to endorse the thanks conveyed to the contributors by the editors in their preface. It is of great value to the worker to have these judicial summaries by experts made available so promptly each year.

Solubility

Solubility of Non-Electrolytes

By Prof. Joel H. Hildebrand. (American Chemical Society Monograph Series, No. 17.) Second edition. Pp. 203. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1936.) 22*s*. 6*d*. net.

It is not often that a reviewer, who has read through the first edition of a book, finds it worth while to do more than glance through a second edition, in order to discover and review the new sections that have been introduced. Prof. Hildebrand's book is an exception, since the reviewer has taken the opportunity to renew his acquaintance with the earlier as well as the later text, and has found this to be a most interesting experience, since the book is full of matter which is not dealt with adequately (and indeed appears to have been largely overlooked) in the ordinary text-books of physical chemistry.

The book has a strict thermodynamic background, which sometimes makes it rather hard for the ordinary chemist to read, and it is not always easy to bear in mind the significance of the symbols which are carried forward from page to page; but for the most part the conclusions are also stated in general terms, so that the significance of the deductions is easily seen and can readily be applied to concrete cases. The author is, however, now inclined to be sceptical of his former deduction (following Dolezalek) that negative deviations from Raoult's law, which lead in extreme cases to the formation of two liquid layers, can be explained by the association of one of the liquids, since the degree of association required is often fantastic, and unsupported by collateral experimental evidence.

One of the first novelties to be introduced is the author's own conception of 'regular solutions', in which the identity of molecular size and molecular attraction of an ideal solution is not required, but in which "thermal agitation is able to overcome any tendency towards molecular orientation, combination or association, and to give the same completely random distribution as exists in ideal solutions". Under this heading, an account is given of Menke's work in Debye's laboratory on the structure of liquids. The forces between polar molecules are discussed on the basis of London's formula for the interaction of dipoles, and those between non-polar molecules on the basis of Lennard-Jones's theory of force-fields. Other novelties include Langmuir's theory of interfacial energies, Bernal and Fowler's investigation of the structure of water, and Butler's work on metallic solutions.

It is remarkable that the new edition actually occupies three pages less than the old one. This result is surely almost without precedent, and is one on which the author deserves to be congratulated heartily.

L'Espèce

Par Prof. L. Cuénot. (Encyclopédie scientifique: Bibliothèque de biologie générale.) Pp. ix+310. (Paris: Gaston Doin et Cie, 1936.) 30 francs.

This book provides a very helpful account of certain aspects of the species problem. Both the meaning of the concept of species, and the process of specification, are well handled, as is the question of isolation. The examples are, throughout, varied and well chosen.

The author wisely gives a preliminary survey of the genetic phenomena relevant to his purpose, together with a satisfactory description of meiosis. Unfortunately, the general treatment is much hampered by omitting the concept of the gene-complex, and a discussion of polymorphism and of the effects of fluctuation in numbers should have been included in a work of this kind. Likewise some reference should have been made to the various problems of relative growth, and the idea should have been developed that the evolution of rare and abundant species is likely to follow different lines.

However, this is quite a stimulating book, and it is provided with a good glossary, bibliography and index.

E. B. F.

Tables annuelles de constantes et données numériques de chimie, physique, biologie et technologie

(Annual Tables of Constants and Numerical Data; Chemical, Physical, Biological and Technological). Données numériques sur l'effet Raman: spectres, intensités, modes de vibration (Numerical Data on the Raman Effect: Spectra, Intensities, Vibration Patterns). Par Dr. M. Magat. Années: 1931 à 1934. Pp. 112. (Paris: Gauthier-Villars; New York: McGraw-Hill Book Co., Inc., 1936.)

THIS is principally a collection of data obtained on the Raman effect between 1931 and 1934. The substances whose spectra are described are grouped according to their chemical constitution, one fifth of the space being devoted to inorganic compounds and four fifths to organic compounds. In making the compilation, Dr. Magat has attempted to assess the relative reliability of the work of different authors where more than one investigation has been made of a particular substance, and, where necessary and possible, has given mean wave-numbers. He has also made an individual contribution of considerable value in making an attempt to correlate intensity data. It is a pity that so little attention is usually paid to accurate measurement of intensities when the original plates of the spectra are obtained. The methods of photographic photometry are not unduly difficult, and in the present case the technique is often simplified by the fact that the spectrum is comprised within a small wave-length range. There is little doubt that much of the work described here will have to be repeated ultimately on this account, when it becomes necessary to compare it with the rapidly developing theory of polyatomic molecules.

There is an appendix on the modes of vibration of polyatomic molecules, and two lists of papers—in addition to those in the text—one on the theory of the Raman effect and the other on some of its applications. The apparent completeness of the data, many of the sources being inaccessible to the ordinary worker, and the excellent way in which they are reproduced, combine to make the book indispensable for anyone interested in this field.

The Making of Modern Turkey, from Byzantium to Angora

By Sir Harry Luke. Pp. viii + 246 + 1 plate. (London: Macmillan and Co., Ltd., 1936.) 10s. 6d. net.

SIR HARRY LUKE's personal acquaintance with Turkey began so long ago as 1904, and at one point or another he has been in touch with the Turk ever since that date. In consequence he speaks with authority and understanding of the ideals and aspirations which inspired the political and social movements of the present century and have transformed Turkey from the titular seat of an international spiritual hegemony, as was claimed, into a nationalist State. His purpose is not to write a history of the Turks, but to analyse the forces and the elements which, partly rooted in Byzantium, partly arising out of the consequences of the conversion of the Turks to Islam, made the country in the end "the Sick Man of Europe", and in the inevitable disintegration of an international society, left nationalism and a dictator as apparently the only way open to reform.

Sir Harry Luke's critical judgment places recent developments in Turkey in their true historical perspective, and his book is indispensable to anyone who seeks to understand the play of race, language and politics in modern Turkish social development.

Handbuch der Vererbungswissenschaft

Herausgegeben von E. Baur und M. Hartmann. Band 3: Genetik und Tierzüchtung. Von C. Kronacher. Pp. vii + 280. (Berlin: Gebrüder Borntraeger, 1934.) 37.50 gold marks.

THIS handbook of animal breeding is a valuable summary of practical results in the improvement of domestic animals, including rabbits and some birds as well as horses, cattle, sheep, pigs and goats. Such questions as twinning in cattle are dealt with and two pairs of identical twins are described. Various interspecific crosses are discussed, as well as the inheritance of numerous abnormalities in all domestic breeds. The considerable amount of knowledge of serology in the different groups is also summarized. Emphasis is laid on the inheritance of qualities of practical value, such as milk yield in cows, wool characters and fertility in sheep. Such a summary should be of much value to all veterinarians and practical breeders. The book ends with a short index and a full bibliography occupying 87 pages.

An Enquiry into Prognosis in the Neuroses

By Dr. T. A. Ross. Pp. vii + 194. (Cambridge: At the University Press, 1936.) 10s. 6d. net.

THIS is an account of the results of treatment at the Cassel Hospital for Functional Nervous Disorders. The account covers twelve hundred patients. About 40 per cent of the patients reported themselves well at the end of three years, 34 per cent at the end of five years. We do not like to think that the nursing staff were meant to be neutral. An understanding nurse can do so much to help a patient; the doctor need not think he is a little tin god who gets all the patient's confidence. Nurses trained on psychological lines can be so understanding. The common-sense attitude adopted towards the much over-rated *placebo*, occupation therapy, is welcome.

Heredity and the Ascent of Man

By Dr. C. C. Hurst. Pp. ix + 138. (Cambridge: At the University Press, 1935.) 3s. 6d. net.

DR. HURST's little volume is less stereotyped and more discursive than the usual elementary book on this subject. His nine chapters begin with "The Mystery of Life" and the gene, ending on the experimental creation of new species, the ascent of man and the future of man and mind. The gene is regarded as the origin of life, and the evolution of man and his civilization are briefly traced. While highly speculative in places, yet Dr. Hurst succeeds in bringing out many of the salient recent facts of genetics.

Chemistry and Food Science

In the opening paper of a symposium on "Chemistry and Food Science" in Section B (Chemistry), held at the Blackpool meeting of the British Association, Dr. Leslie Harris, of the Cambridge Nutritional Laboratory, spoke of a 'food cycle', analogous to the 'nitrogen cycle' of the chemist. To explain what was meant by the food cycle, he said that food in the first place must be collected or gathered; then it may undergo some manufacturing process; next it may be transported (by sea, rail or road); after which it may be preserved or stored in the cold; before at last it is prepared for the table and eaten. To complete the 'food cycle', it has to be remembered that food, or some part of it, is ultimately converted into manure, and so fertilization is brought into the picture—and with fertilization goes food production, the raising of crops and the rearing of farm animals. In each of these stages of the food cycle, the work of the chemist has been of service to the community, and in the discussion each stage was in turn dealt with by an expert. It might be thought that the logical order is to discuss first food manufacture, and then transport and storage and finally nutrition. On the other hand, all these complicated processes are of no avail, if the final product fails to nourish—so that nutrition must be the final criterion, and may be given pride of place.

On the purely chemical side, as Dr. Harris pointed out, a great body of knowledge has been won in the science of food and nutrition. For example, what were formerly mysterious and intangible 'antiscorbutic' or 'antirachitic' properties in foodstuffs have been shown to be due to 'vitamins', still unidentified and given only vague descriptive letters, C, D, etc. Recently, the chemist has been able to reach one of his final goals by determining the structural formulæ of the vitamins (or five of the better known of them, at least), and in more than one instance he has even synthesized them in the laboratory. The consequences of such discoveries have not been insignificant. For example, the pharmacologist or clinician is now able to prescribe an exact dose consisting of a given number of International Units of an accurately standardized synthetic vitamin. But perhaps more important is the fact that the science of nutrition is now placed on a rational, logical basis instead of being an arbitrary, empirical and rule-of-thumb art. We can now speak with certainty and precision about matters which before, since they lacked formal proof, were open to dispute or disbelief.

THE SCIENCE OF NUTRITION

The next point raised was that it is a mistake to consider food and nutritional science too exclusively from the *chemical* angle. Nutrition is a *biological* process, and therefore can only be adequately studied by the combined methods of biochemistry and biophysics, of physiology and pathology, etc. No progress would have been possible for the pure chemist in his effort to solve nutritional problems without the aid of biological technique, such as animal-feeding tests, biological assays, etc. This is the justification for the existence of that highly trained specialist, the nutritionist—who, to be competent, must needs use the methods not only of chemistry and physics but also those of various biological sciences. In addition, we are beginning to realize that nutrition as a social science is inextricably bound up also with agriculture, and no less with economics.

PREVALENCE OF MALNUTRITION

In conclusion, Dr. Harris said that as a main function of the British Association is to examine "the services of science to the community", the present problem is to inquire how far the science of food and nutrition has served the needs of the people and, more important, how much room there still is for improvement. What constitutes an adequate diet, and how far is it attained in practice? For the present purpose it is not necessary to consider the nutritional needs of the human individual from the more technical aspect —that is, the requirement for given *food constituents*, as fats, proteins, vitamins, etc. It is sufficient to point to the common *errors of diet* as met with in Great Britain, for example, inadequacy of such 'protective foods' as milk, fruit and vegetables.

How can the position as it exists in Britain at the present time be summed up? It is true that people are better nourished than they were (few are now unable to obtain sufficient energy or crude protein), but much remains to be done to furnish a sufficient supply of those accessory factors which are essential for health and optimum growth. In the past, it has been difficult to assess at all accurately the prevalence of malnutrition because of the lack of definite standards of reference: average weights and heights for different age groups are available, but these are not the optima to be striven for. But recently progress in biochemical and other methods has provided specific diagnostic tests for partial deficiencies, and these are now being applied to random groups of the population and might with advantage be utilized on a large scale. Recent inquiries from various angles (for example, Sir J. B. Orr's from the economic side, and a number of surveys from the clinical side) are beginning to make it possible to assess fairly accurately the prevalence of specific disorders of malnutrition in Great Britain to-day.

It is no longer disputed that malnutrition (or 'sub-optimum nutrition') is widespread. It is due to some extent to ignorance, but much more to economic causes—there is still 'starvation in the midst of plenty'; such are the official conclusions of authoritative bodies which have been called upon to give their verdict, such as the International Committees recently appointed by the League of Nations, and by the International Labour Office.

Scientific evidence of malnutrition, presumptive or direct, has been obtained along several different lines: (1) economic (that is, insufficiency of money spent on food), (2) dietetic (inadequacy of food eaten), (3) medical (existence of disorders of deficiency), (4) sociological (comparison of the health standards of poorly-fed and better-fed social groups), and (5) experimental (improvement in health observed in controlled tests when the inadequate food is suitably augmented).

THE PREPARATION OF FOOD

The discussion of the scientific aspect of the preparation of food was very appropriately entrusted to Dr. L. H. Lampitt, head of the research department of an important catering firm.

Dr. Lampitt said that there have been at least five factors stimulating scientific investigations of food. These are—fear of food shortage, fear of war, national economic policies, commercial competition, and one general factor—the desire of man to search into the unknown.

"The coining of the word vitamin," claimed Dr. Lampitt, "has made the English stomach-conscious in a new way, and while I personally cannot see that any nation gains much by that neurotic attention to food which is obvious in certain classes in more than one foreign country, yet possibly an intelligent interest in food can be stimulated which will react to the betterment of the health of our people. One sometimes feels that the vitamin cult has perhaps blinded some of its votaries to the need of calories . . . and perhaps the inorganic salts will receive their due recognition in the near future."

Moreover, as Dr. Lampitt emphasized, people are apt to forget that palatability is a first essential in food, and that proper cooking, in its way, may be as important as a knowledge of calories and vitamins and inorganic salts. Mass production of food, in canning and preserving, and in restaurants, has necessitated the application of science by commercial firms to maintain the quality of food and to enable it to be kept for long periods of time. Thus it is comparatively simple for a chef to make a mayonnaise sauce; but its production in hundreds of gallons, so that the product will remain in good condition, no matter how badly treated by the retailer, and afterwards in the home, involves a whole series of problems which the chemist alone can solve. Mass production also introduces another factor, in the form of metallic contamination. None the less, the unfounded scaremongering about the contamination of food from aluminium cooking-vessels is altogether to be deprecated. Bacterial contamination is another matter, and is one of the most difficult and insistent problems in food industry. But thanks to the help of legislation and scientific investigations, the standard of purity of food in Great Britain is higher, Dr. Lampitt claims, than in many other countries which, in contrast with our own, have the most complete bureaucratic control.

FOOD PRESERVATION AND TRANSPORT

Numerous interesting points were briefly touched on in a paper by Dr. Franklin Kidd, head of the Low Temperature Research Station at Cambridge, which was read in his absence by Dr. Thomas Moran. For example, on the practical side, in the work on proteins, two problems have been solved. In the first place, it has been shown how even the toughest meats from old animals can be rendered tender by hanging for the right time at the right temperature. Conditions are now also understood for avoiding that *hardening* which may occur during preservation in a frozen condition. An important result of this discovery has been that summer catches of choice halibut from far northern waters may now be taken to any region of the earth and eaten at any season. With quick freezing and thawing, and holding at extremely low temperature, the herring gluts of to-day can be preserved and 'spread'. In these matters, as Dr. Kidd concluded, we are at the beginning of great changes in the structure and organization of the fish trade in all countries.

An important aspect of modern food science relates to the conditions of food transport, and these were discussed by Mr. T. Herbert, of the L.M.S. Railway Company. As he pointed out, improvements in refrigeration and chilling processes have created entirely new branches of overseas trade. At home, improved containers have been installed on the railways, and more compact and efficient freezing plant has been evolved. As a result the consumer has been able to receive quicker deliveries, fresher food and greater variety. A vivid impression was conveyed to the audience of the different problems which have already been solved by showing them lantern slides illustrating the imposing provision made on board ship and on rail for the transport of such commodities as meat, bananas, etc.

SOCIAL IMPLICATIONS

That topics concerning nutrition and malnutrition are still liable to be controversial issues was apparent with the opening of the general discussion by the president of the Association, Sir Josiah Stamp, who pleaded for scientific definition of the terms used and statistical treatment of conclusions, and emphasized that these questions have social and even political implications. How, he asked, can one define the "amount of money needed for an optimum diet" when a French housewife is able to manage on so much less than her English counterpart, or how is one to define the "amount of money *available* for food" when it depends on how much of it is spent on beer!

FOOD SCIENCE AND AGRICULTURE

Prof. H. G. Denham, who followed, spoke of the benefits which scientific research has rendered to agriculture in New Zealand, and Prof. W. J. Young, of Melbourne, paid a similar tribute on behalf of Australia. In New Zealand the use of superphosphate has enabled the farmer to put a cow on every acre instead of only one cow on three or four acres. As a result of the drop in its price, the consumption of butter has been greatly increased. In the same way, the consumption of milk might be raised with marked effects for good on many sections of the community. Another contribution of the chemist to agriculture and to food science is the discovery that borax cures a disease of Cox's orange apples. Another is that cobalt, not iron, is needed to secure New Zealand sheep against certain common infectious diseases. Both Prof. Denham and Prof. Young united in expressing their obligation to the work of the Low Temperature Research Station at Cambridge.

The value and indispensability of the contribution of the analytical chemist to food science was the theme chosen by Dr. G. Roche Lynch, president of the Society of Public Analysts and other Analytical Chemists. As he pointed out, much of our "newer knowledge of nutrition" has its origin in the work of the public analyst in controlling the adulteration of food.

Positive Economics of the Fungi

THE emphasis of the study of economic mycology is so much upon the negative side, the effect of fungi as producers of disease, that it is very stimulating to have the presidential address to Section K (Botany) of the British Association, delivered on September 10, deal with the beneficial activities of these organisms. Mr. J. Ramsbottom has collected very numerous examples where fungi are of positive value to the community, and his paper makes fascinating reading.

Perhaps the most obvious use of fungi is as articles of food. In addition to the common mushroom, blewits (*Tricholoma personatum*) and species of the genus *Boletus* (*B. edulis* and *B. scaber*) are eaten in Great Britain; but Mr. Ramsbottom also mentioned the use of *Pholiota ægerita* and *Polyporus tuberaster*, of literary lore, the Canadian *Grifolia* (*Polyporus*) *Tuckahoe*, the Indian bread of America (*Poria cocos*), the blackfellow's bread of Australia (*Polyporus mylittæ*) and various tropical species of the genus *Lentinus*. Three species of the larger fungi are cultivated by man, namely, the field mushroom, the shiitake (*Cortinellus Shiitake*) and *Volvaria volvacea*. A historical review of the development of mushroom culture finds a natural place in Mr. Ramsbottom's paper, and a consideration of modern methods of pure-culture also appears therein. Production of the shiitake has little horticultural similarity to mushroom growing. A pile of logs is sprinkled with powdered wood from previously infected material, or covered with straw mats bearing spores. The cultivation of *Volvaria volvacea* is less precise, for heaps of rice straw, chopped banana leaves, or other vegetable refuse, are merely watered with rice-wash or sugar-cane juice, and usually bear within a fortnight. There is an extensive cultivation of this fungus within the tropics.

Truffles (*Tuber* spp.) still occur in Great Britain, and Mr. Ramsbottom's paper contains an implicit invitation for field mycologists to follow the example of C. E. Broome, who, in the middle of last century, always used a rake upon his fungus forays, and found truffles from very numerous localities.

A whimsical reference to the criminal use of poisonous fungi led to a consideration of the medicinal value of certain species. *Lycoperdon Bovista* has been used in the past for stanching wounds, ergot of rye (*Claviceps purpurea*) holds the seal of the British Pharmacopœia, and many other examples of more homely uses of fungal remedies are given. *Cordyceps sinensis*, a parasite of caterpillars, is much used in China, being sold along with the caterpillar, and tied with red silk.

Perhaps few dentists or fly fishermen would recognize the soft flesh of *Fomes fomentarius* as the amadou of their craft, and relatively few photographers have experienced the use of the inky juice of *Coprinus comatus* as a retouching medium. Hottentot and Egyptian ladies used fungus spores as face powder, and one wonders why their modern sisters have not made greater use of the delicate shades of spore colour for this purpose. Wood attacked by fungi is not necessarily worthless. The green colour of oak or birch attacked by *Chlorosplenium æruginosum* is the 'green wood' used in the manufacture of Tunbridge ware, whilst 'brown oak' of commerce is the result of inoculation with *Fistulina hepatica*. A most fascinating use of a mould, *Mucor racemosus*, is described from Chiloe Island and eastern Patagonia, for there the wood of such trees as *Eucryphia cordifolia*, *Weinmannia trichosperma* and species of *Nothofagus*, is converted to a palatable food for cattle by the agency of the fungus and associated bacteria.

No account of the uses of fungi would be complete without some reference to the symbiotic mycorrhiza of orchid plants. The work of Noel Bernard showed that inoculation with a fungus was necessary for the germination of orchid seeds, and gave abundant growth where previously had been great waste of seed. Although the work of B. L. Knudson has shown that the seed can germinate under aseptic conditions, if supplied directly with glucose, the symbiotic method of Bernard is still used extensively in some countries.

A very large part of Mr. Ramsbottom's address dealt, very naturally, with fermentative changes brought about by fungi. As an introduction to this section, he quoted the discovery of nineteen different enzymes—"apparently sufficient for any purpose here below"—from the fungus *Aspergillus Oryzæ*. Compressed yeast, which is now used extensively in bread manufacture, has evolved gradually from the older preparations, as leavens, barms and more liquid ferments. Wines are still made chiefly with naturally occurring yeasts, usually allied to *Saccharomyces ellipsoideus*; but various strains of *S. cerevisiæ* are maintained in pure culture for all the more distinctive brands of beer. A point of general mycological interest is the discovery by K. Kruis and J. Šatava that there is an alternation of generations in yeasts; *Torula* and other non-sporing forms are regarded as haploid phases.

The world's coal resources must come to an end sooner or later, and it is very satisfying to have the assurance that suitable methods for the production of power alcohol could be brought into operation on a large scale, as soon as international interest should demand. Fungal organisms can also be employed for the conversion of starch to sugar in malting operations, and give better results than the use of enzymes derived from the germinating grain.

Mr. Ramsbottom had many interesting facts to relate about the production of fermented foods and drinks. The reader cannot but revel in the international nature of his discourse, for he described the preparation of *shoyu koji*, from soy beans in Japan, China, Java and other countries, *tamari*, *miso*, *to-fu*, from the same parts, *saké*, a beverage made from rice in Japan, and the ripening of various kinds of cheese in all parts of the world, and probably dating back to Neolithic times. There is also detailed mention of Russian *kvass*, Mexican *pulque*, *laette* in Scandinavia, the old English ginger-beer plant, *kephir* and *koumiss*, beverages made from fermented milk in central Asia, *leben*, a similar drink of Egypt, and *mazu* of the Armenians. The accounts of cheese-ripening are particularly interesting, and many practical problems are described. One cannot but sympathize, for example, with the up-to-date farmer who pulled down his old wooden dairy shelves, and replaced them with tile and slate, only to find that he had also parted with the "esteemed special quality" of his Stilton cheeses—the wooden shelves had been the unsuspected culture medium for the specific organism concerned.

The work originated by Pasteur led to a new era in the production of organic compounds, and since the time when Van Tieghem, Pasteur's pupil, first studied the formation of gallic acid from tannin, many compounds have been produced mycologically. Glycerol, which is a very important compound in many industries, can be produced if sugar is fermented in the presence of alkaline salts. W. Connstein and K. Lüdecke, under the stress of war conditions in 1914, showed that disodium sulphite was much more suitable than the commoner alkaline salts; it could be added in large quantities without detriment to the yeast, and kept out other contaminating organisms. Commercial diastase, oxalic and citric acids, gluconic acid, and an imposing host of organic compounds, some of them never previously prepared in the laboratory, have been made by the action of fungi. Exhaustion of our coal reserves need have no terrors, for in addition to power alcohol, dyestuffs can be made with the aid of fungal organisms. α-Hydroxyanthroquinone pigments can be produced through the agency of certain species of the genus *Helminthosporium*. Ergosterol, fats and proteins must also be added to the list of mycologically producible substances, and the discovery by Chapman that a species of *Oidium*, found to be blocking sewer channels, could produce a thick film on nutrient medium, which had the odour and flavour of cream cheese, illustrates the romantic possibilities of science.

There is a great deal in Mr. Ramsbottom's address which can be used to render the acquirement of knowledge by the student a pleasant experience. The subject-matter is about candy, cheese, 'Marmite', coffee, mushrooms, baking and brewing—instances of common experience; but the discourse gave sufficient detail to make it of interest to the technician also. The dominant impression was one of confidence in the future. Natural mineral resources are now being exploited at an enormous rate, to produce power, dyestuffs and various chemicals; but many of these needs could also be met by the gentle ministrations of fungi. Perhaps the large number of substances already produced by these organisms might be taken as earnest that man need not fear the exhaustion of Nature's experiment with carboniferous conservation.

Genetics and Ecology in Relation to Selection

ONE of the most striking features of post-War biology has been the reanimation of Darwinism on a genotypic, instead of a phenotypic, basis. That such an attitude to evolutionary theory derives strong support from modern genetic and ecological work is undoubtedly the chief fact which emerged from the discussion on selection held on September 10 by Section D (Zoology) of the British Association at the recent Blackpool meeting. This occupied the first morning, and immediately followed Dr. J. S. Huxley's presidential address to the Section, which itself provided a comprehensive introduction to the subject. For his review of "Natural Selection and Evolutionary Progress" was a remarkable achievement, including almost everything that could and should be said in a general survey of selection.

In recent years experiment has largely replaced observation in the study of evolution. It is now plain that selection can operate only on genotypically controlled variability. Consequently, the effects of mutation, which is the initiation of a heritable variation, demand careful study. That these are nearly always disadvantageous need, however, cause us no surprise, for any organism must represent a system carefully balanced and adjusted to its environment; so that any random change within it is immensely more likely to impair than to improve its efficiency. Yet occasional mutations have actually been observed which might be of advantage at least in special circumstances: like that mentioned by Dr. Huxley, in which a variety of tobacco failed to flower until the ratio of light to darkness was altered to correspond with what would prevail in a semi-tropical summer, when it proved superior to the normal form. But the relative viability of the genes may be most favourably compared in crowded cultures, when it can be studied as a deviation from expectation in Mendelian ratios. Dr. Timoféef-Ressovsky, who has elaborated this technique, pointed out that such tests also demonstrate that genes have different survival values in different degrees of crowding. For this work he has employed populations of *Drosophila*, and his method has provided an experimental basis for the study of selection in the laboratory.

Using the same genus, Dr. C. Gordon has now supplied proof of selective elimination in Nature. He finds that the number of autosomal recessives is very significantly in excess of the number of recessive sex-linked genes per length of chromatin —a discovery to be correlated with the fact that selection can operate on the former only when the genes in question are present in double dose, but on the latter, in every individual of the heterogametic sex in which they occur. Dr. Gordon has also demonstrated the reality of selection in Nature by releasing, and afterwards studying, a balanced population of *Drosophila melanogaster*. This consisted of normal and 'ebony' flies in a known ratio, set free in England, where the species is not indigenous. The latter is a dark mutant form, mono-factorial and recessive. It proved to be progressively eliminated in the open.

Selection, however, operates not merely to reject one character and conserve another: it may also alter the *effects* of the genes, but not the genes themselves. This view, the evolutionary implications of which have been developed only in recent years, follows naturally from the consideration that genetic factors interact with one another to produce the characters for which they are responsible. Thus mutations which are pathological in one gene-complex may be harmless or even advantageous in another, and such effects are open to the influence of selection. This concept, ably elaborated in Dr. Huxley's address, was illustrated by Mr. E. B. Ford by an example drawn from work on *Gammarus chevreuxi*. A gene which changed the eye-colour from black to red at one mutation, changed it to brownish when it mutated in another stock. A mating between the two showed that the same locus was concerned. Furthermore, successive back-crossings of each type of red into the other stock reversed their effects, demonstrating that the phenotypic difference was due to the action of the total gene-complex, not to mutation to another allelomorph at the same locus.

The effects of the genes, then, are susceptible of modification by selection, and Mr. Ford pointed out that the evolution of polymorphic mimics can be explained by no other means. It is often found that two forms of mimetic butterflies, each highly adapted in a number of distinct characters, are controlled by a single factor-pair. The allelomorphic difference concerned must have originated spontaneously by mutation, but we cannot suppose that selection has had to wait for the fortuitous occurrence of a change producing all the characters required. Such would seem an almost impossible event even in a single instance, yet the condition is common. The alternative explanation of the occurrence of parallel variation in model and mimic is disposed of by the superficiality of the resemblances between them. Thus Mr. Ford has found that the red pigment produced by the mimetic forms of *Papilio polytes* is chemically different from that of the models, though this is well known to be an instance in which the polymorphism concerned is under simple Mendelian control.

Furthermore, the study of mimetic insects has clearly demonstrated the reality of selection as an agent in stabilizing the population. Prof. G. D. Hale Carpenter, who discussed the forms of *Pseudacræa eurytus*, which mimics various species of *Bematistes*, has collected this butterfly on an island in Lake Victoria in which the proportion of models to mimics varied in different years. He found that when the models were the commoner (70 per cent of the association), intermediates between the different forms of *P. eurytus* were rare (4 per cent or less); but when the mimics were in excess, such intermediates were quite frequent (11–30 per cent).

Finally, Darwin's view of sexual selection has evoked much criticism. It is rightly felt that his analysis of this subject is one of the least satisfactory steps in his argument. However, Mr. F. C. Minns provided evidence of sexual selection in budgerigars. He further pointed out that in some forms the process must favour vigour and activity in the male and the reverse in the female, a condition proved in *Drosophila*.

It was the duty of Prof. H. J. Muller to summarize the whole subject, and he performed this difficult task with success. There can be no doubt about the value of a carefully planned discussion such as this, illuminating, as it did, a single problem from widely different angles. Each of the speakers has himself worked on the particular aspect of selection which he developed, and took the opportunity to bring forward recently ascertained or unrecorded facts.

Obituary

Dr. W. H. Harrison

WE regret to record the very sudden death, on August 18, of William Hudson Harrison, late of the Indian Agricultural Service, at his home near Leeds. Harrison was born in 1876. He graduated with honours in chemistry at the Yorkshire College in 1897, having been highly distinguished as a student and personally beloved by all. After graduation he was appointed chemist and manager at Knostrop Sewerage Works, Leeds, which post he held for nine years, receiving the warmest appreciation for his work both from the Leeds authorities and from the Royal Commission on sewage disposal.

In 1906 Harrison was appointed agricultural chemist to the Government of Madras, India. Here he commenced work by carrying out some valuable soil surveys, and then went on to a study of rice cultivation as practised in India under swamp conditions. He discovered the most obscure phenomena, and proceeded to elucidate them step by step. His work was highly original and practical and is assuredly a classic in this field. His papers are a record of his resource and genius. For his earlier papers on this subject he was awarded the D.Sc. degree of the University of Manchester.

Harrison's extensive work on swamp soils can only be referred to here in mere outline. His preliminary observations showed that the anærobic fermentation of soil organic matter and green manure in these submerged soils produced large quantities of methane and nitrogen and relatively small amounts of carbon dioxide and hydrogen. On the other hand, anærobic fermentation of green manure without soil to hold up the gas produced much carbon dioxide and hydrogen in the first phase and carbon dioxide and methane in the second phase. Only a small amount of gaseous nitrogen was formed. Other experiments showed that by a secondary reaction under swamp soil conditions, carbon dioxide and hydrogen are recombined by bacterial agencies with the formation of organic matter and even methane. Hence the important conclusion was reached that the gases actually found in swamp soils are a residue of the gases produced in the primary fermentation, thus providing a rational explanation for the peculiar composition of the soil gas.

The gas evolved from the surface of swamp soils was found to consist mainly of oxygen and nitrogen. This gas is entirely distinct from the gases in the soil, and the soil gases do not normally escape from the surface. The evolution of oxygen at the surface was shown to be the work of a mixed film composed of certain bacteria, diatoms and algæ. The bacteria were isolated and characterized and shown to have the power of oxidizing methane and hydrogen. The photosynthetic utilization of carbon dioxide with liberation of oxygen by the film was proved, and it was shown that the development of oxygen was dependent upon the supply of methane and carbon dioxide from the soil gases.

From these and other inquiries, Harrison demonstrated that an important indirect manurial effect of green manure is to aerate the soil water in this type of cultivation. Comparing cropped and uncropped soil, it was found, among other interesting facts, that cropping greatly increased the formation of gaseous nitrogen, especially during the later stages of growth. Evidence from numerous experiments showed that the extra nitrogen formed in cropped soils is derived from the fermentation of dead roots which accumulate as the plant grows. The nitrogen cycle did not seem favourable, and it is evident that Harrison was aiming at further work on this aspect of the subject, but at this stage he was appointed Imperial agricultural chemist and transferred to Pusa. The appointment was an honour and a call to greater responsibility. He had to abandon his work on rice, but he has left a contribution which is unique.

At Pusa, Harrison undertook inquiries into soil nitrates and phosphates and soil reaction. The work on the influence of calcium carbonate on the penetration of certain phosphatic manures into the soil yielded notable information. Eventually administrative duties filled more and more of his time. He was first appointed joint director of Pusa and later became head of the service as director and agricultural adviser to the Government of India, from which post he retired in 1931.

Dr. Panchanan Mitra

THE death occurred on July 25, after a short illness, of Dr. Panchanan Mitra, head of the Department of Anthropology of the University of Calcutta.

Panchanan Mitra, born in Calcutta on May 25, 1891, was a member of a family already distinguished in the study of Indian history and culture. His grandfather, Raja Rajendra Lal Mitra, was the first Indian president of the Asiatic Society of Bengal. After a distinguished career at the University of Calcutta and four years as a lecturer in English, Panchanan Mitra in 1919 was awarded the Premchand Raichand Scholarship of his university for a thesis afterwards (1923) published under the title "Prehistoric India"; and in the same year was appointed to the staff of the Department of Anthropology, of which he became head on the retirement of Diwan Bahadur Dr. Anantha Krishna Iyer in 1932. In 1929, at the instance of Dr. Craighill Handy, he was appointed to a fellowship of the Bernice P. Bishop Museum, Honolulu, and travelled extensively in Polynesia, collecting evidence bearing upon the problem of the influence of Indian cultural traits on Polynesia. His results are now on the point of publication. A period spent at Yale University working with Dr. Clark Wissler on distributional studies resulted in "A History of American Anthropology" (Calcutta, 1931), for which he was awarded a Ph.D. In 1931 also he visited Spain and southern France as a member of the American School of Archæology in France. Two years later he presided over the Anthropological Section of the Indian Science Congress.

Dr. Mitra was not only himself a distinguished research worker, but he was also an organizer of research. He was responsible for the close conjunction of research in the laboratory and in the field, which is now an important feature in the work of his Department. His premature death is a great loss to anthropological studies in India.

Prof. Eugène Lagrange

EUGÈNE LAGRANGE, seismologist and emeritus professor of physics at the École militaire at Brussels, died in that city on June 15 (*Boll. Ital. Soc. Sism.*, **34**, 156; 1936). Born in 1855, he entered the École militaire in 1873 and, after passing through its course, was appointed first as assistant professor, and then as professor, of physics, an office that he held until his retirement in 1907. In 1898, he spent some time in Strassburg, in order to become acquainted with the use of seismological instruments. Through the generosity of M. Ernest Solvay, he was enabled to construct a seismological station at the Royal Observatory of Uccle, where he installed three horizontal pendulums of the Rebeur-Ehlert type. His observations there were continued until the end of 1903, when M. Solvay presented the station to the Belgian Government. At the same time, two other stations were placed under his direction, one of them at a depth of more than half a mile in a disused passage of a coalmine, the principal object of which was to discover if any relation exists between microseismic movements and the emission of firedamp. From 1908, Prof. Lagrange directed the well-known journal *Ciel et Terre*, until, in 1910, it was combined with the *Bulletin de la Société belge d'Astronomie*.

Mr. Alan A. Blakeway

WE regret to record the death, at the age of thirty-eight years, of Mr. Alan Blakeway, director of the British School of Archæology at Athens, which took place at Winchester after an operation on October 9.

Alan Albert Antisdel Blakeway was a son of the late Charles Edward Blakeway, Archdeacon of Stafford, and was educated at Shrewsbury School and Christ Church, Oxford. After taking first class honours in the school of *Literæ Humaniores*, he was for six years a master at Winchester, and then in 1931 was elected a fellow and tutor in ancient history of Corpus Christi College, Oxford. In May last, on the death of Humfry Payne, he accepted the directorship of the British School for the time being. His death took place on the eve of the opening of the exhibition at the Royal Academy of Arts, which celebrates the fiftieth anniversary of the School, and in the preparations for which both he and Payne had taken a very active part.

Blakeway had excavated on behalf of the School both at Perachora and in Crete, and he had for long been engaged in research on the commercial relations of Greece with Italy, Sicily and France in the eighth and seventh centuries B.C. The first fruits of his researches, which he had begun to publish in the *Annual* of the School and the *Journal of Hellenic Studies*, had already won recognition as of outstanding merit.

WE regret to announce the following deaths:

Dr. J. W. Folsom, senior entomologist in the United States Department of Agriculture, an authority on cotton insects, on September 24, aged sixty-five years.

Dr. George Forbes, F.R.S., formerly professor of natural philosophy in Anderson's College, Glasgow, on October 22, aged eighty-seven years.

Prof. F. Hendrickx, emeritus professor of veterinary medicine in the Belgian Veterinary School.

Dr. S. M. Kintner, vice-president in charge of engineering of the Westinghouse Electric and Manufacturing Company, formerly professor of electrical engineering in the University of Pittsburgh, an authority on radio engineering, on September 28, aged sixty-four years.

Prof. W. A. Parks, F.R.S., professor of geology in the University of Toronto, on October 3.

Dr. E. E. Prince, former Dominion Commissioner of Fisheries, Canada, an authority on the life-histories of marine food fishes, aged seventy-eight years.

Dr. Gustaf Schack-Sommer, a pioneer in the sugar-beet industry in Great Britain, aged eighty-two years.

Prof. G. Sergi, emeritus professor of anthropology in the University of Rome, aged ninety-five years.

Prof. W. J. Sollas, F.R.S., professor of geology in the University of Oxford, on October 20, aged eighty-seven years.

News and Views

Prof. A. R. Radcliffe-Brown

ALFRED REGINALD RADCLIFFE-BROWN, who has been appointed to the recently instituted professorship of social anthropology in the University of Oxford (see p. 772), was educated at the King Edward High School, Birmingham, and Trinity College, Cambridge, where he was elected to the Anthony Wilkin scholarship in ethnology, carrying out ethnographical investigations in the Andaman Islands. He was a fellow of Trinity College from 1908 until 1914, and a lecturer in ethnology in the University of London in 1909–10. After the Great War, Prof. Radcliffe-Brown held an educational post in Tonga for a time and was afterwards on the staff of the Transvaal Museum until he was appointed to the chair of social anthropology in the University of Cape Town in 1921. This he held until his appointment as professor of anthropology in the University of Sydney. Here, as at Cape Town, he was active in promoting ethnographical work in the field, and the present activity of anthropological studies in Australia is largely due to his enthusiasm and power of organization. In 1931 he left Australia to join the staff of the University of Chicago. Prof. Radcliffe-Brown was president of the Anthropological Section of the British Association at the centenary meeting in London in 1931, when he dealt in his presidential address with the methods of investigation in social anthropology, of which he had already given a practical demonstration in "The Andaman Islanders", which is, up to the present, his most important and considerable contribution to anthropological literature.

National Museum of Wales and Welsh Cultural Studies

IMPORTANT developments in policy and organization, made possible by an increased Treasury grant, were announced in the annual report of Council of the National Museum of Wales, which was presented at the court of governors held at Cardiff on October 23, when Mr. W. G. A. Ormsby-Gore, vice-president of Council, was in the chair. An immediate addition of £1,500 per annum, to be followed by two increments of £750 per annum, will raise the Treasury grant to £20,000 per annum in all by April 1, 1938. Of the additional income, the Council proposes to set aside part to form a fund for the purchase of collections of outstanding importance, otherwise beyond the normal resources of the Museum. Of even greater interest, however, is the second development, to which effect has already been given. The Sub-Department of Folk Culture and Industries within the Department of Archæology has been advanced to the status of a full department. It will cover the national ethnography and cultural history of Wales from the Act of Union of 1536 to the present day, with the proviso that the modern industrial civilization will not be covered, save to a limited degree. It will, therefore, concern itself with the trades and crafts, the ways of living and working, the domestic and industrial environment, and the clothes and customs of past generations of all ranks of the Welsh people. The enhanced status of this section of the National Museum is no more than due recognition of the value of a piece of work to which much time and research have been devoted by the responsible authorities, and from which important studies have already accrued. The collections at Cardiff illustrating the life and culture of the Welsh people—even more now that this opportunity for expansion is afforded them—provoke regret that no similar unitary collection deals in like manner with the folk history of England.

Future of Liquid Fuel Production

SIR PHILIP DAWSON's presidential address to the Institute of Fuel on October 15 entitled "Road, Rail and Fuel" emphasized our dependence on imported liquid fuel, and especially motor spirit. He stated that in the present year, Germany will produce more than fifty per cent of her needs of light motor fuel. The use of Diesel fuel is increasing in all forms of transport. Discussing the relation of road and rail, he said that the former employs almost twice as many persons as the railways, and in ten years the number of railway employees has fallen by fourteen per cent. Sir Philip advocated an extension of railway electrification, but pointed out that this would involve a big reduction in the consumption of coal, even were the power generated from steam boilers. At the same meeting Dr. Franz Fischer, of the Kaiser Wilhelm Institut, Mulheim, delivered the Melchett Lecture to the Institute, taking as his subject the conversion of coal into liquid motor fuels and other products by way of carbon monoxide. Having indicated the advantages of beginning with a single pure gas such as carbon monoxide rather than raw coal, as in direct hydrogenation, Dr. Fischer traced the development of his work from 1921 until the present stage when large-scale plant is in use. Very extensive efforts were necessary in the search for a suitable catalyst and a method for adequately purifying the gaseous raw material. Hydrocarbons ranging from petrol to paraffin wax are obtained by this 'Kogasin' synthesis. Thus these researches have shown that from coal and water all necessary liquid fuels would be obtainable from coal even if mineral oils were entirely exhausted. Fischer's process offers the advantage over the process of direct hydrogenation, that high pressures are not used and that only plant of common materials, easy to fabricate, is required.

Electric Services in Buildings

MR. H. T. YOUNG, who is connected with the installation and contracting section of the electrical industry, gave his presidential address before the Institution of Electrical Engineers on October 22. In the early days, electrical installations in buildings were for lighting and bells. Wood casing was used, and, so far as possible, it was concealed from view. Cables, wires and equipment were placed anywhere where they would be out of sight. Now new and larger buildings are being erected all over the country, and electrical contractors are having difficulty in doing their work satisfactorily under the new conditions. The steel and concrete buildings of to-day, if once completed, are almost impregnable to electric services. The item in electrical accounts entitled "cutting away and making good" averages about ten per cent of the cost of the whole installation. In new buildings which are planned and designed for electrical services, this item is much smaller and the time of building is accelerated; Mr. Young urged that channels, ducts and conduits for the reception of wires and cables should be considered in the future as an integral part of the building from the point of intake to the outlets. In the United States and Canada, underfloor duct systems have been adopted for more than ten years as standard practice in nearly every type of building, except private houses. The ducts are made of steel or fibre and are laid in the floor during construction. In Great Britain, a beginning of the duct system has been made. Three ducts are used, one for telephones and signalling wires, one for heating and power, and one for lighting.

MR. YOUNG showed lantern slides of installations in progress and completed where electrical engineers and architects have planned their work together. In particular, he mentioned the new buildings of the University of London, which he said are the most interesting buildings in the course of erection in the country to-day, and also seem to have the most complete electrical installation, as the lighting, space-heating, water-heating, and many other services are all electric. There is one flue only, and that is for a coal fire in an official's study. In blocks of flats in London, arrangements are now being made for the reception of sound and television services. These are taken from one central aerial system and distributed by cables to a terminal box in each flat. The tenant receives both services on his own equipment through a 'socket outlet' and plug attachment. A special type of cable is used for carrying the extremely high frequency currents used in television. The estimated total annual consumption of all-mains radio sets is 300 million units. This equals twice the estimated load in 1910 for lighting, heating and cooking. He mentioned that a large store in London (Selfridge's) has an annual consumption of electricity (7¼ million units) which equals that of places like Weymouth, Perth, or the whole of the Isle of Wight. There are other buildings in London, such as stores and hotels, which consume five million units per annum. He considers that none of these could be described as fully equipped electrically.

The Training of the Engineer

IN his inaugural address as president of the North-East Coast Institution of Engineers and

Shipbuilders on Friday, October 23, Prof. C. J. Hawkes took as his main theme "The Training of the Engineer" and, as a background, his work and experience in the revision of the engineering degree courses at the University of Durham lent an unusual interest and value to his remarks. Engineering is not a science but an art depending on science and, between the two, there are still many gaps, which the engineer has to bridge. His decisions have to be in a form capable of being translated into practice, and he has to be trained to make use of established scientific principles in conjunction with a knowledge of the needs of the world, of the natural forces to be contended with, of the properties of the materials to be used, of the capacities and limitations of those through whom the work has to be done and of the plant, tools, and machinery on which the processes depend. Prof. Hawkes indicated how the curricula at Durham have been revised to comply with these comprehensive demands. The more human aspects are provided for by weekly reports and discussions in college, and by the personal contact during the workshop training with men of all classes, perhaps the most broadening influence that could be found. By the limitation of available time, the graduate course is mainly confined to the study of scientific principles and their applications. Such subjects as economics, works organization and administration are considered preferably as post-graduate studies. Prof. Hawkes also took occasion to report the progress of research work at Armstrong College, which has been greatly fostered by the members of the Institution he was addressing.

Observatory for St. Albans High School for Girls

ON October 23, Sir Frank Dyson inaugurated at St. Albans High School for Girls the observatory recently bequeathed to the school by the late Dr. William Alfred Parr. Dr. Parr, a well-known amateur astronomer and past-president of the British Astronomical Association, resided in St. Albans during the last few years of his life, and had erected in his garden a small but well-equipped observatory, containing a four-inch clock-driven equatorial by Cooke, with a photo-visual object-glass, Evershed solar spectroscope and other accessories. The entire observatory, which is of wood, surmounted by a 10-foot revolving dome, was, with its small annexe, removed from Dr. Parr's garden during the summer, and re-erected in the school grounds near the new gymnasium, under the supervision of Dr. W. H. Steavenson. Following an address by Sir Frank to the staff and pupils, assembled in the latter building, the observatory was formally opened and dedicated with picturesque ceremony, the Dean of St. Albans, the senior science mistress and the head girl taking part.

Food and the Family Budget

THE Engineers' Study Group on Economics, which was formed towards the end of 1933 to investigate the economic and social problems presented by the co-existence of poverty and actual or potential plenty, has now published its investigations on family budgets in a pamphlet entitled "Food and the Family Budget" (Engineers' Study Group, Hazlitt House, Southampton Buildings, W.C.2. 1*s*. 6*d*.). This investigation has been confined to conditions as they exist in Great Britain to-day. The problem is treated quantitatively, and an attempt is made to deduce some general minimum standard of living which would be both desirable and practicable. The method used was that of analysing and comparing published data on family budgets, at the same time taking into consideration modern trends in consumption and requirements indicated by scientific research. The total budget required to provide the minimum standard desirable was found for a "statistical average family" of 3·72 persons to be about £6 per week (equivalent to about 63*s*. per week for each wage earner) and of this sum about 37*s*. a week would be required for expenditure on food. The suggested food budget is shown to be compatible with (*a*) the dietetic requirements laid down by the British Medical Association Committee on Nutrition; (*b*) actual national consumption; and (*c*) the increased consumption of home-grown foodstuffs that would raise the dietetic standard to a level adumbrated by Sir John Orr. There is little doubt, it is stated, that a large part of the population is suffering from lack of nutritious foodstuffs, particularly fresh dairy produce, fruit and vegetables.

Noise on the Road

THE Departmental Committee which was set up in 1934 by the Minister of Transport, under the chairmanship first of Sir Henry Fowler and afterwards of Dr. G. W. C. Kaye, to study the question of motor-vehicle noises, has issued its second interim report (London: H.M. Stationery Office. 1*s*. net). The report elaborates and extends the first report of the Committee, which dealt with new vehicles including motor-cars, sports-cars, motor-cycles and goods- and passenger-carrying vehicles. It appears from the report that a consensus of opinion considered that a loudness of ninety British standard phons represents in general a transition point between tolerably noisy vehicles and unduly noisy ones. Two types of tests are therefore proposed by the Committee: (*a*) normal-running tests in which a vehicle running under full throttle at 30 m.p.h. must not generate an overall noise exceeding 90 phons at 18 feet lateral distance; (*b*) racing-engine tests in which a stationary vehicle the engine of which is racing at maximum-power speed must not generate an overall noise exceeding 90 phons at 25 feet behind the open end of the exhaust pipe. A temporary tolerance limit is suggested for motor-cycles and commercial vehicles. In the meantime, the Minister has received an assurance from the manufacturers of motor-cycles and sports-cars, which are among the chief offenders on the road, that no new vehicle shall in future leave their works the noise of which can be regarded as offensive. The Ministry of Transport is proposing to set up six noise-testing stations to assist the industry in this laudable object. Meanwhile, work is proceeding on the production of a simplified objective noise meter so as to facilitate its production in greater numbers. Detailed results of the tests, which were carried out by the National Physical Laboratory, are given in the report.

Recent Acquisitions at the Natural History Museum

THE Museum has received as a permanent loan from His Majesty the King a fine series of elephant tusks. The series comprises the record pair of Indian tusks, three pairs and a single large tusk of the African species, and an ornamented tusk of the Malayan elephant. The Indian tusks, which are figured in Rowland Ward's "Records of Big Game", are of exceptional size for Indian ivory, measuring 8 ft. 9 in. and 8 ft. 6½ in. in length and weighing 161 lb. and 160 lb. respectively. Good Indian tusks rarely exceed 6–7 ft. in length or weigh more than 80–100 lb. The Trustees of the American Museum of Natural History, New York, have handed over to the National collection the type specimens of fifteen races of British and Irish birds, described by the late Dr. E. Hartert and Mr. H. F. Witherby. These types formed part of the famous Rothschild collection which was purchased by the American Museum in 1932. Through the generosity of Mr. E. C. Stuart Baker, the Museum has received the largest collection of birds' eggs ever presented to the British Museum. This great collection consists of approximately 50,000 eggs belonging to some 1,960 different species of birds found in the Indian Empire. Very many of these eggs were not previously represented in the national collection and in a considerable number of cases Baker's specimens are the only ones known. A collection of more than 6,000 invertebrates, chiefly Brachiopoda and Trilobita, including 40 new species, as well as type and figured specimens, collected by Mr. B. B. Bancroft with great exactness as to horizon and locality, from the Ordovician of the Welsh Borderland and the Lake District, has been purchased for the Department of Geology. The Mineral Department has received from the Director of the Geological Survey of Nigeria as a donation a piece, besides several fragments, of the meteoric stone which fell near Udei station, Benue river, Nigeria, in 1927. The meteorite is of unusual interest because it belongs to the rare pallasite group of stony-irons containing olivine.

THE Department of Botany has received from Mr. C. J. Brooks his fern herbarium, containing about 2,650 specimens. Mr. Brooks was employed as a chemist in the gold-mining industry in Sarawak and later in Sumatra, where he collected insects and ferns. He discovered many new species in the mountains of Borneo and Sumatra, including Gunong Dempo. He also visited Celebes and Amboina. In the latter island he made a very complete collection and ascended the volcano Salahoetoe. Mr. Brooks's plants were mostly worked out by Capt. C. R. W. K. van Alderwerelt van Rosenburgh at Buitenzorg, and many are types or paratypes not otherwise represented in Europe. He was also in touch with Prof. E. B. Copeland and the late Prince Roland Bonaparte, and obtained some specimens by exchange. Especially notable are a set of Schlechter's New Guinea ferns and some from Papua collected by the Rev. Copland King. His herbarium is the most valuable acquisition that the fern collections have had for many years, the more so as it comes from a region which was previously somewhat scantily represented. The Oxford University Exploration Club has presented the botanical collections made by Mr. H. G. Vevers on the recent expedition to Greenland. This comprises more than five hundred numbers. Dr. G. N. Humphreys of the Mount Everest (1936) Expedition has sent to the Museum a collection of 88 flowering plants which he made at the higher camps used by that Expedition. Considering the conditions under which Dr. Humphreys worked, the plants are very well collected and dried, and he appears to have obtained a good representation of the alpine flora. The Department has particularly fine collections from Nepal, and Dr. Humphreys' specimens will add further to the importance of this Himalayan material. A number of the species represented reach the altitudinal limit of flowering-plant vegetation, and it is particularly valuable to have the precise altitude at which each specimen was collected.

Colonial Territories and Economic Opportunity

THE Advisory Committee of the National Executive of the Labour Party has prepared a pamphlet on "The Demand for Colonial Territories and Equality of Economic Opportunity" in which the position of the three 'dissatisfied' Powers—Germany, Italy and Japan—is examined (Labour Party, Transport House, Smith Square, London, S.W.1. 4*d*.). In analysing access to raw materials, the division of the world, recently adopted by the *Economist*, into the British Empire, the French Empire, the Dutch Empire, the U.S.A., the U.S.S.R., and the rest of the world, is used. The general conclusion is reached that colonies are of some, but not of great, economic importance. Only in the case of rubber are the colonial possessions of a Great Power of dominant importance. It is held that the abolition of discrimination rather than the exchange of territories should be the objective. To this end, the Labour Party should advocate the bringing of Colonial possessions, such as those of Britain in Africa, under the mandates system—approximately of the present *B* Class of mandates. The pamphlet is full of information and deserves close study.

Teaching Electric Cookery in Switzerland

IN the *Electrical Age* of October, a magazine published by the Electrical Association for Women, an interesting summary is given of Swiss methods of teaching electrical cooking in schools. Swiss manufacturers supply special electric cookers for use in school kitchens. These are made to stand away from the wall so that access can be obtained from all sides. The oven is placed on one side instead of being put under the hot plates as in the ordinary domestic cooker. This facilitates access to it and at the same time provides standing place for cooking utensils on the top of the oven. The arrangements are such that the pupils can be conveniently divided into four groups. Each group is self-contained and has charge of a cooker with oven, table and washing-up arrangements, and a cupboard for utensils and crockery. The items of equipment are arranged as close together as possible and in the order in which they are required. In order to teach economy, the pupils are required to reckon up the total cost in materials and electrical consumption of all food prepared. A separate meter is usually installed in the circuit supplying each cooker. Although rarely used in schools, descriptions are given of the tilting cauldron and the tilting oven often used in hotels and institutions. The cauldrons, instead of having a tap for withdrawing the contents, are arranged to tilt and pour out the contents over a wide lip. They are mounted on trunnions and worked by a worm gear so that the tipping is done gradually without the risk of spilling. They can be kept clean as easily as a basin, and the heat control is such that even milk cannot boil over.

Agricultural and Horticultural Pests

MUCH recent research into the incidence and overwintering of the potato blight fungus (*Phytophthora infestans*) has made it necessary for the Ministry of Agriculture to revise its leaflet upon this subject. The new Advisory Leaflet, No. 271, shows that the fungus overwinters upon infected tubers, and there are usually sufficient of these left from previous crops, or thrown out from storage pits, to begin fresh infection in the spring. Control by spraying and dusting is described, and other methods include the removal and destruction of haulm before digging the crop, and the disposal of blighted tubers. Advisory Leaflet No. 273 replaces leaflet No. 195, and deals with American gooseberry mildew (*Sphærotheca mors-uvi*). The subject-matter has been brought up to date. A short Advisory Leaflet (No. 182) deals with spurrey (*Spergula arvensis*) as an agricultural weed. Spraying with 5 per cent solution of copper sulphate, or 7–10 per cent sulphuric acid, are recommended for control of the weed amongst cereal crops, in addition to the application of lime, and other methods.

Medallions of Manganese Steel

WHEN King Edward, as Prince of Wales, visited the Hecla Works of Hadfields, Ltd., some years ago, he cast a medallion portrait of himself in manganese steel. A similar medallion, 20 inches in diameter, was recently cast showing the head and shoulders of General the Right Hon. J. C. Smuts, P.C., and both are now on view at the Johannesburg Empire Exhibition, of which General Smuts is honorary president. The manganese steel of which these medallions are made is run into the moulds at a temperature of about 1,450° C., but despite this high temperature, and owing to the specially developed moulding sand employed, the definition of the features is remarkable, each detail being reproduced as clearly as in a photograph.

Faraday House Journal

WITH the opening of the Michaelmas term at Faraday House Electrical Engineering College, *Faraday House Journal* makes its reappearance and, in addition to the usual personal, social and collegiate items, the present number contains several short papers of note. The principal, Dr. A. Russell, writing under the title "Unfettered Mathematics in Engineering", continues his articles on capacitance coefficients, and here shows that the capacitance of a system of two external spheres can be expressed in terms of certain spherical condensers, the values of which can readily be found. In a paper "On a Natural System of Absolute Physical Measurement", Sir Ambrose Fleming puts the case for, and gives data relative to, a system based on the rest mass of the nucleus of the hydrogen atom and the wave-lengths and periodic times of certain of its radiations. "Fluorescence under Ultra-Violet Light" by Dr. W. R. C. Coode-Adams and "Perspective" by the Rev. L. Van Vestraut complete this section of the contents and their titles sufficiently indicate the nature of these two papers.

Bureau international des Poids et Mesures

DR. CHARLES-EDOUARD GUILLAUME, director of the Bureau international des Poids et Mesures, is retiring after fifty-three years in the service of metrology. The permanent administrative committee of the International Committee of Weights and Measures, which consists of Prof. V. Volterra of Rome (president), Prof. B. Cabrera of Madrid (secretary), Prof. P. Janet of Paris, Prof. P. Zeeman of Amsterdam, and Dr. C. E. Guillaume, has nominated M. Albert Pérard, assistant-director of the Bureau, to succeed Dr. Guillaume. M. Pérard, like his predecessor, has spent all his life at the Bureau; he is best known for his work on the metrology of the interference of light. The Bureau, the oldest of the international scientific organizations, is at the Pavillon de Breteuil, Sèvres, Seine-et-Oise; since the signature of the Convention of the Metre in 1875, it has been under the direction in turn of G. Govi, O. J. Broch, J. R. Benoît and Dr. Guillaume.

New Midwives' Service

A CIRCULAR on the Midwives Act, which has recently become law, has been issued by the Minister of Health (Circular 1569. London: H.M. Stationery Office. 6*d*. net). The Act marks an important advance in the policy of improving the public health services of Great Britain, and should do much to improve the maternity services, and secure a reduction in the present rate of maternal mortality. The Act aims at providing every prospective mother whose baby will be borne at home with the services of a trained midwife for her confinement and fourteen days thereafter. The new arrangements should also do much to improve the status and prospects of midwives who enter the new service. The Circular, which is addressed to the local authorities administering the Act, contains a memorandum fully explaining the provisions of the Act.

Leonard Darwin Scholarship of the Eugenics Society

THE Eugenics Society has established a second Leonard Darwin scholarship, which is to be devoted to the investigation of racial crossing. The first holder is J. C. Trevor, a graduate of Oxford in anthropology, who has spent the last two years studying mixtures of negro and white stocks in the United States, with the aid of a Commonwealth fellowship. He has collected ethnological material in the Virgin Islands and in East Africa, and with Dr. Dudley Buxton has made an investigation of English medieval skulls. He has also a collection of biometric material on West African and American negro crania. Mr. Trevor will devote a year to a survey of the literature on the subject of inter-racial crossing.

Another New Star in Aquila

THE Swedish observer, Mr. Nils Tamm, who discovered a nova of magnitude 8 in Aquila last month, has now detected another of these bodies in the same constellation. The latest nova was announced on October 20 as having been found on a plate taken on October 7, when the magnitude is stated to have been 7·0. Dr. W. H. Steavenson, who gives the position of the nova for 1936·0 as R.A. $19^h\ 23^m\ 28{\cdot}16^s$, North Decl. 7° 28′ 32·5″, finds the magnitude to be about 8·0, with little fading between October 21 and 25. He reports the colour as being fiery red. In the spectrum the red line of hydrogen (Hα) is very bright and prominent, and contributes a large proportion of the total visual light of the nova. Tamm's earlier nova is still of about the eighth magnitude, after undergoing some marked fluctuations since its discovery. The two novæ can just be seen simultaneously in a good prism binocular, being only a little more than six degrees apart.

The Night Sky in November

AT the beginning of the month, the duration of night (defined as the interval from sunset to the following sunrise) is 14·4 hours, and at the end of the month 15·9 hours in the latitude of London. The moon is new on November $14^d\ 4{\cdot}7^h$ and full on November $28^d\ 16{\cdot}2^h$ U.T. Occultations of stars brighter than magnitude 5 occur on November 28–29, when κ Tauri reappears at $17^h\ 30{\cdot}6^m$ and τ Tauri disappears at $23^h\ 48{\cdot}4^m$ and reappears at $1^h\ 0{\cdot}2^m$. The planet Venus sets this month in the early evening, and at sunset is low in the south-west. Jupiter is in the same region of the sky, and on the evening of November 12 will be found about 2° above Venus. The near approach of these two bright objects (actual conjunction takes place on November $13^d\ 12^h$) will be well worth looking for at nightfall on November 12 and following with telescopic aid about midday on November 13. Mars is a morning star of magnitude about + 1·8. Saturn is above the horizon during the first part of the night; on November 15 it sets just before 1^h. Watch may be kept on November 15–16 for a possible display of the Leonid meteors. This shower, the radiant point of which is at R.A. $10^h\ 0^m$, Dec. + 22°, is generally visible every November, but at epochs of every 33 years it yields, with some exceptions, an unusually brilliant display. The last great shower was due in 1932, but in Great Britain it failed to come up to expectations, though at one station in the United States as many as 240 meteors were observed in an hour. November 19–20 is the date of maximum of the Andromedids, a shower associated with the lost comet of Biela; the radiant of the shower is not far from the star γ Andromedæ. (Near ν Andromedæ may be seen, with the naked eye, a tiny, faint hazy patch which is the Andromeda nebula, distant 870,000 light years.) The light variations of Algol (β Persei) can be observed at about the following times: November $8^d\ 2^h$, $10^d\ 23^h$, $13^d\ 19^h$, $28^d\ 4^h$ and December $1^d\ 0^h$. In mid-November at about 22^h, the constellations Cassiopeia, Perseus, Andromeda, Aries and Cetus are on or near the meridian, but the eastern half of the sky, rich in first magnitude stars and led by the Pleiades, will probably claim the observer's attention.

Announcements

THE Right Hon. Lord Rutherford will deliver the twelfth annual Norman Lockyer Lecture of the British Science Guild at the Goldsmiths' Hall, Foster Lane, London, E.C.2, on November 12 at 4.30 p.m. The title of Lord Rutherford's lecture will be "Science in Development". This is the last occasion upon which the Norman Lockyer Lecture will be arranged by the British Science Guild as an independent body. In future the lecture will be carried on under the auspices of the British Association. Tickets for Lord Rutherford's lecture are obtainable, free of charge, on application to the Secretary, British Science Guild, 535–7 Abbey House, Victoria Street, London, S.W.1.

SIR THOMAS HOLLAND will deliver the Huxley Lecture at the Imperial College of Science and Technology on May 4, 1937, at 5.30 p.m. The subject of Sir Thomas's lecture will be "The Permanence of Oceanic Depressions and Continental Elevations".

PROF. S. CHAPMAN, chief professor of mathematics in the Imperial College of Science, has been elected a member of the Kaiserlich Deutsche Akademie der Naturforscher, Halle, in recognition of his researches in terrestrial magnetism.

THE Chadwick Gold Medal and Prize for excellence in municipal engineering and hygiene was presented to Mr. E. A. Drew, of University College, London, on October 27.

AT the annual statutory meeting of the Royal Society of Edinburgh held on October 26, the following Council was elected: *President:* Prof. D'Arcy Wentworth Thompson; *Vice-Presidents:* Principal O. Charnock Bradley; Prof. P. T. Herring; the Marquis of Linlithgow; Prof. E. B. Bailey; Prof. F. A. E. Crew; and Lieut.-Col. A. G. M'Kendrick; *General Secretary:* Prof. James P. Kendall; *Secretaries to Ordinary Meetings:* Dr. A. C. Aitken and Dr. C. H. O'Donoghue; *Treasurer:* Dr. James

Watt; *Curator of Library and Museum:* Dr. Leonard Dobbin; *Councillors:* Principal J. C. Smail; Sir Harold J. Stiles; Prof. J. Walton; Prof. Edwin Bramwell; Prof. T. H. Bryce; Prof. I. de Burgh Daly; Mr. J. A. Inglis; Prof. A. D. Peacock; Dr. J. E. Mackenzie; Prof. Sydney Smith; Prof. Ralph Stockman; and Dr. E. Maclagan Wedderburn.

A BRONZE bust of Dr. Emile Roux was recently unveiled at Angoulême, where addresses were delivered by Prof. Marchoux, representing the Paris Academy of Medicine, and Dr. Louis Martin, Roux's successor at the Pasteur Institute.

A PAN-RUSSIAN scientific institute for the study of the bacteriophage has been erected at Tiflis, and will be opened next year under the direction of Prof. F. d'Hérelle.

AT the ninety-fourth Congress of the Society of German Men of Science and Physicians, recently held at Dresden, a German Society of Hygiene was founded under the presidency of Prof. Hans Reiter, president of the Health Office of the Reich.

THE Argentine Government has formed a national committee of intellectual co-operation with the object of promoting intellectual co-operation with different countries in science, literature, art, education, etc. The committee will enter into relations with the International Institute of Intellectual Co-operation in Paris and the International Office of Education at Geneva.

MESSRS. JAMES TREGASKIS AND SON, of 66 Great Russell Street, London, W.C.1, in their Caxton Head Catalogue, No. 1023, are offering for sale some interesting Newton papers. This includes John Flamstead's "Historia Cœlestis", a collection relating to the "Historia Cœlestis" published by Newton and Halley without the consent of the author; a letter by Newton to Sir Richard Onslow; Newton's signature on an oblong vellum document; a letter from Menschikoff to Newton concerning the former's fellowship of the Royal Society, together with three autographed drafts of Newton's reply; a note on the calculus by Newton; several letters on the calculus; and a letter to Newton from John T. Desaguliers, inventor of the planetarium.

THE Imperial Council of Agricultural Research, Simla, announces that there is a surplus stock of certain agricultural and veterinary publications for free disposal (packing and carriage to be paid by the indentor). The following are listed: Handbooks of Commercial Products (17 different volumes); Catalogue of Indian Insects (parts 1–22, part 11 excepted); Proceedings of the Board of Agriculture in India (1906–29—series incomplete). The number of copies available is limited, but in the case of the Commercial Handbooks is quite considerable. Application for any of these publications should be made to the Manager of Publications, Civil Lines, Delhi, on or before November 30.

ERRATUM. In NATURE of October 3, p. 589, in the letter entitled "A New Strigeid Parasite of the Rare Genus *Cyathocotyle*", for "*Cyathocotyle calvusi*" read "*Cyathocotyle calvi*".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

An assistant engineer in the Roads Department of the Ministry of Transport—The Establishment Officer, Ministry of Transport, Whitehall Gardens, London, S.W.1 (October 31).

An assistant (Grade II) (physics or engineering) in the Signals Experimental Establishment, Woolwich Common, S.E.18—The Superintendent (November 2).

An assistant lecturer in mechanical engineering, and a workshop instructor in Coventry Technical College—The Director of Education, Council House, Coventry (November 6).

An assistant physicist in the Radiotherapy Department of the Middlesex Hospital Medical School, W.1—The Dean (November 9).

AN assistant (man) in the Technical Education Branch and a woman organizer of instruction in domestic subjects in the Education Department of the West Riding of Yorkshire—The Education Officer, County Hall, Wakefield (November 9).

A University reader in mechanical engineering in King's College, London—The Academic Registrar, University of London, W.C.1 (November 10).

An Imperial mycologist at the Imperial Institute of Agricultural Research, Pusa, Bihar, India—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (November 10).

A metallurgical inspector in the Indian Stores Department—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (November 13).

A principal of Twickenham Technical Institute—H. M. Walton, 10 Great George Street, Westminster, S.W.1 (November 14).

A technical officer (ref. A. 263) and assistants (Grade III) at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (November 14).

A lecturer in experimental zoology in the University of Edinburgh—The Secretary (November 21).

A St. Mungo professor of pathology in the University of Glasgow—The Secretary to the University Court (November 26).

A principal of the Farm School and Officer-in-Charge of the School Farm and Experimental Station in the Department of Agriculture, Peradeniya, Ceylon—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, S.W.1 (November 30).

An assistant research chemist at the British Drug Houses, Ltd., Graham Street, City Road, N.1—The Secretary.

An executive engineer in the Public Works Department of the Government of Sierra Leone—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quote *M*/4572).

A reader in bacteriology in the Department of Pathology, University of Oxford—The Professor of Pathology.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 764.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Hydrogen Bond and the Structure of Proteins

IN a theory put forward in these columns in March last[1], it was suggested that the molecule of simple native protein may contain closed polypeptides: that the polypeptides, open or closed, fall into rings: and that the ring system is such as to allow the possibility of a regular and orderly arrangement of hundreds of amino and imino acid residues which, to some extent at least, is independent of the particular residues in the molecule. These suggestions, as was clear from the outset, can be given precise formulation in more than one way. Two in particular seemed worthy of detailed consideration.

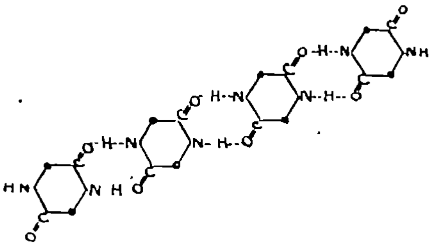

FIG. 1.

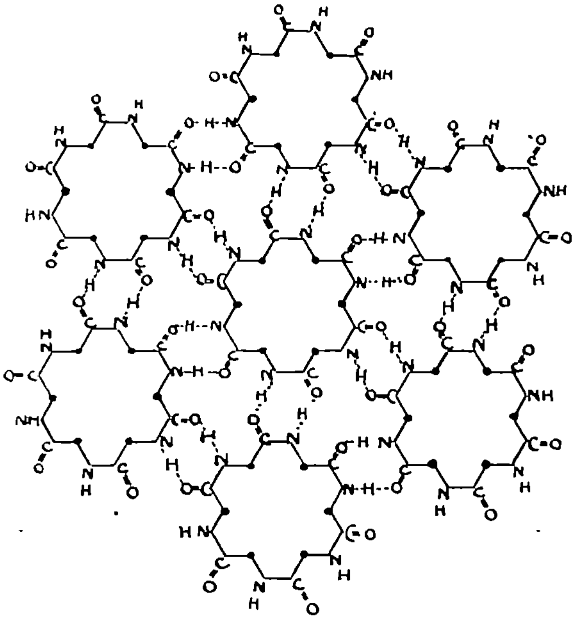

FIG. 2.

In the previous communication the formulation was in terms of the cyclization of polypeptides and the polymerization of diketopiperazines and other closed polypeptides by means of the intra- and intermolecular lactam-lactim transformation

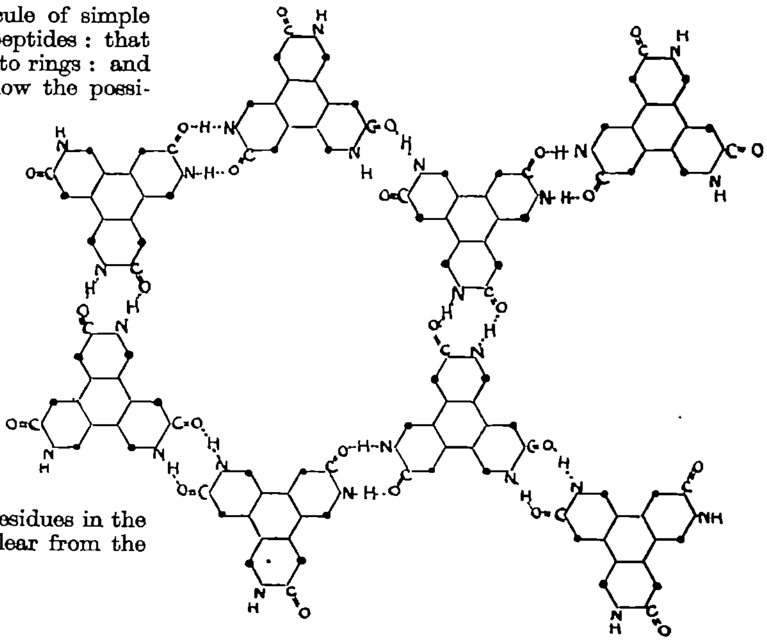

FIG. 3.

$$\rangle C=O\ H-N\langle\ \rightleftarrows\ \rangle C(OH)\ -N\langle$$

This postulate, that polypeptides cyclize and polymerize by means of this transformation into laminar molecules, carried with it the deduction that lamina may be linked to lamina by hydroxyl bonds[2], a conclusion in good accord with many facts as to the behaviour of proteins, for example, capacity for hydration[3].

In the present communication, a correlative interpretation in terms of hydrogen bonds[4]—which have a close relationship to hydroxyl bonds—is presented for consideration.

The suggestion that hydrogen bonds play a part in the structure of the protein molecule was put forward by Jordan Lloyd in 1932[7] and 1933[5], and afterwards by many writers, in particular Mirsky and Pauling[6] who, in a paper of great interest, have shown that it throws considerable light upon the phenomena of denaturation and floculation of proteins. This postulate can be developed very much on the same lines as the lactam-lactim postulate. Using the hydrogen bond as the mechanism whereby closed polypeptides may polymerize, we can build a linear polymer from substituted diketopiperazines (Fig. 1). Similarly, the hexapeptide anhydride can build a surface polymer (Fig. 2). Mixed polymers may also be constructed. Hydrogen bond polymerization (like lactam-lactim polymerization) thus allows the construction of laminar molecules of considerable extent having characteristic densities and characteristic lacunæ. The laminæ need not be plane. The use of hydrogen bonds also for intra-molecular links in polypeptides is under consideration.

In putting forward the two postulates we would stress the fact that there is no conflict between them. Indeed the formation of a hydrogen bond may be an intermediate step in the lactam-lactim transformation. Further, the hydrogen bond can be the mechanism of polymerization not only of polypeptides such as those shown in Fig. 2 but also of the cyclized polypeptides which are derived from the earlier postulate, for example, of cyclol 6, as shown in Fig. 3. It may also be pointed out that these postulates yield deductions which lend themselves to testing by experimental methods. As an example we take the deduction that individual protein films have characteristic lacunæ—and so characteristic permeabilities—and characteristic densities.

D. M. WRINCH.
Oxford. D. JORDAN LLOYD.

[1] Wrinch, NATURE, 137, 411 (1936). Also *ibid.*, 138, 241 (1936).
[2] Bernal and Megaw, *Proc. Roy. Soc.*, A, 151, 384 (1935).
[3] Jordan Lloyd, *Biol. Rev.*, 8, 463 (1933).
[4] Latimer and Rodebush, *J. Amer. Chem. Soc.*, 42, 141 (1920); Pauling, *Proc. Nat. Acad. Sci.*, 14, 359 (1928); Sidgwick, "The Electronic Theory of Valency" (Oxford, 1929).
[5] Jordan Lloyd, *Biol. Rev.*, 7, 254 (1932). Jordan Lloyd and Marriott, *Trans. Far. Soc.*, 29, 1228 (1933)
[6] *Proc. Nat. Acad. Sci.*, 22, 439 (1936)

Reaction Kinetics and the Walden Inversion

DESPITE forty years of research, much mystery still surrounds the conditions determining the occurrence or non-occurrence of the Walden inversion. This is partly due to the difficulty of relating rotation to configuration; but it is due even more to the evident circumstance that these conditions must be intimately connected with the mechanism of substitution: it is only in comparatively recent years that the mechanism of aliphatic substitution has been fruitfully studied. In this field, mechanism has revealed itself principally through the examination of reaction kinetics; and by this means mechanism has been brought into intelligible relation with the structures of reactants and the conditions of reaction. For details we may refer to an early note in NATURE[1], and to a number of papers on the subject which have since appeared mainly in the *Journal of the Chemical Society*. It is an obvious sequel to apply the same weapon, the study of kinetics, in attacking the problem of the Walden inversion; for it should certainly be possible to trace a connexion between inversion and kinetics, and thus, with the aid of the knowledge already gained, to relate inversion to mechanism and its determining factors, structure and conditions.

This was our point of view a year ago when we commenced this method of approach. It is now no longer hypothetical that kinetics is able to link inversion with mechanism of substitution, and thus with structure and conditions.

It is not the purpose of this note to summarize interim results, the presentation of which would require too much space: our primary object is to direct attention to a highly effective method of investigating this problem. It seems appropriate, however, to give in outline a single illustration of the type of observation which in our view supplies the missing link in the argument connecting the occurrence of inversion with structure and conditions.

The hydrolysis of optically active α-bromopropionic acid was studied by E. Fischer[2], who obtained lactic acids of opposite sign of rotation according to whether he used silver carbonate or potassium hydroxide; much discussion has been based on this contrast, especially since in the case of some other halogeno-acids the two reagents give products having the same sign of rotation. Now Fischer was not in a position to know what we were able to predict from the electrical properties of the groups concerned, namely, that the α-bromopropionate ion is a critical structure for hydrolysis: the rates of halogen-ionization and of bimolecular replacement being comparable, it is possible to make either the unimolecular or the bimolecular mechanism dominant by changing the concentrations. He could not know either that in his hydrolysis with potassium hydroxide he was working in the range of the bimolecular mechanism, which, with moderate dilution, would have given place to the unimolecular mechanism; or that unimolecular hydrolysis would have given the opposite result, and, therefore, the same result as silver carbonate. In the scheme

$$\begin{array}{c} l\text{-}\alpha\text{-Bromopropionic} \\ \text{acid (as anion)} \end{array} \left\{ \begin{array}{l} \textit{Unimolecular } l\text{-Lactic acid } (S_N1) \\ \textit{Bimolecular } d\text{-Lactic acid } (S_N2) \end{array} \right.$$

the prefixes refer to configuration, signs of rotation being in this case oppositely related.

The principles underlying the dependence of inversion (including racemization) on the kinetics of substitution were considered in a previous paper[3]. The hydrolysis of α-halogeno-acids is one of the cases in which the two mechanisms, S_N2 and S_N1, lead to stereochemically different forms, and the identity or non-identity of the hydroxy-acids obtained with the aid of silver oxide and potassium hydroxide depends jointly on the constitution of the halogeno-compound and on the mechanism of the substitution. Several experimental studies of the nature illustrated have now been completed and will shortly be published, together with a general survey of the relevant theoretical principles.

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[1] NATURE, 132, 938 (1933).
[2] *Ber.*, 40, 489 (1907).
[3] *J. Chem. Soc.*, p. 244 (1935).

Linkage in Man

SINCE hæmophilia and colour-blindness are both sex-linked conditions, the genes determining them may be expected to show linkage. That is to say, if a hæmophilic is colour-blind the majority of his hæmophilic relatives should be colour-blind, and the majority of his non-hæmophilic relatives should not be so. Similarly, if a non-hæmophilic brother of a hæmophilic is colour-blind, a majority of his hæmophilic brothers and other relatives should not be colour-blind; a majority of his non-hæmophilic brothers should be colour-blind, while most of his sisters should be transmitters of hæmophilia or colour-blindness, but not of both or neither.

To the two existing pedigrees showing both of these diseases we have added four more. The existence of linkage is established. The probability that our results are due to chance is less than 4×10^{-6}. For example, in one pedigree the three living hæmophilic relatives of a colour-blind hæmophilic, namely, a brother, a first cousin twice removed, and a second cousin once removed, were also colour-blind, while five male relatives who might have been, but were not, hæmophilic, had normal vision.

In the six pedigrees there was one case of crossing-over, a colour-blind hæmophilic having a colour-blind non-hæmophilic brother. There had been 28¾ opportunities of crossing-over, so the frequency of crossing-over (after allowing for certain small corrections) is as likely to be below as above 5 per cent.

A full account will be published elsewhere. We have to thank a number of colleagues, and particularly Drs. Birch, Macfarlane, Madlener, Riddell and Wright, and the Medical Research Council, for their assistance. We should like particularly to acknowledge the cordial co-operation of many members of the families concerned.

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J. B. S. HALDANE.

Galton Laboratory and
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Oct. 15.

Distortion of Iron and Molybdenum

THE recent communication in NATURE by Túry and Krausz[1] may be helpful regarding work on the plastic distortion of metals and, in particular, on the nature of the yield point. In their letter, Fig. 1, No. 2, shows a load-extension curve for molybdenum wire after a certain treatment and involving the use of nitrogen at 1,300° C. for 20 sec. This curve closely resembles the well-known load-extension curve for iron and soft steel, apart from a horizontal portion at the top of the curve. Fig. 1, No. 1, shows a curve for wire treated in hydrogen only, but no such yield point is shown in this case. The shape of the curves may be partly due to the different treatments affecting the crystal size, and it would be useful to know the size of the crystals in the wire and to know the behaviour of iron wire after similar treatments. In this connexion, data[2] given by Arrowsmith for 'Armco' iron show that for material in which the crystal width was approximately 0·11 mm. did not have a marked yield point, but for a crystal width of approximately 0·07 mm. there was a considerable yield. Curves given by Edwards and Pfeil[3] suggest that for aggregates of iron crystals the marked yield may not occur when the crystals are wider than approximately 0·25 mm. or 0·4 mm.

In iron and soft steel, the remarkable yield is associated with the Piobert effect[4] (also known as Lüders' lines) which has also been reported, but much less frequently, as occurring in non-ferrous metals (for example, in aluminium and copper, but I believe that the distortion may be rather different in such cases because of the absence of the marked yield, though possibly related). It has been attributed to the presence of a second constituent in the structure and, on the Continent, to the presence of thin films of cementite at the boundaries of the ferrite crystals forming a strong network of cementite. The network was assumed to take the applied load for stresses up to the yield point, at which it broke down, thus releasing the load on to the weaker and more ductile crystals of ferrite which, as a result, extended immediately.

This I believe to be unlikely for several reasons[5] and that, so far as is known, it seems probable that the yield in aggregates of iron crystals (Piobert effect) is due primarily to the mode of distortion of the single iron crystal together with small crystal size, and that the effect may occur in aggregates of crystals of other metals provided that the mode of distortion of the single crystal of the metal resembles that of iron, and that the crystals be very small. (Crystal size may be of great importance. Thompson and Millington[6] attributed the distortion associated with the marked yield to certain kinds of motion in the body-centred cubic crystal, but it may occur in metals of dissimilar lattice because of the apparently unknown influence of crystal size.) Further, the effect shows a ready response of the aggregate of iron crystals to distort in a general way according to the internal distribution of stress, and it seems that the *transmission* (which results in the yielding) of the distortion throughout the aggregate is facilitated by the large number of planes in the body-centred cubic latticed crystals of iron on which slip may occur, and also, if body-centred cubic crystals can distort on planes (those of maximum shear stress) other than crystal planes[7], and again by crystal size.

This *transmission*, without 'jamming' as it were, would happen, presumably, if the crystal size be not too big or if the capability of the individual crystals to collaborate with the influence of the general stress distribution be relatively unlimited. (Of the possible slip-planes in iron there appear to be at least three types, {110}, {112} and {123}, and the number of types appears generally to be more than for other metals, whilst for β-brass the types appear to be {110} and {112}. By symmetry, there are a large number of planes, some of which will be possible slip-planes in virtue of their proximity to the planes of maximum shear stress.)

A thorough investigation of the distortion associated with the Piobert effect in soft steel, using X-ray diffraction methods, is in progress here and, as yet, reveals distortion in the crystals, but without the appearance of 'preferred' orientation of crystal planes, and suggesting that the distortion within the aggregate is complex. Present work also consists in examining the properties of aggregates of very small crystals. C. F. Elam (Mrs. G. H. Tipper) concludes that there is no material difference between facts ascertained about the distortion of single crystals of iron and β-brass[7]. Attempts were made here during the summer of last year to produce the Piobert effect in aggregates of body-centred cubic latticed crystals of β-brass, but the desired smallness of crystal size could not be produced, which was unfortunate; so work on molybdenum, rather than tungsten (both of similar lattice as the brass), has already been started.

E. W. FELL.

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University, Manchester.
Sept. 28.

[1] NATURE, **138**, 331 (August 22, 1936).
[2] *J. Iron and Steel Inst.*, **110**, 317 (1924).
[3] *J. Iron and Steel Inst.*, **112**, 93, Fig. 9 (1925).
[4] E. W. Fell, "The Piobert Effect in Iron and Soft Steel", *J. Iron and Steel Inst.*, **132**, 75 (1935).
[5] *J. Iron and Steel Inst.*, **133**, 389P (1936)
[6] *J. Iron and Steel Inst.*, **103**, 82 (1924).
[7] "The Distortion of β-Brass and Iron Crystals", *Proc. Roy. Soc.*, A, **153**, 273 (1936).

Simultaneous Transmission and Reception of Radio Waves

WE have succeeded in operating a valve receiver R_1 and a valve transmitter T_1 both working on the same antenna, and during their operation, receiving through R_1 another distant transmitter T_2, working on exactly the same frequency as T_1. This has been done by a device making use of simultaneous modulation of T_1 and R_1.

The frequencies used are about 11 megacycles per sec. for the carrier waves of T_1 and T_2, and 750 cycles/sec. for modulation. We have also worked with lower frequencies, for example, a carrier wave of 1 megacycle/sec. and modulation frequencies of 50–16,000 cycles/sec.

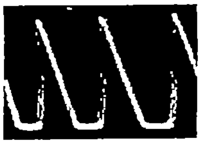

FIG 1.

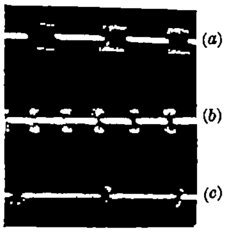

FIG. 2.

A special wave-form of modulation other than the common sinusoidal wave has been advantageously used for this purpose. This wave-form as well as the transmitted groups of waves can be observed during actual work, by a cathode ray oscillograph. Fig. 1 is from a photograph of such a wave-form used for modulation (frequency 750 cycles/sec.) Fig. 2*a* shows a pattern of transmitted groups of waves of a frequency one megacycle/sec. modulated by 750 cycles/sec.; Fig. 2*b* is the same pattern as Fig 2*a* modulated at double frequency, that is, 1,500 cycles/sec.; Fig. 2*c* is the same pattern as Fig. 2*a*, but using for the transmitting valve a high negative grid-bias near to the point at which the modulated transmitter T_1 stops oscillation.

Owing to the development of short-wave technique, this problem of simultaneous transmission and reception may form the basis of many future scientific and technical applications.

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FARIS MINAW.

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Cairo.
Aug. 18.

A Cosmic Cyclotron as a Cosmic Ray Generator?

MANY hypotheses have been propounded regarding the origin of cosmic radiation, but none of them seems to be able to account for the enormous energies found. In this note I shall try to show that a double star may constitute a gigantic cyclotron, which can give rays with energies of the right order of magnitude.

Let us assume that a charged particle (for example, an electron) moves in the magnetic equatorial plane of a star. If the field is H (equal to a constant multiplied by R^{-3}), the particle moves in a small circle with radius ρ which has a precessional movement around the star in a circle with radius R (Fig. 1). The angular velocity of the precession is

$$\omega=\frac{3}{2}v\frac{\rho}{R^2},$$

where v is the velocity of the particle. If v is very near c, the velocity of light, we have $\rho = V/300H$, if eV is the energy of the particle in electron volts. Then we get:

$$\omega=\frac{c}{200\,R^2}\;\frac{V}{H} \qquad . \; . \; . \quad (1)$$

We now assume that a planet, or a second star, rotates around the first star, with the same angular velocity ω. Then an electric field F (deriving from a difference of potential between the stars or from the rotation) can constantly increase the energy of the particle in the same way as a rotating electric field accelerates ions in a cyclotron. When the energy of the particle increases, R is diminished and the particle seems to be in a rather stable equilibrium in relation to the rotating system.

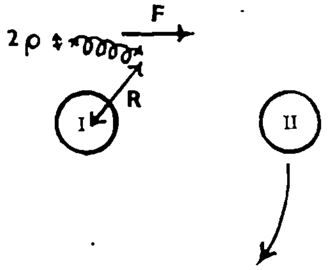

FIG. 1

The maximum energy of the particle can be calculated from (1). If R is 7×10^{10} cm. (about the radius of our sun) and H is 50 gauss (about the magnetic field at the surface of the sun), and further, $\omega = 0{\cdot}5 \times 10^{-4}$ sec.$^{-1}$ (a reasonable value for the rotation of a double star), we get

$$V \sim 10^{11} \text{ electron volts},$$

which is of the order of magnitude of the energy of the bursts.

HANNES ALFVÉN.

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Oct. 4.

Wilhelm von Waldeyer

IN the note on Wilhelm von Waldeyer in NATURE of October 3, p. 579, there appears the statement that this German anatomist was the first to describe the neurone theory. Most discoveries have been based on the work of previous investigators, and there is much useless discussion on priority concerning almost every great contribution to pure or applied science. In the present instance, however, a survey of the relevant literature readily shows that Waldeyer's only significant contribution to the neurone theory with which his name is so often linked was the introduction of the term 'neurone'.

The doctrine that the nervous system is formed of cells is a corollary of the cellular theory of Schwann and Schleiden. Leeuwenhoek and Malpighi saw cells ('globuli') in the cerebral cortex and, so early as 1741, Swedenborg, in his "Oeconomia Regni Animalis", described the cortical cells and their supposed functional importance in a manner surprisingly similar to the views which are now held. Waller's work (1850) on the degeneration of nerve fibres showed the trophic influence of the nerve cell on the fibre. Deiters, in 1865, showed that each nerve cell possessed an axis cylinder and dendrites. His

(1886) established the fact that nerve cells are derived from columnar ectodermal cells and are, therefore, almost certainly autonomous cellular elements themselves. He wrote: "Als festehendes Princip vertrete ich dabei den Satz : dass jede Nervenfaser aus einer einzigen Zelle als Ausläufer hervorgeht. Diese ist ihr genetisches, ihr nutritives und ihr functionelles Centrum ; alle anderen Verbindungen der Faser sind entweder nur mittelbare oder sie sind secundär entstanden."

Golgi's introduction (1873) of the method of silver impregnation provided an elegant technique for the study of the nervous system and, although Golgi himself mixed considerable *a priori* reasoning with his objective findings, Forel, of Zurich, used Golgi's results as the basis of a vigorous appeal for the application of the cellular theory to the nervous system.

It is to Ramon y Cajal, however, that we owe most of the fundamental data on which the neurone doctrine rests. He established, by work which must for ever be of basic significance, the conception that "the nervous system is built up of conductive chains of individually distinct and discrete conducting nerve-cells". It was this conception which Waldeyer called the neurone doctrine, and only too frequently in the literature is the credit for its establishment given to him. Sir Charles Sherrington, in his Royal Society obituary notice of Cajal, has presented the real position admirably. He writes : "The doctrine was his chief life-work and he felt it his due that it should be recognised as his. In his Memoirs, in each edition, he reverted to it : 'that which, and all that, Waldeyer did was to publish in a weekly newspaper a résumé of my research and to invent the word *neurone*'. Cajal had reason to feel hurt ; the injustice is unaccountable. Not at any time had the researches of Waldeyer touched the subject. He had not contributed either to the discoveries or to the generalisation".

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The Red Blood Corpuscles of Primitive Mammals

ALTHOUGH the investigations of Weidenreich, Lohner, and Jordan, and the more recent studies of Arey and Ponder have led to considerable discussion concerning the actual form of the red corpuscles in the circulating blood of the Eutheria, it has long been recognized and generally accepted as an established fact that the mature erythrocytes are non-nucleated in all groups of the Mammalia.

Whilst subscribing to this view, Rogers[1] has brought forward the suggestion that at least two mammals (llama and echidna) possess red blood corpuscles which do not conform to this condition in their adult stages.

Rogers's statement, made in the course of a discussion on the transport system in the vertebrates, that "In all the mammals, with the possible exceptions of Llama and Echidna, they (that is, the erythrocytes) are non-nucleated", led me to prepare and examine a series of blood smears from the primitive Prototheria. These animals, confined entirely to the Australian region, are represented by a single living order, the Monotremata, including the duck-bill or platypus (*Ornithorhynchus anatinus*) and the spiny anteater or echidna (*Tachyglossus aculeatus*).

I am not in a position to offer any personal observations on the blood of the llama, but an abstract in French by Robert Tissot, of Biffi's paper "Alcune osservazioni sul sangue del lama", states that "Les erythrocytes du lama sont elliptiques et biconvexes ; leur forme est donc celle des verres de lunettes pour presbytes ; ils ne sont pas nucléés".

The red blood corpuscles of platypus and echidna are typically mammalian in form, being non-nucleated, biconcave discs. An examination of the mature erythrocytes from the blood of echidna clearly disproves Rogers's contention that the red corpuscles of this primitive mammal were possibly exceptional in regard to their structure. The suggestion that these corpuscles might prove to be nucleated is, therefore, without foundation.

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Sept. 22.

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[1] Rogers, "Textbook of Comparative Physiology" (New York, 1927), p. 118.

Analysis of Tissues for Metallic Content

REFERENCE was made in a previous letter[1] to the occurrence of nickel and cobalt in a number of plant and animal tissues and in some New Zealand soils, and also to the vital part cobalt has been found by workers in Australia to play in the lives of sheep. The location and function of cobalt in sheep were not known, and efforts have been directed to discover in which tissues of the sheep cobalt is normally present.

Ordinary direct spectrographic analysis of tissues by the oxy-coal gas flame method gave no indication of cobalt or nickel, and experiments were made on quantities of 50–100 gm. of wet tissues, using chemical methods to extract and partially to separate the metals before analysing them spectrographically. The results obtained indicate that this method has wider applications and will give new information regarding the relations between healthy life and the mineral content of the soluble (chemically active) and insoluble (physically active) parts of tissues. Experiments made with sheep's liver, spleen and heart, show that hydrochloric acid of about normal strength, acting at room temperature for 18–24 hours, extracts the alkalis, magnesium, zinc, manganese, nickel, etc., with only a small portion of organic matter, and that calcium, copper and iron are only partially extracted from the much larger part of the tissue which remains.

The best procedure found so far has been to digest 100 gm. coarsely cut tissue with a mixture of 100 c.c. of water and 15 c.c. of strong hydrochloric acid. Filter next day, evaporate to low volume and add successive quantities of 2 c.c. nitric acid and some hydrochloric acid, so long as any marked action is apparent : keep the hydrochloric acid in excess at the end to expel the nitric acid, dilute and filter. A mixture (about 1 drop for healthy to 10 drops for diseased livers) of resinous and oily compounds remains on the paper ; the former retains traces of copper, silver, etc., and a small precipitate sometimes separates from the filtrate on cooling, which may contain lead and calcium. The liquid is diluted to about 80 c.c., making it weakly acid, and is precipitated, filtered, etc., successively with (1) hydrogen sulphide, (2) ammonium acetate after oxidizing iron, (3) hydrogen sulphide, that is, in acetic acid, and

(4) after adding hydrochloric acid, with potassium ferrocyanide. All the reagents used can be obtained free from metallic impurities.

As examples of the results obtained, calcium was reduced in sheep's liver (all tissues being dried on filter paper to remove oil) from 0·10 to 0·04 per cent; copper from 0·05 to 0·035 per cent; and iron from 0·03 to less than 0·008 per cent. In sheep's spleen the calcium was reduced from 0·09 to 0·03 per cent and iron from 0·15 to 0·05 per cent, but the percentage of copper was slightly higher in the residue than in the dried spleen.

Further analysis by the flame method proves that precipitate (1) contains most of the copper, silver and some lead, (2) iron phosphate, (3) zinc and cadmium sulphides and (4) manganese, nickel, cobalt, cæsium (sometimes present) and some rubidium as ferrocyanides. Healthy liver contains much more zinc than appears to be realized; nickel was easily detected in it, but of cobalt there has only been the slightest evidence of its strongest line. The spleen and heart also contain zinc and minute traces of nickel, and traces of cadmium were found in one sheep's liver and in a salmon's liver which also contained zinc and nickel. Arc or spark spectra of these precipitates would probably reveal the presence of other trace metals. The 'ashing' of tissues is often a very slow process, and some metals such as zinc, cadmium and the alkalis volatilize in varying degrees. These results are given tentatively as indications of the merits of the method and of the uses to which it may be applied.

Sheep diseases are very serious matters also in parts of Great Britain and are under investigation. Mr. J. B. E. Patterson, of Dartington Hall, Devon, recently sent me samples of the livers of four sheep which had died from one of these diseases, and evidence of changes in the mineral content as compared with normal livers has been obtained. There are indications too of a faulty metabolism resulting in the accumulation of oil, or compounds containing oil, in the liver to such an extent as to affect its normal working.

Many questions present themselves: for example, (1) effects of age on the composition of extract and residue; (2) changes caused by diseases, such as cancer; (3) changes due to imperfect feeding; (4) the effects of 'drugs', etc.; but the facilities at my command—a (spectroscopic) laboratory 14 ft. × 7 ft., furnished only with gas service—will not enable me to go far in answering them. This letter will serve, perhaps, to attract attention to what I believe to be a new and useful line of attack.

HUGH RAMAGE.

5 Carrow Hill,
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Oct. 12.

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[1] NATURE, 137, 67 (1936).

Relation of so-called *Streptococcus apis* to certain Lactic Acid Streptococci

ONE of us has previously reported the isolation, from larvæ affected with European foul brood, of strains of *Str. apis* identical in every respect except that of gelatinolysis and caseolysis[1]. It has now been found that these two *Str. apis* strains are indistinguishable morphologically, culturally and biochemically from the well-recognized dairy types *Str. glycerinaceus* and *Str. liquefaciens*, the former being a non-proteolytic variant of the latter[2,3]. Thus all four types occur as diplococci and occasionally as short chains. They grow well in litmus milk at 15° and at 45° (the proteolytic *Str. apis* causing a breakdown of the casein similar to that produced by *Str. liquefaciens*); ferment glucose, fructose, lactose, galactose, maltose, mannose, sucrose and salacin strongly; glycerol, dextrin and trehalose slightly; but not arabinose, inulin, starch, xylose, inositol, adonitol or erythritol. Sorbitol and mannitol are usually, and raffinose not usually, fermented. Aesculin is fermented to give a positive reaction with ferric chloride. In glucose broth a final pH of 4·1–4·2 is obtained. All four types also grow in bile salt lactose broth, and resist heating at 60° for 15 minutes in milk at pH 6·6.

The question of nomenclature and the relation of these types to other streptococci will be dealt with later.

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[1] H. L. A. Tarr, NATURE, 137, 151 (1936). *Ann. Appl. Biol.*, 23, 558 (1936).

[2] S. Orla-Jensen, "The Lactic Acid Bacteria" (1919).

[3] J. G. Davis, *Proc. Soc. Agric. Bact.* (1936).

A New Microcolorimetric Apparatus and a Method for Determination of Total Blood Volume

IT is a matter of importance in physiology to construct an apparatus by which it is possible to determine the concentration of very weak dye-solutions in small quantities, without any decrease in its layer-thickness. In my apparatus a capillary tube is used with a volume of 10 cubic millimetres and a length of 20 millimetres. In this capillary tube is placed the dye-solution, the concentration of which is to be determined. The tube is covered with a black paper-hull to keep out the light from the side. The tube is hung vertically by a holder of simple construction on the object stage. This dye-solution is enlarged by the microscope, from which the eyepiece has been removed. In its place there is a prism-system, which is similar to the upper part of a Duboscq colorimeter. The prism cuts off the rays in one half of the field of vision. Under the other half of this prism is fastened a wedge in order to compare the concentrations of the dye solutions. This wedge can be moved horizontally by a screw in front of a scale. Under the wedge is a light-filter, a diaphragm and an illuminating mirror from which the rays are directed through the filter, diaphragm and wedge to the other half of the eyepiece; the scale is determined by the aid of dye solutions of defined concentration. The unknown dye solution is put into the capillary tube. The wedge is screwed until there is an equalization of colour intensity and so the concentration of dye solution can be easily calculated. In this way one can estimate the colour concentration of dye solution between 1 : 10,000–1 : 100,000. It can be used also for determination of weaker and stronger dye solutions by changing the length of the capillary tube.

This method was used for the estimation of the total blood volume of white rats. For the determination, Congo Red was used. The blood volume of forty normal white rats of the same breed was estimated. 25–50 cubic mm. of blood is necessary for the estimation. The process is similar to Went and Drinker's method, but in the colorimetry there is an essential difference. As a result of this investigation it was found that the total blood volume per 100 gm. body weight is 4·19 ± 0·6 cubic centimetre on the average. Other control experiments are in progress.

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Mock Suns observed at Nanda Devi in Garhwal

DURING the recent British American Himalayan Expedition, from an altitude of about 21,000 ft. on Nanda Devi in Garhwal, we saw at 3.30 p.m. on August 20 a particularly fine display of parhelia, or 'mock suns'. The two lateral images and the lower one were especially bright, and were arranged as usual on a broad halo of light. The weather was cold at the time, unusually so even at that altitude for the monsoon period, 20° F. being recorded on the mountainside that same evening. We had on several previous occasions seen solar haloes, as we approached Nanda Devi via the Rishiganga gorge, but no certain appearance of 'mock suns', and the weather following the occurrence of these haloes had been fair and not particularly cold.

The afternoon of August 20, however, preceded by about thirty hours the worst blizzard we experienced during the course of the expedition. This blizzard, accompanied by a violent wind from the east—a southerly monsoon wind, we believe, deflected off the neighbouring great south face of Nanda Devi—held us in our tents at 21,300 ft. (Camp III) for about thirty hours, the minimum temperature on this occasion being recorded at 12° F.

I am well acquainted with the phenomenon of 'mock suns' in the Arctic, but I am unaware that it has been recorded previously from such low latitudes as those of the Himalaya, in this instance lat. 30° 22′. Its occurrence during the monsoon period, and at the altitude observed, would appear to indicate exceptionally low temperatures in the upper atmosphere. But 1936 will long be remembered in India for its unusually intense and prolonged monsoon.

It may also be of interest to record that on August 29, from the summit of Nanda Devi (25,645 ft.), Mr. H. W. Tilman and I looked through a still and clear atmosphere (the air temperature was 19° F. at 3 p.m.) towards the great 70-mile circuit of mountains of the rim of the Nanda Devi basin. The latter, as well as features beyond, were partially obscured by rising columns of cumulus cloud of very beautiful form. We learnt later that, while we were bathed in sunshine throughout the day, the districts to the south and west beyond the "rim" were experiencing disastrous floods, Mussoorie receiving as much as 19 inches of rain in the course of that day.

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Oct. 12.

Points from Foregoing Letters

USING a hydrogen bond as the mechanism whereby 'laminar' protein molecules are formed from closed polypeptides, Dr. D. M. Wrinch and Dr. D. Jordan Lloyd elaborate possible structural formulæ and deduces that individual protein films must possess characteristic permeabilities and densities.

The optical rotation of lactic acid obtained from l-α-bromopropionic acid may be either left-handed like that of the parent compound, or may show inversion to right-handed rotation; this depends on whether the conditions are such as to favour a uni- or bimolecular reaction, as shown by the rate at which the change takes place. W. A. Cowdrey, Dr. E. D. Hughes and Prof. C. K. Ingold mention this as a particular instance of the general importance of paying attention to the rate of reaction in connexion with the Walden inversion.

From an investigation of the pedigree of four more families in which both colour blindness and hæmophilia occur, Dr. Julia Bell and Prof. J. B. S. Haldane conclude that these conditions, which are sex-linked, are also linked (and therefore transmitted) together. In the six pedigrees studied there was only one case of crossing-over, a colour-blind hæmophilic having a colour-blind non-hæmophilic brother.

The cause of the distortion associated with the remarkable yield in iron and soft steel is discussed by Dr. E. W. Fell. He considers it probably due to the mode of distortion of single iron crystals (multiplicity of slip-planes) and to small crystal size. This facilitates *transmission* of the distortion throughout the aggregate of crystals. Attempts to confirm this by producing similar effects in β-brass and molybdenum are described.

By means of a device making use of simultaneous modulation of a valve transmitter and a valve receiver, H. Antoun and F. Minaw have succeeded in carrying out simultaneous transmission and reception of radio waves. They submit a photograph showing a special wave form of modulation and another showing patterns of transmitted groups of waves.

How a double star may act as an enormous 'cyclotron' and accelerate charged particles moving in the electric field derived from a difference of potential between the stars or from their rotation, is described by Prof. H. Alfvén, who calculates that the particles can in this way obtain energies such as are found in cosmic rays.

Following upon Rogers's suggestion that the red blood corpuscles of echidna might prove to be nucleated, Prof. E. A. Briggs has examined a series of blood smears from the primitive Prototheria, platypus and echidna. The erythrocytes are typically mammalian in form, being non-nucleated biconcave disks.

In view of the importance of small amounts of certain metals for the health of animals, H. Ramage describes a method of extraction of the 'soluble' mineral constituents by means of dilute hydrochloric acid, and gives the percentage of calcium and iron found by this method in the liver and spleen of sheep.

An experimental arrangement for determining the concentration of weak coloured solutions in small amounts of the liquid (one drop or less) is described by Dr. J. Ch. Somogyi. The method has been used in estimating the total blood volume of white rats.

Research Items

Boat Construction in Ancient Scandinavia and Oceania

MR. JAMES HORNELL, following up previous studies of similarities in the methods of boat construction in ancient Scandinavia and Oceania, directs attention in *Man* of September to the character of a boat from Botel Tobago, a small island off the coast of Formosa, now in the Hamburg Museum of Ethnology. This bears out a statement made in general terms by J. W. Davidson that the Botel Tobago boats were almost an exact counterpart of the boats constructed in the Solomon Islands as to form, method of construction and ornamentation. They are, in fact, of the Solomon Island *mon* type, and with the Moluccan *orembai* belong to the same class of naval design. The greater crudity of the *mon* and the *orembai* is probably due to degradation. The boat is equal ended, each end being sharp and rising in a gracefully abrupt fashion, and terminating in an acuminate point. The greatest beam is amidship, and the gunwale assumes a broadly lanceolate shape. The base of the hull consists of a narrow salient keel spliced to a narrow curved stern post. On each side of the keel are three wide strakes. The two lower run horizontally, and are shorter than the third, of which the terminal sections form the up-curved end-pieces. Each half end-piece is cut from the solid. The planks are held together initially by means of wooden dowel pins inserted into opposed edges. The dowel attachment is reinforced by lashings. Three sets of cleats, shaped out in the planking, give attachments for a transverse frame, a triangular bulkhead board, and the tie of the converging sides at each end. Probably there were paddling thwarts, though none is now present. The method of lashing the hull planking is more nearly related to that of the Scandinavian type than in either the *mon* or the *orembai*; and the presence of keel and stem posts is another approximation to the later Viking boats, which is not present in the round-bottomed *orembai* and *mon*. The striking resemblances to the Scandinavian boats raises interesting questions as to distribution and diffusion of design.

Yavapai Indians

A FURTHER study of Yuman peoples has been added to the series which is now nearing completion in Mr. E. W. Gifford's investigation of the culture of the north-eastern and western Yavapai (*Univ. California Pub. Amer. Archæol. and Ethnol*, 34, 4). The Yavapai were unique among the Yuman groups in inhabiting a vast territory, embracing some 20,000 square miles and roughly 200 miles in east-west dimensions and 100 miles in north-south dimensions. This country afforded a wide variety of territory, ranging from the low country of the confluence of the Gila and Colorado Rivers to the high ground of central Arizona; and therefore affords an exceptional opportunity for studying the adaptability of a hunting and gathering people to various environments. These adaptations must have been made within a few centuries, as the country is dotted with the settlements of an earlier Puebloid population. Evidently they adopted little of the cultural habits of their agricultural predecessors. They were nomadic; and their country was sparsely occupied, each group wandering over its territory in search of the ripening plants and the animals on which it subsisted. This is indicated by the table of seasonal occupations given by one of the informants. The Yavapai have much in common linguistically and culturally with their northern neighbours, possibly owing to a not very distant origin from a common stock, as they themselves assert. The Western Yavapai appear to have absorbed certain elements of Yuma-Mohave culture and rejected others. The Navaho traded with the North-eastern Yavapai, bringing woven blankets, shell-beads and turquoise on donkeys. Occasionally the Yavapai visited the Navaho country with buckskin, mountain lion skins, and mescal, sometimes speaking Navaho themselves, sometimes using Tonto Apache as interpreters. The Yavapai afford an unusual opportunity for appraising the influence of two environments, one geographical and one social.

Prehistoric Relics in Malta

A STRIKING feature of the annual report of the Museum Department of Malta for 1935–36 is the number of discoveries of prehistoric relics of human beings and animals made on the island. Twelve rock-tomb burials were accidentally met with, and are described briefly, and prehistoric cave-dwellings and a neolithic site (at Kalet Marku) were excavated. The remains of prehistoric animals are equally interesting and impressive: elephants, tortoises, a frog or toad, extinct birds, and a new species of otter and others from one Pleistocene fissure, and from another, *Elephas falconeri*, *E. melitensis* and *Hippopotamus pentlandi*. These represent only a small part of the remains discovered and described during the year.

Food Production and Nutrition

"STATISTICS of Food Production, Consumption and Prices" is the title of the fourth volume dealing with food and nutrition issued by the League of Nations (The Problem of Nutrition, vol. 4. London: Allen and Unwin. 3*s*.). It is a preliminary study by the International Institute of Agriculture, Rome, of the available statistical material on the production, consumption and prices of the chief protective and other foodstuffs, for example, milk and dairy products, meat, eggs and poultry, fruit and vegetables, cereals and sugar. Half the volume is devoted to an analytical examination of the situation in the limited number of countries for which data exist. The remainder of the volume gives statistical tables relating to production and consumption, with wholesale and retail price indexes. The financial assistance rendered to agriculture in some of the principal agricultural countries is also dealt with. The information collected illustrates the incompleteness of the data available in respect of most of the foodstuffs considered.

Geckos of Japan

THE first of a series of papers to be published upon the lizards of Japan deals with the geckos (Yaichiro Okada, *Sci. Rep. Tokyo Bunrika Daigaku*, 2, 233; 1936). Fourteen species are here recorded, described and illustrated. They belong to seven genera, all found in tropical and subtropical regions. But of the fourteen species, only seven are regarded as endemic, the remainder having a wide distribution embracing South China, the Malay Peninsula, and the Philippines. Such distribution is easily accounted for by the ease with which the species, attached to vegetation or some object, are transported by Nature or by man. Yet in spite of the possibilities none has succeeded in establishing itself in the Arctic region.

Environment of Marquesan Insects

THE insect fauna of the Marquesas Islands has been extensively investigated under the auspices of the Pacific Entomological Survey, the central organization of which is at Honolulu. In Bulletin 139 (1936) of the Bernice P. Bishop Museum (forming Pacific Entomological Survey, Publication 9), Mr. A. M. Adamson gives an interesting account of the topography, geology, flora, etc., of the islands, which serves as a background, or basis, for the discussion of their faunistic relations. The islands are the most remote from a 'continental' region of any archipelago in the world, the coast of Mexico being nearly 3,000 miles away and Fiji about 2,700 miles. Their total area is only about 400 square miles; their general altitude is but little more than 4,000 ft. and the coasts are almost entirely unprotected by coral reefs. The greater part of the endemic fauna is now restricted to the higher altitudes, where the climate is very moist and the temperature temperate, rather than tropical. The specific endemism of the flora is much lower than that of Hawaii, with which it has affinities: on the whole, the flora is most nearly related to that of the Society Islands. Three vertical zones of plant distribution can be distinguished, the uppermost, or rain forest, containing the chief food plants of the indigenous insects. The native flora below 1,000 ft. has been replaced in large measure by immigrants and to a certain extent up to 2,500 ft. also. It is evident that the changes being brought out by colonization, either directly or indirectly, are already very marked, and the present survey is a timely one. Probably many species of insects have been already lost, and many more will disappear in the not-distant future.

Hormones and Horticulture

A USEFUL résumé of present-day knowledge of plant hormones, or growth-regulating substances, is given by Dr. M. A. H. Tincker (*J. Roy. Hort. Soc.*, 61, Pt. 9; Sept. 1936). The history of investigation in this subject goes back to Darwin, and the work of Rothert and Fitting, of Boysen-Jensen, and later of Loeb and Went, established the idea of chemical 'messengers' or regulators, as a feature of plant physiology. Much of the earlier work dealt with the bending of coleoptiles of cereal seedlings, but the findings of Went, that a root-forming substance was produced by leaves, initiated a new line of horticultural inquiry. Later investigations showed that the growth-promoting substance was an organic acid. It was produced by a wide variety of plants, and was even found in such products as rice polishings, wheat-germ oil and pollen. The active substance is β-indolylacetic acid, and it can be synthesized *in vitro*. Perhaps the most valuable line of future horticultural work is that suggested by Hitchcock and Zimmerman, who have used root-producing hormones in the propagation of difficult cuttings such as maple and apple.

A New Disease of Stocks

A PAPER by Mr. W. M. Ware (*Gard. Chron.*, Sept. 26, 1936) announces the appearance of a new disease of cultivated Stock plants (*Matthiola* spp.). It is caused by a fungus belonging to the genus *Alternaria*, but its exact specific relations have not yet been determined. The fungus can flourish when conditions are good for the growth of Stocks, and it appeared first in a greenhouse where a crop was being raised through the winter. Extensive spots, either somewhat dry, or bearing a copious fructification of spores, appear on the lower leaves of hybrid strains, the Ten Weeks Stocks being apparently immune or highly resistant. Control by removal of diseased leaves proved laborious and only partly effective, whilst fructifications actually appear amongst sulphur dust. The problem of eradication is still further complicated, for it is imperative that the fungus be controlled in its early stages, before the leaves which must be included with the marketable bloom are infected.

A Catalogue of Earthquake Epicentres

IN the University Observatory at Oxford, two card catalogues of epicentres are kept, one arranged in order of latitude, the other in that of longitude, with the dates on which the corresponding foci have been in action since the year 1913. Both catalogues are in constant use at the Observatory, and Miss Ethel F. Bellamy has done good service to seismology by reproducing the former in her "Index Catalogue of Epicentres for 1913–1930" (Isle of Wight: County Press, Newport, 40 pp.; 1936). Miss Bellamy's "Catalogue of Earthquakes 1925–1930", an abbreviation of the "International Seismological Summary", was published a year ago, and all who have worked with it must have appreciated its accuracy. Her new work, which must have been equally laborious, she regards as a geographical index to the Summary. It is divided into four parts. In the first, the epicentres in north latitude and east longitude are arranged in increasing order of latitude, and, when several epicentres lie on the same parallel, in increasing order of longitude. The other parts are similarly arranged for the remaining quadrants. The dates on which earthquakes have occurred beneath each epicentre are entered according to the year, month and day, those in which earthquakes possessed deep foci being printed in italics. The positions of the epicentres are plotted on an equal area projection map of the world, a map that shows very clearly the concentration of activity in the Mediterranean area, the East Indian Archipelago and the margins of the Pacific Ocean. A similar map represents the distribution of seismological stations throughout the world, their clustering in Europe and Japan and their sparseness in Africa, Central Asia and the East Indies and neighbouring islands. This distribution may be in part responsible for the much greater number of earthquakes recorded in the north-east quadrant and in the zone between the parallels of 35° and 45° of north latitude.

Railway Signals for Fogs

IN the October issue of the *Journal of Scientific Instruments*, Mr. A. E. Tattersall describes two forms of signal lamps which, while not so effective as those he described in the same journal a year ago, require less power and will do something towards securing greater safety in running during fogs. Both are operated by wires from the signal box placing the necessary coloured glasses before the lamp, which is about 11 ft. above the rails. Both secure a parallel beam of light by reflecting the light of an electic lamp with a concentrated source of 5–10 watts at a spherical mirror the spherical aberration of which is compensated by a glass lining. Any special form of distribution of the issuing light beam is secured by the form of the glass front of the box in which the lamp is housed.

X-Ray Method for determining Electronic Charge

THE absolute wave-length of X-rays is now known from ruled grating measurements with a high degree of accuracy. A precise determination of the angle of diffraction from a crystal leads to a value for the crystal spacing, and by using the crystal density, to a value for the absolute atomic masses and for the electronic charge. A new measurement by J. W. M. Du Mond and V. L. Bollman (*Phys. Rev.*, 50, 524) overcomes the objection which has been made to this method that the density is determined for a large crystal while the X-ray reflection involves only the surface layers. The crystals used in the work were very finely powdered calcite in which the depth of penetration of the rays embraces the whole fragment. The density was determined on the same powder specimen. The value obtained for e was $4{\cdot}799 \pm 0{\cdot}007$ E.S.U.

Excitation of Nuclei by Proton Bombardment

L. R. HAFSTAD, N. P. Heydenburg and M. A. Tuve (*Phys. Rev.*, 50, 504) have been able to study in detail the yield of alpha- and gamma-rays from fluorine and lithium as a function of the energy of the bombarding protons. The tube and the Van de Graaff type generator are improved versions of those used in former experiments, and the voltage was measured by a galvanometer and high resistance. The alpha-particle emission from lithium had to be studied with a thick lithium target, and unambiguous results on the excitation function were not obtained. In the gamma-ray excitation of lithium, a resonance-voltage at 440 kv. was observed, and the half-width of this resonance was estimated as 11 kv. In the excitation of fluorine, resonance levels were found at 328 kv., 892 kv. and 942 kv., with half-widths of 4, 10, 15 kv. respectively. The width of the lithium excitation region is probably connected with the time of relaxation of an excited level in ^{8}Be, and a discussion of the probable mechanism of this relaxation is given.

Phosphatase of Cows' Milk

THERE is already strong evidence that the phosphatase of cows' milk arises directly from the secretory cells of the mammary gland. This is confirmed by S. J. Folley and H. D. Kay (*Enzymologia*, 1, 48 ; 1936) as the result of the study of the phosphomono-esterase content of the milk of sixty-six Dairy Shorthorn cows in relation to the progress of lactation. They find that the advance of lactation is accompanied by regular changes in the concentration of the phosphomonoesterase, the output of the enzyme in the milk rising to a maximum at about 180 days post-partum, whereas no such regular changes in enzyme content occur in the blood serum as lactation progresses. The results suggest that the rate of secretion, or it may be unavoidable loss of phosphatase in the milk, is in general inversely related to the functional efficiency of the mammary gland. It is therefore considered highly probable that the enzyme comes from and is continually being synthesized by the secreting cells of this gland.

Absolute Activity of Choline Esterase

THE enzyme choline esterase arouses interest not only because of its function in the body of destroying the acetylcholine by means of which so many nerves produce their effect; it is reversibly and specifically poisoned by a group of synthetic urethanes allied to eserine. L. H. Easson and E. Stedman (*Proc. Roy. Soc.*, B, 121, 142 ; 1936) have reached various interesting conclusions as the result of a quantitative study of the activity of this enzyme under different conditions. They assume that the substances which inhibit the enzyme act by combining with it in the same way as the choline esters, and thus blocking the active groups. They assume that the combination between enzyme and inhibitor is governed by the laws of mass action. The experimental data agree well with these assumptions. The authors have thus calculated the number of active groups in their enzyme preparations and have come to the conclusion that each active group hydrolyses about 3,500 molecules of butyryl choline per second, or 1,490 molecules of acetylcholine. This conclusion may be compared with various calculations of the rate of working of each molecule of an enzyme. The new method of reasoning gives results that refer to active groups rather than molecules, but they are of the same order of magnitude as those obtained for molecules of invertase. Some enzymes work more quickly than this, others work more slowly. The calculations are complicated by the fact that the inhibitor substances are themselves slowly destroyed by the enzyme.

A Catalogue of Stellar Proper Motions

A KNOWLEDGE of stellar proper motions—the small progressive angular changes of the relative positions of stars—is of basic importance to astronomy. In the first place, proper motions provide data for the study of the spatial movement of individual stars, for 'star-streaming', and for the motion of the solar system ; secondly, they enter into any work involving the reduction of measures for star places on photographic plates, such as astrographic chart work and the determination of the parallaxes of stars. Proper motions may be derived from a comparison, after a sufficient lapse of time, of the positions of stars as given in various catalogues, based on meridian observations, or from photographs taken with a fairly long time-interval (say, thirty years) between them. In 1923, Dr. Richard Schorr, director of the Hamburg Observatory at Bergedorf, published a catalogue of proper motions including more than 21,000 stars, compiled from various sources. He has now published a new edition of this work (*Bergedorfer Eigenbewegungs-Lexikon*, 1 and 2) in which all proper motions available up to the end of the year 1935 are collected together from every available source. The new catalogue, which is conveniently arranged for reference in one degree zones of declination, contains no fewer than 94,731 stars, of which 60,642 are in the northern hemisphere. These tabulations, together with footnote references to the large number of proper motions published in the *Greenwich Astrographic Catalogue* (4, 5 and 6) and in the five catalogues by Schlesinger (*Yale Transactions*, 4, 5, 7, 9 and 10) provide a complete means of ascertaining in a few minutes whether a star has any measurable proper motion. The value of such a catalogue is obvious, and Dr. Schorr will deserve the thanks of astronomers for the compilation of this extensive work.

International Commission on Large Dams

CONGRESS AT WASHINGTON

THE Second Congress of the International Commission on Large Dams was held in Washington, D.C., on September 7–12, concurrently with the meetings of the World Power Conference. The joint opening session of the Conference and Congress was held on September 7 in the Constitution Hall and a joint closing session on September 12 in the Government Auditorium. A further joint meeting was also held on September 11 when President Roosevelt addressed the delegates and welcomed the numerous visitors from abroad.

Apart from the joint sessions, the meetings of the Dams Congress were confined to the discussion of a limited number of technical questions. These questions, five in number, had been selected well in advance of the Congress, and more than sixty papers were presented for discussion. In addition, there had been appointed for each question a general reporter whose duty it had been to prepare a general report summarizing the various papers on each topic. Advance copies of most of the papers were available before the meeting, and were accompanied by summaries in English, French, German and Spanish. The five questions selected for discussion were special cements, design and waterproofing of shrinkage contraction and expansion joints, the facing of masonry and concrete dams, geotechnical studies of foundation materials, and the calculation of the stability of earth dams. Some twenty communications on miscellaneous topics were also presented, but were not discussed at the meetings.

The importance of the use of special cements for concrete dams and other large concrete structures, to which attention was directed at the first Congress held in Stockholm in 1933, was evidenced by the numerous papers from many countries which this subject attracted. Subsequent to the Stockholm Congress, an International Sub-Committee on Special Cements was set up by the International Commission on Large Dams, and national committees were also formed in many countries in collaboration with it.

The object of the work of the International Sub-Committee was to examine, and, so far as possible, obtain agreement, on methods for testing those properties of cements which assume special importance in large mass concrete structures; and to stimulate the interest of cement manufacturers in the production of cements specially suited for such types of construction. The properties demanded of such cements are: as low a heat of hydration as possible in order to reduce the temperatures attained in the concrete mass, a rather long setting time so as to enable large volumes of concrete to be placed without undue stiffening, good workability to facilitate placing without segregation or separation of water from the mixed concrete, a high ultimate concrete strength but only relatively low strengths at early ages, good resistance to the solvent action of percolating water, and no abnormal drying shrinkage. The necessity in modern dam construction for paying special attention to the properties of the cement used has its origin in the much increased rate at which large concrete dams are now built.

Two papers of particular importance were the interim report of the International Sub-Committee on Special Cements and the report from the U.S. Bureau of Reclamation. The former report, which was the result of experimental work carried out in a number of different countries, including Great Britain, tentatively recommended test methods for measuring the heat of hydration and solubility of cements; it also contained a description of the method used in Germany for comparing the drying shrinkage of cements and reports by Swedish investigators on the workability of concrete. The report from the U.S. Bureau of Reclamation prepared by Mr. J. L. Savage, chief designing engineer, was a document of more than two hundred pages containing a very valuable summary of investigations made in the United States on special cements, and of the experience gained with them in the construction of a number of large dams, including Boulder Dam on the Colorado River, Bonneville and Grand Coulee Dams on the Columbia River and Norris Dam in the Tennessee Valley.

In discussing the design and waterproofing of joints in mass concrete, a distinction was drawn between shrinkage joints, the function of which is limited to the construction period and to the earlier part of the operating period, and contraction and expansion joints which are intended to guard against movements occurring over the entire life of the dam. The general consensus of opinion was that contraction joints at intervals of 12–15 metres should be provided in all concrete gravity dams, but with respect to arch dams no general agreement as to their necessity or otherwise was reached. The various methods for sealing joints by the use of metal plates, of bitumen, rubber, and cement grouting were discussed in detail in several of the papers presented. The use of copper or stainless steel joints was preferred.

The reports submitted on the subject of facings for masonry and concrete dams dealt with the different methods which have been developed for reducing or preventing water percolation through the upstream face, and, when climatic conditions are severe, for protecting the face against damage by frost and by abrasion from floating ice and debris. The relative merits of masonry, cement mortar and rich concrete facings formed a controversial subject, some authors holding that under severe frost conditions not even a rich concrete can be expected to stand without damage, if it is exposed in a wet state, and that protection, as by a masonry facing, is necessary. Other contributors were not, however, in favour of masonry facing on account of the risk of the opening of joints owing to differences in thermal expansion between the face and the concrete behind. The use of metallic coverings or diaphragms, and of bituminous coatings suitably protected to obtain an impervious face, was also discussed. At a subsequent meeting of the Executive Committee of the International Commission on Large Dams, a resolution was passed that when suitable precautions are taken to obtain a resistant concrete face, no other protection is necessary.

Under the topic of geotechnical studies of foundation materials, most contributors dealt with the geological investigation of dam sites and the treatment of unfavourable conditions by grouting with cement, bitumen, clay and chemical consolidation processes. The discussion mainly centred round the best methods of sampling and coring in investigations of the foundations for proposed structures.

The discussion on the stability of earth dams was largely concerned with problems of design, foundations, construction, and resistance to earthquake shocks, and the stability of the slopes of dams.

Both before and after the Conference and Congress in Washington a series of study tours was organized to permit visitors to inspect hydro-electric power plants in the United States and Canada, and to visit some of the large dams recently constructed or now under construction. The visit to the Tennessee Valley authority was also of more than technical interest since it afforded an opportunity for the study of the application of hydro-electric power development in regional planning.

The longest tour, which attracted some two hundred visitors from abroad, including more than twenty from Great Britain, was concerned with major constructional projects, largely in the field of dam construction and hydro-electric power development. Visitors on this tour were privileged first to visit Canada for the inspection of plants near Montreal and Ottawa and then to proceed to Niagara, Chicago and the west coast of the United States. Visits to the Fort Peck Dam on the upper reaches of the Missouri River in Northern Montana—to the Columbia and Skagit River developments in the State of Washington, to power development schemes in California, and to Boulder Dam, as well as to various laboratories in which research work bearing on problems of dam construction was being carried out, all combined to make a memorable tour.

Throughout the meetings at Washington and the subsequent tours in the United States, visitors were afforded widespread hospitality and help from their American hosts, to whom all owe a deep debt of gratitude. Special mention should also be made of the hospitality shown in Ottawa, Montreal and Niagara by the Canadian Government, and the provincial Governments of Quebec and Ontario.

F. M. Lea.

International Congress of Experimental Cytology

Meeting at Copenhagen

The fourth International Congress of Experimental Cytology was held in Copenhagen on August 10–15 under the presidency of Prof. T. Huzella, the office of local president being filled by Dr. Albert Fischer.

The opening meeting of the Congress took place in the Reception Hall of the Parliament, Christiansborg Castle, where the members were welcomed by the local president and by the rector of the University of Copenhagen, after which two short lectures were given, one by Dr. Alexis Carrel on "La Cytologie Nouvelle" and the other by Dr. August Krogh on "Modern Biology".

The ordinary sessions were held in the Physiological Institute, a modern and beautifully equipped building which was admirably adapted for the purpose. The proceedings of the Congress were not divided into concurrent sections, so that it was possible for a sufficiently robust member to attend all the papers if he so wished. The enormous variety in the subject-matter of the papers presented permitted of only the loosest classification in the programme, and, in this short account, it is impossible to mention more than a few of the communications, selected almost at random, to give some idea of the field of work covered by the Congress.

Two sessions were devoted to the physical chemistry of the cell. Dr. Edmund Mayer described a method for measuring the physical forces acting on growing cells in a semi-solid culture medium by placing small metal balls in the medium and measuring the magnetic force required to displace them. Prof. T. Peterfi described experiments in which the volume of an amœba was measured at different stages in its life-cycle, by sucking the organism into a cylindrical micro-pipette.

One session dealt with histo-chemistry. Miss C. F. Fischmann gave an account of her work on the influence of vitamin D on ossification *in vitro*. Drs. P. Lamarque and J. Turchini described a new technique of historadiography whereby X-ray photographs of histological preparations can be made and examined microscopically.

During the session on cell respiration and metabolism, Dr. K. Linderstrøm-Lang gave an account of his work on the distribution of proteolytic enzymes in the different portions of the glands of the stomach, and in certain other tissues, notably in growing root-tips. Dr. Albert Fischer described experiments on blood coagulation and the mechanism of cell nutrition. Messrs. F. Jacoby, O. A. Trowell and E. N. Willmer read a paper in which they showed, by photographs taken automatically at 6-minute intervals, that embryo tissue juice not only accelerates the migratory movement of tissue culture cells and increases the percentage of dividing cells but also shortens the duration of mitosis.

Papers on the experimental morphology of the cell occupied four sessions. Prof. W. von Möllendorf, in a communication illustrated by a fine film, described how the duration of various phases of mitosis can be altered under the influence of different ions. Dr. C. Robinow discussed the problem of cell boundaries and showed with the aid of lantern slides of singularly beautiful photomicrographs, that the boundaries are much more irregular and complicated than the ordinary impregnation methods indicate. Prof. T. Huzella described the effect of different vibrations on tissue growth *in vitro*. Dr. J. Hämmerling gave a paper on the influence of the nucleus on the development of the unicellular plant *Acetabularia*; he showed that if the proximal nuclear region of one species were cut off and grafted on to the non-nuclear region of another species, the non-nuclear region assumed the specific characters of the nucleated graft, indicating that the specific characters are controlled by the nucleus. Dr. A. F. W. Hughes gave a communication on the influence of the circulation upon the vessels of the area vasculosa of the chicken's egg.

The last two sessions were devoted respectively to the experimental pathology of the cell and to the biological effect of radiation.

A large number of demonstrations were exhibited. Dr. Alexis Carrel and Colonel Lindbergh personally demonstrated their perfusion apparatus in operation. Of special interest were a number of lantern slides showing photomicrographs of histological sections of organs grown in the apparatus for different periods. Similar slides of control organs were shown for purposes of comparison, and there was surprisingly little histological difference between the normal and explanted tissue.

The Congress was marked by the large number and high average standard of the cinema films exhibited. Many of the films were projected immediately after the communications which they illustrated, but the rest were shown on a special evening set apart for the purpose. An enthusiastic reception was given to the last films of the late Dr. Canti, made in conjunction with and demonstrated by Dr. John Bland, in which tissue cultures of gliomata and of cells infected by psittacosis virus are shown.

The local committee deserves congratulation for its highly efficient organization, and the members of the Congress must have carried away with them delightful memories of the lavish hospitality with which they were entertained throughout their visit and of the surpassing excellence of Danish cookery.

Physical Properties of Heather Honey

EVER since Major Hruschka, in Venice, discovered in 1865 the principle of honey extraction by the application of centrifugal force, in a rotary extractor, it became no longer necessary to destroy valuable combs in order to separate the honey from the wax. All the native honeys in Great Britain yield to this method of treatment, excepting that derived from the nectar of ling (*Calluna vulgaris*). Ling honey fails to flow from the combs in an ordinary extractor, and consequently the combs have to be crushed in a press to obtain extraction. Ling honey is rich golden brown in colour and shows a characteristic sparkle due to the presence of minute air bubbles. In the pure form it never granulates but remains as a gelatinous fluid which is more viscous than most other honeys. Its distinctive flavour and aroma also readily distinguish it from other honeys.

In the *Bee World* for August 1936, Mr. J. Pryce-Jones discusses certain of the physical properties of ling honey. Mr. Pryce-Jones has examined more than 250 samples of honeys from various parts of the world: 73 of these were ling honey in varying degrees of purity and 27 were samples of bell heather honey. All the samples of ling honey were thixotropic, but none of the bell heather samples, when free from ling honey, showed this feature. The degree of thixotropy in a sample of ling honey is closely related to its purity. Also the absence of thixotropy in a sample of honey may be taken as an indication that it contains less than 5 per cent of ling honey. The property of thixotropy may be illustrated by taking a small amount of finely divided clay and shaking it with five times its weight of water containing traces of common salt. If such a mixture be shaken in a narrow test tube it flows freely when the tube is inverted, but if it be left at rest after shaking it sets into a jelly. If the tube be shaken again the mixture flows once more but sets anew on standing. This property, which is one of certain colloids, is termed thixotropy.

Ling honey also shows another peculiar and related feature which Mr. Pryce-Jones terms elastic recoil, and he describes the apparatus used in its investigation. These two properties seem to be due to the amount of colloidal material present in ling honey. Appreciable amounts of colloids can be precipitated by suitable reagents. Thixotropy and elastic recoil are eliminated by the removal of this precipitate, while the addition of the ling colloids to other honeys imparts to them these same two properties, which they did not previously exhibit. Certain other honeys, from Australia and New Zealand, also exhibit thixotropy but, so far as the author is aware, ling honey is unique in its physical properties among the honeys of Great Britain.

In the *Journal of the Ministry of Agriculture and Fisheries*, October 1936, Dr. G. W. Scott Blair and Mr. D. Morland contribute an article on practical tests for ling honey. They refer to the closely connected properties of structural viscosity and thixotropy in honeys of this kind. There is reason to believe that the sugar molecules tend to arrange themselves into a sort of structure like scaffolding around a building. When honey is stirred, or caused to flow, this structure is broken up and only becomes reformed gradually. A method devised by Scott Blair (*J. Phys. Chem.*, 39, 1935) is a convenient test for evidence of such a structure. A ¼-in. steel ball-bearing is dropped through a sample of honey, which has been allowed to stand overnight, contained in a 100 c.c. Nessler tube. The tube is marked with two lines about 2½ in. apart and the times at which the centre of the ball passes these two lines is noted. The honey is then stirred by a metal disk perforated with holes and mounted on a rod so that it just slides freely in the cylinder. The disk is pushed to the bottom of the cylinder and withdrawn twice; immediately after this a ball-bearing is dropped and the times noted as before. The 'thixotropy ratio' is obtained by dividing the time taken by a ball to fall between the two lines in the first test by that taken by the other ball in the second test. This simple method is well adapted for the judging of honey samples, since it allows of physical properties to be tested in a way capable of repetition, and so eliminating most of the personal factor that has hitherto prevailed.

New Laboratories of the Mond Nickel Co., Ltd.

At a reception which preceded the inspection on October 21 of the new Research and Development Department Laboratory erected by the Mond Nickel Co., Ltd., in Wiggin Street, Birmingham, Lord Weir referred to the great extension that has taken place in the use of nickel and its alloys during the last decade. Before 1914, most of the nickel produced in the world was utilized for armament purposes. As a result of the research and development work that has been carried out since that time, both by the International Nickel Co. and its associates, and by nickel users throughout the world, the metal now enters into a wide variety of alloys and is employed to an increasing extent in nearly every industry. In 1922, the world consumption of the metal was only eight thousand six hundred tons, but this rose to seventy-five thousand tons last year, most of it for uses unconnected with war.

The new laboratories, which are magnificently housed, are fit to take their place among the more important organizations of their kind in the world. The structure is of reinforced concrete, and consists of a basement and three floors on a site 186 ft. × 43 ft. The building is faced with red brick, and a feature of the front elevation is a curved window extending the full height of the building and lighting the main staircase in the centre of the block. It is a pleasing example of modern architecture.

The opportunity has been taken to display the decorative qualities of some of the Company's products, and nickel alloy metal work is extensively used; the nickel-silver balustrade to the main staircase is particularly effective.

A notable feature of the laboratory is that it is heated and ventilated by the introduction of fresh warm clean and filtered air from a modern air-conditioning plant. This not only avoids the inconvenience of radiators in the laboratory, but also keeps the building free from dust. The automatic control of temperature and humidity thus obtained, as well as the freedom from dust, has definite scientific advantages, particularly in the corrosion laboratory, for the building is situated in the heart of industrial Birmingham where the atmosphere is at times very impure.

Service supplies of gas, water, electricity, etc., are led from the basement through enclosed longitudinal ducts and are distributed to the laboratories through channels in the walls and floors which are enclosed by flush-fitting panels. The benches are mainly tile-covered, and drainage channels are enclosed and hidden under the floor. The walls are finished in cream-coloured enamel and, being provided with big windows, make the rooms very light. The absence of pipes and fittings on the walls gives a general air of tidiness, which is further enhanced by the use of nickel alloy sink and other fittings. The general effect is rather that of a modern luxury bathroom than of a typical scientific laboratory.

A portion of the building is devoted to a large semi-technical laboratory, in which new processes can be studied on a larger scale, preliminary to their transfer to the works.

The general equipment of the laboratories is excellent, and the apparatus available for physical metallurgy is particularly to be commended. The wide variety of alloys of which nickel forms a component renders necessary a particularly wide range of testing appliances, and, except for an X-ray spectrometer, nothing of importance appears to have been omitted.

The laboratory is clearly designed principally for development work rather than pure scientific research; that is, it is intended to supply information, mainly obtained by known testing methods, to users of nickel alloys. For this purpose it is excellent, and it is doubtful if any better laboratory of the kind exists in Great Britain. There is, however, a certain rigidity about the lay-out of the building itself and of the apparatus which is perhaps not quite so desirable in a laboratory devoted to scientific research; but it is, perhaps, ungracious to criticize where there is so much to praise.

Development of the Scottish Highlands

The drastic depopulation of the Highlands, its causes and the possibilities of development form the subject of a broadsheet on the "State of the Highlands" which has recently been published by Political and Economic Planning. In 1931 the population of the Highland counties, which represent nearly 19 per cent of the area of Great Britain, was 356,615, or less than 1 per cent of Great Britain's population and 100,000 below the 1861 figure; nearly 40,000 of the shrinkage has occurred since 1921.

This depopulation is due partly to the poverty of the region in natural resources but also to political, social and economic handicaps. The Highlanders are extraordinarily poor. Crofting was formerly an adjunct to fishing, which has now in almost every area been killed by the trawlers, with consequent impoverishment not merely through loss of income but also through a change-over to a less satisfactory diet in which tinned and packaged foods figure prominently at higher cost. Deer-stalking has lately suffered a heavy eclipse, and grouse-shooting and fishing, while bringing in a certain amount of income, do little to benefit the mass of the population. Except for hydro-electric power development in connexion with the aluminium industry in the Kinlochleven and Fort William area, the natural resources of the area have not proved suitable for exploitation.

A high proportion of the occupied population is notoriously poorly paid, and the age structure of the population is becoming increasingly unsatisfactory, the proportion of persons in the age groups up to forty-five years being lower than for Scotland as a whole, especially in the groups below thirty years, while in the age-groups sixty-five–eighty years it is more than fifty per cent above the average. The marriage rate is well below the Scottish average, but the mobility of the population is greater than is often supposed. Transport charges are a serious obstacle to development, and ferry and other tolls are notorious.

The greatest possibilities of development lie in tourist traffic. More and better-run hotels, improved train and bus services, the encouragement of walkers as well as road touring, and maintenance of more adequate information and propaganda services should assist to attract the necessary money from outside. The tourist industry would also stimulate such other industries as sea-fishing, the cultivation of fruit and vegetables, and local handicrafts. Afforestation linked up with timber-processing, quarrying and wool are other possibilities, all of which demand leadership. Orthodox methods are inapplicable to Highland conditions, and the establishment of a form of Development Board through Parliament may be ultimately required.

Educational Topics and Events

ABERDEEN.—During the interregnum between the departure of Prof. James Ritchie to the University of Edinburgh and the arrival of a successor, the University Court has appointed Prof. Walter Garstang, formerly of the University of Leeds, to take charge of the Natural History Department in Aberdeen.

CAMBRIDGE.—The Managers of the Balfour Fund have made the following grants: to W. Graham-Smith, of Gonville and Caius College, £200 for an expedition to examine the Devonian fauna of Scaumenac Bay in Canada; to H. E. Hinton, of Fitzwilliam House, £200 for researches on the biology and distribution of the water-living insects of Lake Titicaca.

At Downing College, Sir Albert Seward, formerly Master of the College, has been elected into an honorary fellowship.

LONDON.—The following appointments have been made: Dr. W. G. Penney, Stokes student at Pembroke College, Cambridge, to be reader in mathematics in the Imperial College—Royal College of Science; Dr. Charles Reid, since 1933 lecturer in physiology at University College, London, to be reader in physiology at the London Hospital Medical College.

The title of professor of applied physical chemistry in the University has been conferred on Mr. G. I. Finch, in respect of the post held by him at the Imperial College—Royal College of Science. The title of emeritus professor of statistics in the University has been conferred on Prof. A. L. Bowley, on his retirement from the University chair of statistics at the London School of Economics.

The following awards have been made: George Smith studentship to T. J. B. Spencer (King's College); Graham scholarship in pathology to C. H. Gray; Loch exhibitions to Miss A. C. Anderson and Mrs. E. M. Pegram (London School of Economics); Metcalfe scholarship for women to Miss V. M. Rossitter; *proxime accessit*, Miss Adasia Steinberg; Metcalfe studentship for women to Miss G. H. Keir; Rogers prize to Dr. R. P. Kemp.

Dr. S. J. Davies, who has been University reader in mechanical engineering at King's College since 1926, has been appointed, as from January 1, 1937, to the University chair of mechanical engineering tenable at King's College.

MANCHESTER.—Prof. J. L. Stocks will vacate the Sir Samuel Hall chair of philosophy at the end of this term consequent on his appointment as vice-chancellor of the University of Liverpool.

The following resignations take effect from the beginning of the session: Dr. T. A. Bennet-Clark (lecturer in botany, appointed professor of botany at University College, Nottingham); Messrs. Frank Morton and L. W. Derry (demonstrators in applied chemistry in the Faculty of Technology).

The following appointments have been made as from the beginning of the session: Mr. A. C. Lovell, to be assistant lecturer in physics; Dr. R. F. Hunter, to be assistant lecturer in chemistry; Dr. V. J. Chapman, to be assistant lecturer in botany.

The Metallurgical Department has received a research grant from the International Tin Research and Development Council.

OXFORD.—Prof. A. R. Radcliffe-Brown has been appointed to the newly created chair of social anthropology as from January 1, 1937.

Prof. Frederick Soddy has intimated his desire to resign the Dr. Lee's professorship of inorganic and physical chemistry to which he was appointed in 1919.

In Convocation on October 27 the honorary degree of D.C.L. was conferred on President J. B. Conant, of Harvard University.

Congregation on October 20 accepted by 68 votes to 32 a scheme for altering the traditional rotation for the appointment of the vice-chancellor and giving the Chancellor wide powers of discretion. The aims of the scheme are to get younger men and longer term in office. Some of the promoters of it would have welcomed a permanent vice-chancellorship. Others, while preferring the present temporary appointment, would like to have it thrown open to any member of Congregation. The present feeling, however, is against these radical changes and in favour, merely, of making eligible for office any head of a college independent of his seniority. It is commonly agreed that the present vice-chancellor—the Master of Balliol—who happens to be one of the younger heads of a college, is the most successful one of recent years.

The numbers of those who took research degrees at Oxford in the past academic year have recently been published. They serve to show the main groups of subjects in which research is being carried out. They are—physical sciences: 45 B.Sc., 17 D.Phil.; biological sciences, 6 B.Sc., 6 D.Phil.; medicine, 2 B.Sc., 2 D.Phil.; social studies, 5 B.Litt., 4 D.Phil.; modern history, 12 B.Litt., 6 D.Phil.; all other subjects: 23 B.Litt., 4 D.Phil. Thirty-eight of the forty-five bachelors in the physical sciences are chemists.

Science News a Century Ago

Application of Statistics to Commerce

AT a meeting of the Statistical Society held on November 2, 1836, a paper "On the Application of Statistical Facts to Statistical Science" was read by W. Atkinson. After some preliminary remarks on the expediency of occasionally deviating from the leading regulations of the Society which limited the duty of members to the mere collection of facts, forbidding the expression of opinion, the author proceeded to show "by a critical comparison of numerous passages from the principal writers on the cause of wealth, as Smith, Say, Ricardo, M'Culloch, Scrope, etc., that their statements are involved in great confusion and contradiction ; that up to the present time, we were most lamentably destitute of any certain knowledge in the great branch of statistical science which relates to commerce ; and that in order that the principles of commercial economy may be established on a sure and certain foundation, they must be formed, not on *à priori* assumptions and definitions of vague abstractions, but upon positive facts to be observed, collected and arranged by the science of statistics". The paper led to an animated discussion as to whether statistics be, or not be a science, and also whether it should be an object of the Society not merely to collect statistical facts, but also to make inductions and draw conclusions from them. (*Athenæum.*)

Geology of Asia Minor

ON November 2, 1836, Hugh Edwin Strickland (1811–53) described to the Geological Society the general structure of Asia Minor, and in the course of his paper compared one region he had examined, with a part of France. Modern volcanic rocks, he said, were only observed in Catacecaumene in Lydia. The older cones, nearly thirty in number, were low and flat, and they were covered with vineyards producing the Catacecaumene wine celebrated from the time of Strabo to the present. There were great resemblances between this district and the volcanic districts in Central France. In both countries there are extensive lacustrine, tertiary deposits and volcanic cones extinct from the most remote historical antiquity.

Gray on Museums of Natural History

THE *Analyst* (5, 273) contains an interesting communication by John Edward Gray, F.R.S. (1800–75), entitled "Some Remarks on Museums of Natural History". The notice is dated Blackheath, November 5, 1836. Since 1824, Gray had been assistant zoological keeper at the British Museum, and was evidently well acquainted with museums both at home and abroad. He had recently visited the museum at Newcastle-upon-Tyne, where he had been "especially gratified with the liberality of the subscribers in throwing the Museum open, without the necessity of an introduction, or any charge to their fellow-townsmen—a facility of access scarcely to be expected except in a national establishment like the British Museum". Of other museums in the country, some were open by an order from, or an introduction by, a subscriber. At Liverpool, Edinburgh, Glasgow and Worcester, visitors were charged a shilling. At Manchester, however, Gray found the regulations very stringent, a notice board stating that no gentleman residing within three miles of Manchester, not being a subscriber, could be admitted, while servants and children were not allowed in. Commenting on this, Gray said, "I should have thought the admission of children, with a view of imparting a taste for the beauties of Nature in the rising generation would have been one of the ardent wishes of the subscribers". Referring to his visits abroad, he said he had "made notes of the various museums with the view of introducing into the British Museum any real improvement I might discover".

The Doctrine of Homœopathy

AT the Westminster Medical Society on November 5, 1836, Dr. Bureaud read a paper on homœopathy. "The Doctor," said the *Athenæum*, "appeared to have had great facilities for observing the peculiar mode practised by Hahnemann, its founder, and to have embraced every opportunity to gain information from its various disciples on the continent. He entered into a minute detail of the principles of the doctrine, critically analysed their merits, reported the results of various practical experiments, and concluded with a strong declaration, condemnatory of the practise. A letter was read from Dr. Poyntz, the physician of the Hotel Dieu at Lyons, reporting the *total failure* of Dr. Gerrard, a celebrated homœopathist of that city, who had selected thirty-two cases to be treated in that institution, on Hahnemann's plan and, after a trial of seventeen days, he had been obliged to resign their charge to the medical officers of the hospital, having been in every case, unsuccessful".

Statistics of Suicide at Aberdeen

THE *London Medical Gazette* of November 5, 1836, contains the following statistics of suicides at Aberdeen from 1826 until 1835 inclusive, drawn up by Dr. Francis Ogston. During this period, information was obtained about 52 persons who had seriously attempted suicide, of whom 38 had been successful. The number of attempts was the same in females as in males. The fatal cases among the former was 16 and among the latter 22. In men the actual were to the attempted suicides as 22 to 26, or as 1 to 1·18 ; in females as 16 to 26 or as 1 to 1·62. According to the census of 1830, when the population of Aberdeen was 58,019, there was one attempt annually in the ten year period in every 11,157·5 inhabitants. The age at which the greatest number of attempts was made was 21–25 years inclusive, and next in frequency the quinquennium 26–30 years. Among the men the greatest number of attempts was at 26–30 years, and among the women at 21–25 years. With one exception, after the age of thirty-five years, no ineffectual attempt was made. Attempts to take life by firearms (three cases) and by cutting instruments (six cases) were confined to males ; poison and drowning being the modes most frequently chosen by females. With one exception, when corrosive sublimate was swallowed, the poison selected was laudanum. Of the 52 suicides, 19 were married, 2 were widows, 1 was a widower and 30 were single ; 26 had no children and 16 had families, no information being available in 10. Suicides were most frequent in the last six months of the year, August standing highest with fifteen cases and May lowest with only two cases. As regards the habits of 30 in whom information was obtained, 20, or two thirds, were intoxicated and 10 sober ; 17 had the character of habitual drunkards.

Societies and Academies

Paris

Academy of Sciences, October 5 (*C.R.*, 203, 593–636).

Marin Molliard : The experimental production of variegation in the radish in a confined atmosphere enriched in oxygen.

Jacques de Lapparent : The interpretation of radiograms of crystalline powders based on results obtained with argillaceous phyllites.

Ottokar Borůvka : Singular matrices.

Alexandre Ostrowski : A transformation of the Liouville-Neumann series.

Maurice Gevrey : Certain systems of partial differential equations with multiple imaginary characteristics.

Pierre Ernest Mercier : The most general symmetrical suspension.

André Couder : The photographic measurement of the atmospheric disturbance of stellar images.

René Lucas : The diffusion of elastic waves in fluids.

Edmond van Aubel : Hall's phenomenon in antimony–tellurium and antimony–silver alloys.

Mme. Dorothy Moyle Needham : The phosphorylation of cozymase. It is concluded that the phosphoryl compound of cozymase, a compound containing easily hydrolysable phosphorus, is formed in muscle extract as the result of a reaction with phosphopyruvic acid.

Bertrand Goldschmidt : The coefficient of fractionation of radium and its isotopes in the crystallization of barium chlorate.

Marcel Prettre : The inhibition by hydrogen of the chain reaction of mixtures of normal pentane and oxygen. Hydrogen hinders the oxidation and inflammation of pentane, whilst an inert gas, such as nitrogen, facilitates the combustion under the same conditions.

Thadée Urbanski and Marion Slon : The nitration of some normal paraffin hydrocarbons. The direct formation of nitro-paraffins has hitherto been possible only with hydrocarbons higher than pentane. The authors have obtained nitromethane and nitropropane by the direct action of N_2O_4 upon the hydrocarbons.

Georges Dupont and Victor Desreux : Contribution to the study of β-myrcene. Hydrogenation by sodium and alcohol.

Pierre Lesage : A general review of ten years of culture on acquired and inherited precosity.

Raoul Lecoq : Disturbance in the food balance by the introduction of uric acid or oxalic acid into the ration of the pigeon.

Albert Berthelot and Mme. Germaine Amoureux : The tumours obtained by inoculating *Bacterium tumefaciens* aseptically into seedlings and young cultivated plants.

Albert Peyron and Henri Limousin : Polyembryony in tumours with multiple tissues of the testicle in man.

Maurice Caullery : Remarks on the preceding communication.

Gaston Ramon, André Boivin and Rémy Richou : The flocculating and immunizing properties of anatoxins purified by precipitation with trichloracetic acid. The diphtheric and staphylococcic anatoxins can be purified by the trichloracetic acid treatment without losing their immunizing properties.

Copenhagen

Royal Danish Academy of Sciences and Letters, March 20.

Johs. Hjelmslev : (1) Projective triangle invariants. (2) Introduction to the general doctrine of congruence (third communication).

April 3.

Ad. S. Jensen : *Eriocheir sinensis* from southern Jutland. A review of the immigration of the Chinese mitten crab into Denmark.

April 17.

E. Biilmann : An optically active deuterocamphane.

May 1.

J. N. Brønsted : Relation between heat and work. The thermodynamic postulate that heat cannot be transformed into work without a simultaneous occurrence of compensating changes in the surroundings should be modified into the claim of the general impossibility of a conversion of heat into work. This demonstration leads to a somewhat modified formulation of the fundamental thermodynamic laws.

Harald Bohr : The theory of almost periodic functions (6). Picard's theorem.

May 15.

August Krogh : A new bottom-sampler for investigation of the microfauna of the sea bottom. With remarks on the quantity and significance of the benthonic microfauna.

G. Hevesy : Splitting of atomic nuclei under the influence of neutrons on rare earths. Neutrons are easily intercepted by most atomic nuclei, and the interception often leads to the formation of another element or of a heavier atom of the same element, a heavier isotope ; both may be either radioactive or stable. The investigations of the influence of neutrons on rare earths carried out at the Institute for Theoretical Physics in collaboration with Dr. Levi showed that all rare earths are able to absorb neutrons. Under the influence of the neutrons a great number of radioactive isotopes, hitherto unknown, has arisen. The periodicity of these, and the intensity and hardness of the β-radiation emitted, have been investigated. The radioactivity of the rare earths can be utilized for the demonstration and quantitative analysis of these substances.

Moscow

Academy of Sciences (*C.R.*, 3, No. 3 ; 1936).

G. Fichtenholz : A generalization of the Stieltjes integral.

L. Kantorovič : General forms of certain classes of linear operations.

S. Sobolev : Correction to the paper "On some evaluations concerning the families of functions having derivatives with integrable squares" (cf. *C.R.*, 1, No. 7 ; 1936).

B. Vulich : Correction to the note "Some remarks to the theory of K-normed space" (cf. *C.R.*, 2, No. 2 ; 1936).

L. Mandelstam and M. Leontovič : Supersonic absorption in fluids and certain optical phenomena connected with it.

J. Larionov and A. Seidel : Fluorescence of the salts of trivalent europium in aqueous solutions.

M. Veingerov: The limits of sensitivity of a radiometer based on the principle of a gas thermometer.

D. Mirlis and P. Rehbinder: Kinetics of selective wetting and surface reactions on metals in presence of electrolytes (1).

W. I. Vernadsky: Variations in the atomic weights of chemical elements on the earth.

M. Iljinskij and W. Afremov: Inhibiting agencies in the chlorination of anthracene. Influence of the composition of the solvent on the course of the reaction.

P. Kapterev: Experiments in the revitalization of organisms from permanently frozen subsoil (see Nature, Oct. 24, p. 714).

N. L. Gurvič: The diversity of composition of essential oils in certain species of the Transcaucasian thyme.

Rome

Royal National Academy of the Lincei (*Atti*, 3, 383–458; 1936).

G. Checchia-Rispoli: The Pliocene echinoderm fauna from the neighbourhood of Lentini (province of Syracuse).

U. Broggi: Determinant functions.

B. Segre: Varieties of Veronese with two indices (2).

B. Manià: Complete equations in the problems of Lagrange.

E. Gugino: Single deduction of the dynamic equations of Maggi and of Appell (1). Dynamic equations of Euler-Lagrange according to G. Hamel (2).

C. Jodi: Formula for the increase of a vibratory motion constrained by harmonic forces.

G. Lampariello: Application of the method of images to vortex motions.

C. Tagliacozzo: Observation on the kinetostatics of elastic systems.

E. Volterra: Plane elastic arcs (1). Differential equations of the deformations.

G. R. Levi and A. Baroni: Carbon obtained by the dehydration of carbohydrates.

G. Natta and M. Baccaredda: Examination of cellulose by means of electron rays.

P. Principi: The age of some formations of the Appenines.

M. Mitolo: Oxidation-reduction phenomena and states of functional activity of the neuraxis.

Washington, D.C.

National Academy of Sciences (*Proc.*, 22, 463–523, Aug. 15).

Fred M. Uber and T. H. Goodspeed: Micro-incineration studies (3). Shrinkage phenomena during carbonization and ashing of wood. A hot-stage microscope was devised; an aluminium chamber, 25 mm. × 50 mm., was wound with resistance wire, and temperatures up to 650° C. were available. With this apparatus, sections of wood 5 μ thick were observed while incineration was proceeding.

W. A. Setchell and N. L. Gardner: *Iridophycus gen. nov.* and its representation in South America.

Frank H. Clark: Linkage relations of hydrocephalus (hy_1) in the house mouse, *Mus musculus*. No linkage was observed with 15 characters marking 14 of the 20 chromosomes of the mouse.

H. C. Sherman and H. L. Campbell: A further study of regularity of nutritional response to chemical intake. Animals reared for eight generations on a minimal adequate diet responded to enrichment of diet in calcium, vitamins A and G and protein by increased rate of growth and vitality.

John M. Ide: The elastic properties of rocks: a correlation of theory and experiment. The modulus of rigidity and Poisson's ratio for a series of rock samples prepared by the Committee on Geophysical Research at Harvard were determined by dynamic methods (see Nature, 137, 675; 1936). Elastic constants determined in the laboratory are compared with those derived from theoretical formulæ. Agreement is good for steel, copper and diabase; other materials showed varying discrepancies, suggesting that the rocks studied are imperfect elastic media. The theory of elasticity can be applied safely to the fine-grained igneous rocks presumed to underlie the oceans and continental granites; but not to surface rocks, whether sedimentary or granitic in character.

Francis P. Shepard: The underlying causes of submarine canyons. Examination of recent data on these canyons leads to the following suggestions. Before the glacial period there were depressions on the continental slopes, due to various causes. Next, during the maximum of a glacial epoch, the sea was lowered some 3,000 ft. by ice formation, and these depressions were occupied by rivers which cut true river canyons through relatively recent sediments. With the melting of the ice, the sea rose, submerging these canyons, which are kept clear by mud flows and submarine currents.

C. A. G. Wiersma and George Marmont: Mechanism of inhibition of crayfish (*Cambarus clarkii*) muscle. Evidence was obtained of two inhibition mechanisms, one working directly on the contractile elements and the other influencing the action currents.

Emil L. Smith: Photosynthesis in relation to light and carbon dioxide. Experiments with a freshwater plant, *Cabomba*, in buffer solution exposed to light intensity range of 1 to 1,700, provided data from which curves relating photosynthesis to intensity were drawn. The results of other workers on limited intensity ranges fit the equation derived from this curve. Photosynthetic rate appears to the same function of both light intensity and carbon dioxide concentration.

Kenneth V. Thimann: Physiology of the formation of nodules on legume roots. Experimentally it is found that nodules produce an auxin. Local application of auxin to young lateral roots of a legume inhibits their growth in length, but causes a swelling at their base due to increase in size of cortex cells. It is suggested that the nodule bacteria within the plant produce an auxin, which causes cell enlargement and also the early stages of a lateral root; growth of the latter is inhibited but cell enlargement continues, giving the characteristic nodule.

E. G. Boring and S. S. Stevens: The nature of tonal brightness. Analysis of the frequency spectra of sounds emitted by cardboard sirens suggests that brightness is associated with the presence of higher harmonic partials and depends on the velocity of the air blast, but not on the ratio of size of hole in siren disk to size of interval between holes. Brightness is probably better regarded as density.

A. A. Abramowitz: The action of intermedin on crustacean melanophores and of the crustacean hormone on elasmobranch melanophores. Pituitary extract causes restoration of dark coloration in eyeless fiddler crabs, just as crustacean pigmentary hormone restores that of dogfish (*Mustelus*) from which the pituitary gland has been removed.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, November 2

Royal Geographical Society, at 3 and 8.30.—Hugh Ruttledge: "The Mount Everest Expedition of 1936".

London School of Economics and Political Science, at 6.—A course of lectures on "Current Problems of Business Administration" (succeeding lectures on November 9, 16, 23, 30, December 7, January 11, 18, 25, February 1, 8, and 15).*

Tuesday, November 3

Institution of Civil Engineers, at 6.—Opening Meeting.

Sir Alexander Gibb: Presidential Address

Wednesday, November 4

Royal Society of Arts, at 8.30.—Sir Henry McMahon. "180 Years of Pioneer Work by the Royal Society of Arts".

Thursday, November 5

Royal Society, at 4.30.—O. A. Saunders: "The Effect of Pressure upon Natural Convection in Air".

R. A. Bagnold: "The Movement of Desert Sand".

J. Smiles and H. Wrighton: "The Micrography of Metals in Ultra-violet Light".

Royal College of Physicians, at 5.—Dr. J. D. Rolleston: "The History of Measles" (FitzPatrick Lecture).

University of Leeds, at 8.—Prof D. T. Suzuki: "Buddhism in the Life and Thought of the Japanese People".*

Chadwick Public Lecture, at 8.15—(at the Royal Society of Arts, John Street, Adelphi, W.C.2).—Robert R. Hyde: "Industry's Contribution to Public Health: Firms' Voluntary Medical Services" (Malcolm Morris Memorial Lecture).*

Friday, November 6

Institution of Mechanical Engineers, at 6.—Prof. Alfred Fowler, F.R.S.: "The Spectroscope and the Atom" (Thomas Hawksley Lecture).

North East Coast Institution of Engineers and Shipbuilders, at 7.—Sir Frank Smith, F.R.S.: "Sir Charles Parsons and Steam" (Parsons Memorial Lecture).

Royal Institution, at 9.—Prof. F. A. Paneth: "The Chemical Exploration of the Stratosphere".

Official Publications Received

Great Britain and Ireland

Air Raid Precautions. Handbook No. 4. Decontamination of Materials. (Issued by the Home Office: Air Raid Precautions Department.) Pp. 69. (London: H.M. Stationery Office.) 6*d.* net. [710

London School of Hygiene and Tropical Medicine (University of London) incorporating the Ross Institute. Report to Subscribers by Sir Austen Chamberlain for the Year ending July 31st, 1936. Pp. 132. (London: London School of Hygiene and Tropical Medicine.) [710

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1697 (2013): Full Scale Tests of Landing Flaps on a Percival "Gull". By J. E. Serby and P. A. Hufton. Pp. 8+2 plates. (London: H.M. Stationery Office.) 2*s.* net. [810

Department of Scientific and Industrial Research. Forest Products Research Records, No. 12 (Timber Series, No. 4): Seraya, Meranti and Lauan. By B. J. Rendle and S. H. Clarke. Pp. iv+10+1 plate. (London: H.M. Stationery Office.) 6*d.* net. [810

The Genetics of the Pig. By A. D. Buchanan Smith, O. J. Robison and D. M. Bryant. (Reprint from Bibliographia Genetica, XII.) Pp. 160. (Edinburgh: Institute of Animal Genetics.) 3*s.* 6*d.* [910

Smoke Abatement Exhibition. Handbook and Guide. Pp. 80. (Manchester: National Smoke Abatement Society.) [1010

The Strangeways Research Laboratory, Cambridge. Report for 1935. Pp. 28. (Cambridge: Strangeways Research Laboratory.) [1310

Annual Report of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the Year ended March 31, 1936. (M.O. 398.) Pp. 68. (London: H.M. Stationery Office.) 1*s.* net. [1510

Report of the Council of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, intended to be presented at the Annual Meeting of the Society, 27th October 1936. Pp. 48. (Newcastle-upon-Tyne: Natural History Society of Northumberland.) [1510

Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending 31st March 1936; with Appendices. Pp. 46. (London: H.M. Stationery Office.) 9*d.* net. [1610

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), Nos. 35–41: Report of the Irish Radium Committee for the Year 1935; The Chemical Constituents of Lichens found in Ireland—*Buellia canescens*, Part 2, by P. A. Spillane, Dr. J. Keane and Dr. T. J. Nolan; The Glaciation of the Bantry Bay District, by A. Farrington, The Standardisation of Photo-Electric Cells for the Measurement of Energy, by H. H. Poole and W. R. G. Atkins; A Contribution to Knowledge of the Irish Fungi, by Dr. P. O'Connor; A Comparison of some Dutch and Irish Potato Mosaic Viruses, by Paul A. Murphy and L. B. Loughnane; A Study of the Aucuba or Yellow Mosaics of the Potato, by Phyllis E M. Clinch, J. B. Loughnane and Paul A. Murphy. Pp 317–448+plates 8–12. (Dublin: Hodges, Figgis and Co.; London Williams and Norgate, Ltd.) 10*s.* [1610

Universities Bureau of the British Empire. Report of the Executive Council together with the Accounts of the Bureau for the Year 1st August 1935 to 31st July 1936. Pp 22. (London: Universities Bureau of the British Empire.) [1610

Heriot-Watt College, Edinburgh. Report, Statistics, Prizes and Awards, 1935–36. Pp. 59. Calendar, Session 1936–1937. Pp. 371+14 plates (Edinburgh: Heriot-Watt College.) [2010

Other Countries

Proceedings of the United States National Museum. Vol. 83, No. 2995: Four New Species of Chalcidoidea Parasitic on Cactus Insects. By A. B. Gahan. Pp. 481–486. (Washington, D C.: Government Printing Office) [1210

Geological Survey of British Guiana The Geology and Gold Deposits of the Potaro. By Dr. Gordon J. Williams; with Petrological Appendix by Dr. D. R. Grantham. Pp. iv+62. 72 cents. Geology and Gold Deposits of the Konawaruk By S. Bracewell. Pp. iv+20+2 plates. 12 cents. 1934 Reports. Pp. viii+76+5 maps. 3 dollars. (Georgetown: Geological Survey.) [1210

The Constitution and Properties of Lapachol, Lomatiol and other Hydroxynaphthoquinone Derivatives. Edited by Louis F. Fieser. Memorial Volume to Samuel C. Hooker, 1864–1935. Pp. vi+135. (Cambridge, Mass.: Converse Memorial Laboratory, Harvard University.) [1510

Proceedings of the United States National Museum. Vol. 83, No. 2992: California Crustacea of the Order Cumacea. By Carl Zimmer. Pp. 423–439. (Washington, D.C.: Government Printing Office.) [1510

U.S. Department of Agriculture: Bureau of Biological Survey. North American Fauna, No. 55: The Mammals and Life Zones of Oregon. By Vernon Bailey. Pp. 416+52 plates. (Washington, D.C.: Government Printing Office.) 75 cents. [1510

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 88. *Bassaricyon pauli*, a New Species from Panama. By Robert K. Enders. Pp. 365–366. (Philadelphia: Academy of Natural Sciences) [1510

U.S. Department of the Interior: Office of Education. Bulletin, 1935, No. 13: Statistics of the Education of Negroes, 1929–30 and 1931–32. By David T. Blose and Ambrose Caliver. Pp. iv+47. 10 cents. Bulletin, 1936, No. 3: Junior Colleges. By Walter J. Greenleaf. Pp. iv+86. 15 cents. Bulletin, 1936, No. 4: State Provisions for Equalizing the Cost of Public Education. By Timon Covert. Pp. v+49. 10 cents. Bulletin, 1936, No. 6: Safeguarding Democracy through Adult Civic Education. By J. W. Studebaker. Pp. iii+35. 5 cents. Bulletin, 1936, No. 18–3: Youth—Education for those out of School. By H. B. Swanson. Pp vii+76. 10 cents. (Washington, D.C.: Government Printing Office.) [1510

U.S. Department of the Interior: Geological Survey. Professional Paper 186–A: New Upper Cretaceous Ostreidæ from the Gulf Region. By Lloyd William Stephenson. (Shorter Contributions to General Geology, 1936.) Pp. ii+12+3 plates. 5 cents. Water-Supply Paper 678. Geology and Ground-Water Resources of Uvalde and Medina Counties, Texas. By Albert Nelson Sayre. Pp. v+146+11 plates. 35 cents. Water-Supply Paper 773–A: Geology and Ground-Water Resources of the Elizabeth City Area, North Carolina. By S. W Lohman (Contributions to the Hydrology of the United States, 1936.) Pp. iii+57+4 plates. 10 cents. Water-Supply Paper 773–B: Water Resources of the Edwards Limestone in the San Antonio Area, Texas. By Penn Livingston, A. N. Sayre and W. N. White. (Contributions to the Hydrology of the United States, 1936.) Pp. ii+59–113+plate 5. 10 cents. (Washington, D.C.: Government Printing Office.) [1510

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 142: Sputtered Palladium Films, Part 1: Cracks and Crumples caused by Organic Contaminations. By Sin Tanaka. Pp. 367–406+plates 8–28. 75 sen. No. 143: Buckling of a Rectangular Plate with Four Clamped Edges re-examined with an Improved Theory. By Katsutada Sezawa and Wataru Watanabe. Pp. 407–418. 20 sen. No. 144: Entropy Diagrams for Combustion Gases of Gas Oil. By Keikichi Tanaka, Seiichi Awano, Toyoaki Ôhino and Masami Kobayasi. Pp. 419–434+12 plates+12 tables. 2.35 yen. (Tôkyô: Kogyo Tosho Kabushiki Kaisha) [1610

Catalogues

Original Water Colour Drawings and a fine miniature by Engleheart; Early Vellum Deeds many with beautiful seals; Autograph Letters including some valuable Newton Papers. (Caxton Head Catalogue 1023) Pp. 38. (London: James Tregaskis and Son.)

Galvanometers. (Galvo 36.) Pp. 12. (Delft: P. J. Kipp en Zonen.)

The Polarograph. an Automatically Operating Apparatus for Chemical Analysis Pp. 32 (London: W. Edwards and Co.)

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Empire Co-operation in Agricultural Research

THE term 'scientific' applied without qualification to the British Commonwealth Scientific Conference held on September 21–October 8 is scarcely accurate. Only a part of the machinery of science was under consideration : that part, especially of the sciences relating to agriculture, which is organized on a co-operative basis between the Governments of the British Commonwealth. The delegates to the Conference were mostly those concerned with the administration of Government scientific departments or of national research organizations ; few were persons actively engaged in scientific work themselves.

Even within these limits, the field covered was a large and interesting one. Scientific co-operation of the kind that the Conference reviewed began in London, with a group of African Colonies that had a common interest in the development of knowledge of insect-borne diseases. The Entomological Research Committee set up by the Colonial Office in 1909 became a few years later the Imperial Bureau of Entomology, established on a wide basis of Empire co-operation and charged with the documentation of entomological knowledge and the identification of insects injurious to man and to his crops and stock. This was followed in 1920 by the formation of a similar, jointly maintained, central organization to deal with the fungi and bacteria that injure crops or are otherwise of economic importance—the Imperial Bureau of Mycology. As a result of the Imperial Agricultural Conference of 1927, eight new Imperial Agricultural Bureaux were established to cover the subjects of soil science, animal health, animal nutrition, animal genetics, plant genetics (other than herbage), plant genetics (herbage), fruit production and agricultural parasitology. At the same time the two older Bureaux became Institutes, as they had functions considerably wider than those assigned to the eight new Bureaux, which confine themselves to the collection and dissemination of information. The new Bureaux are attached to research institutes in their subjects at Rothamsted, Weybridge, Aberdeen, Edinburgh, Cambridge, Aberystwyth, East Malling and St. Albans, while the two older bodies are in close contact with the Natural History Museum, South Kensington, and the Royal Botanic Gardens, Kew, there being no research institutes specially devoted to entomology and mycology in Great Britain.

The activities of these ten organizations, a survey of which formed a major part of the work of the Conference, has recently been described in considerable detail in the seventh Annual Report of the Executive Council of Imperial Agricultural Bureaux*. The Council comprises representatives of the United Kingdom, of each of the five Dominions, of India, Southern Rhodesia, and the Colonial Empire. It administers a service of common Empire interest maintained from a fund jointly subscribed by all the members of the British Commonwealth. The acceptance by Governments of the scheme proposed by the 1927 Conference and extended by the Skelton Committee on Economic Consultation and Co-operation which followed the Ottawa Conference a few years later, brought into being a new type of Imperial organization. A glance at the Council's recent report, which indeed will well repay careful reading, indicates how rapidly the service thus set up has expanded and how clearly it seems in most cases to have met a need.

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* Imperial Agricultural Bureaux, Seventh Annual Report of the Executive Council, 1935–1936. Pp. 102. (London: H.M. Stationery Office, 1936.) 5s. net.

The primary function is information. The world literature on the subject with which each Bureau or Institute deals is surveyed and in the main abstracted. The aim in most cases is to miss nothing, no matter where or in what language it sees the light. The *Veterinary Bulletin*, published by the Imperial Bureau of Animal Health at Weybridge, noticed some 3,000 papers in its last annual volume. Early notice and sufficient detail to be of value to the worker who may be unable to secure or read the original paper are the keynotes of the service, the machinery for which has now been brought in most cases to a high level of efficiency. Special reports, in which the whole of the available literature on some particular subject is digested, are a feature of several of the Bureaux ; technical communications and bibliographies of others. Translations or long abstracts are provided by some, while several maintain lending libraries available throughout the Empire, and all are prepared to answer inquiries to the best of their ability. The two older Institutes are characterized, in addition, by a considerable organization for the identification of insects and fungi.

Visiting parties from the Conference spent much time in examining the work of these ten Bureaux and Institutes, and also in considering the possibilities of extending the organization to cover other fields, especially those of dairy science and forestry. What conclusions have emerged from the subsequent discussions in plenary session will, no doubt, become known in due course. At least one may hope that the report to Governments will recognize how much easier has been made the path of the research worker in many branches of agricultural science in knowing what has been and is being done in his chosen field, and thus set off, against the danger of superficialism to which such 'crammed' knowledge might lead, the increased efficiency that must come from the early and wide dissemination of the results obtained by other workers. It is a fair claim that in this kind of organization the British Commonwealth at present leads the world.

In its touring programme the Conference did not confine itself to these joint enterprises. Several of the agricultural, veterinary and dairying research institutes were visited and also some of those under the Department of Scientific and Industrial Research, and the Imperial Forestry Institute at Oxford. In all cases the inter-Imperial aspects of the work came under notice, but evidently more as a guide to the development of research in the various countries of the Commonwealth, than with a view to the extension of jointly financed research projects. Co-operation in Empire research, as distinct from the documentation of research, is tending more in the direction of interchange of programmes and personnel and the holding of conferences than in centralization of staffs and joint finance. It cannot be doubted that this is a healthy sign of the vigour of scientific development overseas, but it is equally clear that important research work is waiting on facilities that no single part of the Empire has as yet felt impelled to provide. Exceptionally there has been financial co-operation in research schemes on subjects such as the transport and storage of foodstuffs and locust investigations, centred at institutions in England, and proposals were before the Conference for a joint investigation into the control of termites. Usually, however, the investigational work done at a central station in the special interests of an overseas Government is paid for by an *ad hoc* grant from that Government, and such work is necessarily limited to problems on which some institute in the country is already engaged.

Considerable as is the field covered by the inter-Imperial organizations now in being, these limitations in their scope are leaving untouched many fundamental investigations that may not be urgent in any single member of the Commonwealth but are of great importance to the whole.

Another aspect of the Conference that should be mentioned was the emphasis laid on the value of the contacts established through the holding of periodical meetings not only of those charged with the direction of research but also of the actual workers in the different fields of applied science. Imperial Conferences are already held in a few subjects at intervals of five years or so, and an extension of this principle seemed to be indicated. Perhaps the greatest value of the Conference just concluded has been the opportunity it gave to members of getting to know the personalities and interests of their 'opposite numbers' in other parts of the Commonwealth and thus to secure a spirit of co-operation that is beyond the reach of official agencies.

A Social Analysis

The Anatomy of Frustration:
a Modern Synthesis. By H. G. Wells. Pp. 274. (London: The Cresset Press, Ltd., 1936.) 7*s.* 6*d.* net.

TO the generation of readers immediately preceding the Great War, H. G. Wells (as a member of a deputation remonstrated with the Minister of Fine Arts, "On ne dit pas Monsieur Renoir, on dit Renoir") was the great illuminator, revealing the power of science to transform the material world, but on the men of science themselves his action has been different. He has awakened them to a consciousness of social disorder, disorder remediable by the application to mankind of the methods by which science is learning to control the other departments of Nature. In the laboratories either of the universities or the works, in the shops wherever the technicians congregate, the talk and thought are permeated by Wells, even though the participators have never read one of his books. Some of these men get labelled 'communists' because of their impatience with current government by slogans and the canons of good form; others incline to Fascism in the hope that a dictator would get things done. Even Wells has flirted with the Fascist idea of the need of a great man, though his leader would be the entrepreneur who had proved his quality in big business. Whatever the particular manifestation may be, the young workers in science to-day no longer regard 'politics' as unworthy of their interest; they are looking for social reconstruction directed by science, and consciously or not, Wells has been the catalyst that has initiated the reaction.

In this latest book "The Anatomy of Frustration" Wells adopts an odd technique. He puts his opinions into the mouth of Mr. Steele—inventor and business man, who after the War had retired to the south of France in order to sort out his ideas about life. This gives Wells the opportunity of a running commentary and of anticipating in advance the scepticism which is part of the outfit of the man of science. He explains his title; Burton's "Anatomy of Melancholy" was an analysis of the despair with which the thinking man of his epoch must regard the world—a universe wholly and irremediably mad. Steele embarks on his examination of frustration in the modern world with the firm determination that a remedy can be found by the methods he has found valid in that section of which he had experience. He starts with a brave assumption—that all men can and ultimately will think very much alike: "Men have no right to a thousand contrasted faiths and creeds and . . . the multitudinousness of people in these matters is merely due to bad education, mental and moral indolence, slovenliness of statement and the failure to clinch issues"; and so we pass on to a discussion of religion and immortality, and of morality that needs re-expression in terms of daily life.

> "Motives are things of deeper origin than intellectual convictions and the real will of *Homo sapiens* is still largely unaffected by his conscious and formulated wishes. His intentions are one thing; his behaviour quite another. The world's expressed desire, its conscious desire, is such and such; the total complex of human impulses is quite another system, darker, deeper and profoundly more real. These desires for world unity and sane economics are conscious and intellectual desires, and they scarcely penetrate at all into the more primitive and substantial mental mass which is the true reservoir of motives and impulses."

But for all that, Steele is not prepared to yield to the sub-conscious—"The essential purpose of all law, all discipline, all training, is the enthronement of a clear general purpose above a subjugated and directed subconsciousness".

Steele would not be Wells if he did not knock a good many heads along his route; socialism is a case of "habitual piecemeal thinking"; "the Moscow frustration is a study in the deterioration of yet another blazing star of hope"; "the League of Nations recognises, intensifies, and does its utmost to preserve the conventions of nationalism and the emotions of patriotism"; schools and colleges are to this day "conducted to put back the new generation where its parents began". Steele has no use for all sorts of things—The People, Zionism and other separatist movements ("Why specialise in Erin and Mother India and Palestine, when the whole world is our common inheritance. *Come out* of Israel"), Liberalism ("The stupid can co-operate loyally upon immediate objectives; the intelligentzia, it seems, cannot co-operate at all"), and the artistic temperament ("Indulgence of appetites to the detriment of fitness and the distraction of energy").

Is there nothing constructive about Steele? He attaches extraordinary importance to the production of that 'World Encyclopædia' of his. It seems to him that it is "the most urgent need of our time. The main intellectual task of education is to put before the expanding mind everything that is clearly known about the nature of the world in which it finds itself". Of such is to be the new education, and we may suppose that it was under the urge of Steele that Wells set about the "Outline of History", and the "Science of Life", as samples of that great and continuous synthesis the World Encyclopædia is to be. And so Wells ends as he has begun and continued—a solvent and a loosener of mental inhibitions, for until freedom is obtained no orderly co-operation of men with men can proceed. "Fine confused thinking" perhaps, but how stimulating; it is better to clear the mind than to trim it into a system.

A. D. HALL.

Wild Animals at Large

(1) Hunting Wild Life with Camera and Flashlight:
a Record of Sixty-five Years' Visits to the Woods and Waters of North America. By George Shiras, 3d. Vol. 1: Lake Superior Region. Pp. xxiv+450. Vol. 2: Wild Life of Coasts, Islands and Mountains. Pp. x+450. (Washington, D.C.: National Geographic Society, 1935.) 2 vols., 5 dollars.

(2) La vie des animaux sauvages de l'Afrique
Par Dr. Émile Gromier. (Bibliothèque géographique.) Pp. 343+36 plates. (Paris: Payot et Cie, 1936.) 40 francs.

(3) Parade of the Animal Kingdom
By Prof. Robert Hegner, assisted by Jane Z. Hegner. Pp. vii+675. (New York: The Macmillan Co., 1935.) 21s. net.

THE art of the camera seems almost wholly to have displaced that of the pen and pencil in the illustration of popular works on animals, and these three books, dealing with wild life in their own special ways, owe a large share of their attractiveness to the photographs which, apart from a couple of maps and a rough sketch, are their only pictures.

(1) The first is an outstanding work of its kind, and must be looked upon as a classic in the history of wild life photography. Its author, George Shiras, born in Pittsburg in 1859, is the pioneer of American Nature photographers. Laying aside the gun for the camera in 1889 he was, according to E. W. Nelson, former chief of the U.S. Biological Survey, the first to photograph animals from a hide in daytime, to make wild animals take their own photographs by operating the camera shutter during the day and with flashlight at night, to use two flashlights and two cameras so that the first caught the wild creature at rest and the second at the moment of its alarm, and the first to practise wing-shooting by means of a specially mounted camera which enabled him to photograph wild fowl flying at great speed. The cinematograph has displaced the camera for some of these purposes, but it has not done more beautiful work than some of the still pictures made by Shiras with his simpler apparatus.

In other ways the author has been a champion of wild life in the United States: his observations and his advocacy led the movement for the preservation of disappearing birds and beasts and for the establishment of national reserves, as they lay at the foundation of the Federal Migratory Bird Law and the Migratory Bird Treaty in which Great Britain co-operated. The articles which make up these two volumes have appeared from time to time in the *National Geographic Magazine*; here they are revised, with much new matter and previously unpublished photographs added. They are chatty, straightforward accounts of the author's long experience of wild life in various parts of North America, and discuss the habits of a great range of animals. The articles are illustrated by striking photographs, none of which could exceed in beauty the pictures of some of the fungi which accompany the article on "Camp Flowers in Northern Michigan".

(2) Dr. Gromier unites in himself two apparent incompatibles, the enthusiastic protector of wild life whose ardent desire is that the nations should unite to conserve the unique fauna of Africa, and the sportsman who on occasion bags the outstanding trophy when it presents itself. He offers advice to sportsmen on the preparation necessary for long journeys in wild country and on the choice of arms and ammunition, and follows his advice with hints upon the photography and filming of wild animals. Photography bulked largely in his own expeditions, and his photographs, although many show signs of amateurish retouching, add to the interest of the text, and indicate the author's intrepidity in the presence of the most dangerous of Africa's big game.

The author gives vivid accounts of journeys in pursuit of elephant, rhinoceros, hippopotamus, lion, buffalo, eland, giraffe and gorillas. To each of these is given a chapter recounting such habits as came under observation, but the observations do not add much to the already fairly extensive knowledge of the fauna. The author had the good fortune to observe and photograph an albino elephant in Cameroon, and his encounter, twenty-five years ago, must be one of the first records of the nightly nests or platforms of branches built by the gorillas of Kivu, some solitary, some grouped, and some apparently built for two individuals, but all defiled by the excrement of their tenants. An interesting feature is the reproduction of forty-three illustrations showing the spoor of various creatures.

(3) Dr. Hegner's book is of a type different from the two preceding. It is not a work of personal experience, but an account, meant for the layman, of many characteristic representatives of the various groups of animals. The account is systematic in that it follows the recognized sequence from Protozoa to the higher monkeys, but its method is unconventional, and the simplicity and liveliness of its language, the beauty of its photographic illustrations by experts and specialists, and its avoidance of technical terms in description and even in naming (scientific nomenclature is omitted), will commend it to many who wish to obtain an accurate and wide but not technical knowledge of the animal kingdom. J. R.

World Weather

Manual of Meteorology
By Sir Napier Shaw, with the assistance of Elaine Austin. Vol. 2: Comparative Meteorology. Second edition. Pp. xlviii+472. (Cambridge: At the University Press, 1936.) 36*s*. net.

THE four volumes of Sir Napier Shaw's monumental "Manual of Meteorology" bear the titles: (1) "Meteorology in History"; (2) "Comparative Meteorology"; (3) "The Physical Processes of Weather"; (4) "Meteorological Calculus: Pressure and Wind". Vol. 2, which after eight years now appears in second edition, gives in a descriptive form our present-day knowledge of the weather all over the world. Sir Napier's comprehensive view of this subject has taken its most perspicuous form in a great number of charts dealing with the entire earth, in most cases given in polar projection for the northern and the southern hemisphere separately. These charts have since their appearance in 1928 exerted a great influence upon the views of meteorologists, and selected samples of them have been reproduced in more than one of the text-books published since that date.

Referring to the great amount of new observational data which has become available during the last eight years, Sir Napier says in his preface: "A complete revision of the representation of meteorological data from the point of view of 1935 instead of 1927 is not possible". As regards diagrams and charts he has, therefore, with good reason limited his efforts to correcting errors and omissions, and substituting a small number of new figures for old ones. The most important new features are discussed in a concluding chapter of "Notes and Supplementary Tables". Characteristic of Sir Napier's sense of humour, this exceedingly useful chapter is headed by the device: "The end must justify the means". These notes show as a matter of fact how Sir Napier still follows with the keenest interest the progress of his science in every detail.

After consideration in Chapter vii of changes in the general atmospheric circulation, Chapter viii and the subsequent chapters deal with the description of the transitory changes in weather conditions, including the description of cyclones and anticyclones. This is a field of rapid scientific progress, and here the greatest changes in the new edition are found. I believe that I can see one of the leading ideas of Shaw's own work reflected in his description of Sir Francis Galton's admirable contribution to the study of transitory changes. On p. 374 we read these characteristic lines, which appear for the first time in the new edition:

"The possibilities of these records have never been explored but their use still remains an obvious responsibility to British meteorologists. It is rather pathetic to remember that after reproducing actual curves for twelve years with all the machinery for continuing the practice the experts at the time preferred the tabulation of five-day means of hourly values and the passing of the original curves through a mechanical harmonic analyser. Every page is suggestive to those who have opportunity of studying it."

I would give these words my full approbation. Sir Francis Galton's records (*Quarterly Weather Report* for the years 1869–80) are a gold-mine which has remained almost unexploited. As an example how they may inspire useful work even to-day, I may refer to a note just recently published by Dr. T. Bergeron, "L'Utilisation des 'Météorogrammes' pour les recherches synoptiques" (*Assoc. Meteor. l'U.G.G.I.*). Speaking of the Galton records he says: "Voila la plus admirable publication de données météorologiques existante !"; and he justifies these words by giving some examples of how the results found in recent years by the highly developed modern weather-chart analysis might have been found with greater ease sixty years ago by the Galton records combined with the weather charts of those days.

But meteorologists did not find this most direct way. The method of averaging directed attention away from the minute examination of individual cases. It is a great merit of Sir Napier that, in spite of all, he never lost his interest for the individual case. He succeeded in understanding the records more fully than his predecessors. A typical protest from his side against the tendency of making all characteristic features disappear by the formation of averages is represented by Fig. 218 (Fig. 211 of the first edition), showing his view of the structure of a cyclone. I have always admired this figure, which appeared almost as a joke, and which ultimately has showed itself to contain so much of concealed truth.

Readers of Sir Napier Shaw's "Manual" will find a special charm in the bold but striking statements so frequently met with in all his writings. The reading of the more than 1,500 pages of his great work, therefore, never becomes dull. This is certainly one of the reasons why the second edition comes so soon after the first one. Sir Napier Shaw is to be most heartily congratulated on the well-deserved success of his great work.

V. BJERKNES.

Geography and Distribution

Plant and Animal Geography

By Dr. Marion I. Newbigin. Pp. xv+298. (London: Methuen and Co., Ltd., 1936.) 12*s*. 6*d*. net.

BY the death of Dr. Marion Newbigin in 1934, geographical science suffered a serious loss. Fortunately her book on biogeography was being prepared for the press, and with the co-operation of Miss Florence Newbigin and Prof. H. J. Fleure, who revised the work, it has now been published.

On such complex problems as the distribution of animals and plants, and the means by which it was brought about, Dr. Newbigin was able to take a broad outlook. Her view was almost detached. She possessed a certain clarity of mind, which enabled her to distinguish between general principles and details; and a power of lucid expression rare among scientific writers. The result is this clear and readable book.

To the student of distribution, one of the main difficulties to a clear understanding of the problem is the fact that, while the geographical causes (in the strict sense) remain constant, the results are very different, mainly owing to the different means available for dispersal. That is to say, the same barriers, ocean, desert, mountain range, and the same land bridges, exist for animals as for plants; yet they operate in very different degrees. Nevertheless, we should expect to find some correspondence at least between the distribution of animals and plants; and it is this which Dr. Newbigin brings out clearly.

Beginning with a general description of the higher forms of life in relation to environment, the author passes on to an outline of taxonomy—not in itself a concern of the geographer—and thence to a description of the principal plant communities with their animal complements. These studies prepare the student for the most important chapters in the book, those dealing with the major faunal and floral regions of the world. Here Dr. Newbigin is at her best. She tries, with considerable success, to reconcile the divergent views of botanists and zoologists as to the main biogeographical regions, while recognizing that complete reconciliation is not possible. As she points out, there is not the same unanimity among botanists that there is among zoologists as to how the earth should be divided. Even if the former confines himself to the flowering plants, his present material is enormous, and the geological record less perfect than it is for mammalian remains. With regard to this last, however, the author is perhaps unduly pessimistic. The fact that there are vastly more flowering plants than there are mammals, while making the problem more difficult, increases the chance of fossil remains being found; and it would indeed be strange if plants—even herbaceous ones—had failed to leave clues which the ingenuity of scientific investigators could follow up. One key to the identification of recent floras has been found in their seeds; and the work of Mrs. E. M. Reid on Pliocene floras in western Europe confirms that of other palæobotanists that, since Tertiary times, plants, like animals, have followed a general southerly direction. It is possible that we know almost as much about Pleistocene floras in Europe as we do of Pleistocene mammals.

In stressing the importance of mountain barriers, such as the Himalaya, to animal and plant migration, the author is apt to overlook the fact that, so far as plants are concerned, they act as carriers as well as barriers. The east to west distribution of alpine plants is to be ascribed to the great Tertiary uplifts of Eurasia; and this movement has to some extent masked the north to south movement, further complicating the problem for the botanist. But the Himalaya was certainly most effective as a barrier just at the most critical time, namely, during the glacial epoch, when great numbers of species which might otherwise have made good their escape southwards, found their way barred, and perished. Almost unconsciously, as it appears, Dr. Newbigin pays tribute to the general truth of Willis's 'Age and Area' hypothesis; for on p. 216 we read: "Thus the problem of distribution for any type seems to resolve itself into the time factor, the length of time which has elapsed since its origin, and the checking factor . . ."

In the opinion of the reviewer, this is the best general account which has appeared for some years of plant and animal distribution, its causes and consequences. The book is well printed and adequately illustrated; although it might be as well to add a map in any future edition showing at least the fourteen botanical regions commonly accepted by geographical botanists. Only the expert can correlate these for himself with the zoological map facing p. 244.

Mélanges Pelseneer

Mélanges Paul Pelseneer
(Mémoires du Musée Royal d'Histoire Naturelle de Belgique, Deuxième Série, Fasc. 3). Pp. ii+1206. (Bruxelles: Musée Royal d'Histoire Naturelle de Belgique, 1936.) n.p.

THIS handsome volume, containing contributions from among the most distinguished of his fellow workers in eleven countries, is dedicated to the eminent zoologist Paul Pelseneer "en témoinage de profonde reconnaissance et de respectueux admiration". Although he is pre-eminently a malacologist, his interest in all aspects of zoology is well known, and there are few groups in which he has not worked. A knowledge of this interest is manifest in the wide range of subjects chosen by the sixty-six authors represented, for nearly every animal group is included, from Protozoa to man, and each contributor choosing the subject specially his own in many cases has chosen one already in some measure touched upon by his illustrious colleague.

Not only in malacology but in the general papers also this interest is felt. Strohl's work on bipolarity is a case in point, and the paper by Pérez dealing with the influence of trematode sporocysts on the genital glands of *Turritella* recalls to us the fact that Pelseneer has himself investigated the larval trematodes parasitizing various molluscs, and has recorded several new species. In this connexion also comes Van den Berghe's ecological account of Congo molluscs as hosts for trematode cercariæ. It is the same with the Crustacea. Among the four papers dealing with this group, Redeke, in his research on *Atyaephyra desmaresti*, follows in the footsteps of Pelseneer, who was the first naturalist to record this species from Belgium.

Naturally the molluscs predominate, twenty-four of the contributions being devoted to them. To select two bearing specially on Pelseneer's own work we may mention Odhner's extensive paper on the Nudibranchia Dendronotacea, emphasizing our indebtedness to that author's exact investigations which afford such a solid basis for a modern natural classification, and Orton's observations and experiments on sex-change in the European oyster *Ostrea edulis*, in which he acknowledges "inspiration and advantage from this distinguished and honoured colleague". Yonge, on the evolution of the swimming habit in the Lamellibranchia, has chosen a subject peculiarly his own; and Navez, in his observations on the cardiac rhythm of *Anomia simplex*, offers a very interesting subject in a totally different field.

Four papers deal with echinoderms. Here Hörstadius's "über Heterosperma Seeigelmerogone" stands out. His beautiful and exact work, entailing the finest microtechnique, is well known, and needs no introduction here.

Physiology, embryology, ecology, morphology and systematics all have their share of attention, both in the mollusca and elsewhere. It is, however, impossible to mention them all in so short a space. All are valuable and interesting, and the whole volume is well got up and well illustrated.

(1) Botany for Children

By Lady Elphinstone. Pp. iv+160+12 plates. (London: Burns, Oates and Washbourne, Ltd., 1936.) 3*s*. 6*d*.

(2) The Junior Gardener

By Harriet Price. Edited by Walter P. Wright. Pp. xii+134+4 plates. (London: J. M. Dent and Sons, Ltd., 1936.) 5*s*. net.

THAT the child is indeed father of the man is being made increasingly obvious by the findings of modern psychological research. Any books, therefore, that aim at awakening in the developing child a sincere interest in a human activity so worth-while as the study and cultivation of plants are to be welcomed.

(1) In "Botany for Children" Lady Elphinstone revives a method of exposition very popular in the early part of last century. Jean, Mary and John, three inquiring children, learn about the characters of British plants from the lips of Dame Nature. The idea is, on the whole, well carried out; but the terms order, family, genus and species are used exceedingly loosely throughout the book. There are line block and coloured illustrations, the latter being arranged on a novel plan. The whole plant (including root) is shown against a background of its usual habitat, with a single fruit inset in one corner. On the whole, the paintings are accurate and give a fairly good impression of the plant.

(2) "The Junior Gardener" is written to help boys and girls who are taking up practical gardening for the first time, whether at home or at school. It tells in simple language how to carry out the various basic operations of gardening, and is fully illustrated with diagrams, drawings and coloured plates. The author has had personal experience of the problems of school gardening, and the chapter devoted to that subject should prove one of the most valuable in this well-planned and well-written book. J. S. L. G.

Mercury Arc Rectifier Practice

By F. C. Orchard. Pp. xi+224+23 plates. (London: Chapman and Hall, Ltd., 1935.) 15*s*. net.

DURING recent years there has been an increasing demand for machines and devices which will convert alternating currents into direct currents. Bulk supplies are usually given by alternating currents, but for some supply networks and for traction, direct currents are required. In these circumstances, devices such as machines called rotary converters, or stationary apparatus utilizing a physical property of electrolytes—electric arcs, gas discharge tubes, etc.—are employed. The latter kinds of apparatus are called rectifiers and are of many types utilizing very different physical phenomena.

Most books on rectifiers devote much time to explaining the mathematical and physical theories on which the working of the various kinds of rectifiers is based. To the men who have to instal and operate the glass bulb and steel tank types of mercury arc rectifiers used commercially for service on public supply systems, on railways and for industrial purposes generally, a book that will assist them in their daily work is required, and we think that they will find the book under notice a real help.

Handbuch der Geophysik

Herausgegeben von Prof. Dr. B. Gutenberg. Band 1, Lief. 3: Breitenschwankungen, von Prof. Walter D. Lambert; Theorie des irdischen Schwerefeldes, von Prof. E. A. Ansel. Pp. iv+501–730. Lief. 4 (Schluss des Bandes): Beobachtung der Schwerkraft; Die Lotabweichungen; Das Problem der Isostasie. Von Prof. Dr. W. Heiskanen. Pp. 731–970+xv. (Berlin: Gebrüder Borntraeger, 1934, 1936.) 31 gold marks each part.

DR. LAMBERT's account of the variation of latitude is good, but a little too brief. Ansel on the theory of the gravitational field is mostly excellent, and so is Heiskanen on observations of gravity, pendulum deflections, and isostasy. Ansel claims to have detected an algebraical error in Darwin's theory of the figure of the earth, which affects the sign of the term in $\sin^2 2\varphi$, and he is apparently supported by Heiskanen. Here I think Darwin is right. One misses an account of the important work of de Sitter and his colleagues. Such omissions, however, are very few. These parts complete vol. 1 of the "Handbuch"; vols. 2 and 4 are already complete. H. J.

Lessons in Elementary Analysis

By Dr. G. S. Mahajani. Second edition. Pp. xii+264. (Poona: Aryabhushan Press, 1934.) n.p.

THIS book, first published in 1929, is designed to cover the analysis required for the bachelor's degree in most of the Indian universities. It deals mainly with the theory of number, in which there is an interesting examination of Dedekind's method; the theory of limits; infinitesimals and continuity; the mean value, Maclaurin's and Taylor's theorems; Riemann integration; infinite integrals, uniform convergence and Fourier series. There is also a useful addendum on beta and gamma functions, power series, the application of Taylor's theorem to functions of several variables, Euler's theorems on homogeneous functions and Young's theorem on implicit functions.

Each chapter contains a set of exercises for the student, and the text is thoroughly well written, the exposition of difficult points being exceptionally clear. The book should serve admirably the purpose for which it was written.

Praktische Übungen zur Vererbungslehre:

für Studierende, Ärzte und Lehrer. Von Prof. Dr. Günther Just. Zweite vermehrte und verbesserte Auflage. Teil 1: Allgemeine Vererbungslehre. Pp. vi+137. (Berlin: Julius Springer, 1935.) 6.90 gold marks.

ALTHOUGH small, this compactly produced book contains a well-arranged exposition of methods in genetics. While mainly devoted to statistical methods, it includes measuring instruments, the technique of breeding *Drosophila*, and different types of mouse cages. The statistics deal with continuous and discontinuous variation, the binomial curve, correlation tables, back-crossing, sex-linked characters, the testing of Mendelian ratios, the χ^2 test and other methods commonly used by geneticists.

Trends in Modern Physics*

By Prof. Allan Ferguson

THE world-picture of the older generation was, as we look back on it to-day, extraordinarily simple. It is, or has been, the fashion to describe nineteenth-century science as materialistic. There certainly was Buchner, and there was Tyndall's Belfast address. But *Dr. Stoffkraft* had neither a long reign nor an influential following, and we shall be nearer to the truth if we look upon Victorian science as showing a simple realism—the realism of the man in the street—not wholly unrelated to that simple realism of to-day which sees in an alpha-ray track evidence for the existence of an atom, of the same order as that furnished by a diffraction photograph (or, for that matter, by our own eyes) for the existence of a star.

What we have learned to call the classic outlook was based on those notions of velocity, acceleration, momentum and force which were first formed into an ordered scheme by the genius of Newton—a scheme which sufficed to describe, succinctly and clearly, the series of perceptions involved in such phenomena as the motion of a pendulum, a billiard ball, a railway carriage, and (with certain reservations concerning fine points) the complex motions of the bodies of the solar system. The physical science of the eighteenth and nineteenth centuries was occupied in extending and clarifying these concepts, although eighteenth-century science in England was hampered by an excessive devotion to the memory of Newton, which committed the English mathematicians to the fluxional notation. It required the formation of a society at Cambridge "to inculcate the principles of pure *d*-ism, and to rescue the University from its *dot*-age", before the British physical school could rival the advances of their Continental brethren.

As we have said, the attitude of the physicist to the fundamentals of his science was, in general, naïvely realistic. Mass was quantity of matter, and matter itself was defined as "that which can be acted upon by, or can exert force", or alternatively "that which may have energy communicated to it from other matter". *Obscurum per obscurius*, with a vengeance!

Quantitatively, mass was defined, following Newton, as the product of volume and density; and even Thomson and Tait are roused to a hint (without attempting to resolve the difficulty) that such a process results in a circular argument, inasmuch as we have no other way of defining density than as the ratio of mass to volume.

Early in the nineteenth century, discoveries, mainly in the realm of chemistry, gave fresh interest to atomic doctrines, and the simple concept of the billiard-ball atom proved to be brilliantly successful in explaining old happenings and in predicting new ones. It is not immediately obvious that an extrapolation of those laws which describe the motions of bodies of the dimensions of a locomotive or a planet down to bodies of the indescribably minute dimensions given to an atom or molecule is likely to be successful in subsuming certain perceptual events; the extraordinary thing is, not that such an extrapolation should break down somewhere, but that it should have any validity at all; and the triumphs to be put to the credit of the hypothesis are sufficiently remarkable, as any treatise on the kinetic theory of gases will testify.

No survey of the physical science of the last generation would be complete did it contain no reference to radiation and to the nineteenth-century concept of the mechanism by which radiation is conveyed. Despite the difficulty of framing a theory of the ether which should satisfy dynamical laws—"Why should it?" we might remark incidentally to-day—the concept of an ether of space was so brilliantly successful in correlating and predicting so many and so diverse phenomena—we need but instance that bending of light round corners which we call diffraction, that alternate heaping up and destruction of light which we term interference, and that remarkable refraction of a ray of light by certain crystals as a cone of rays—as to draw from Lord Kelvin the downright statement, "This thing we call the luminiferous ether . . . is the only substance we are confident of in dynamics. One thing we are sure of, and that is the reality and substantiality of the luminiferous ether". Strange reading, to-day; and reading which might well introduce a note of hesitation into some of the confident declarations of present-day realities.

Molar mechanics, the billiard-ball atom, the ether: the nineteenth century had built on these apparently stable foundations an immense structure of ordered knowledge. The closing years of the century were fated to show cracks in the superstructure and weaknesses in the foundations.

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* From the presidential address to Section A (Mathematical and Physical Sciences) of the British Association, delivered at Blackpool on September 11.

The facts of radioactivity and the discovery of the electron showed that the concept of the atom must increase in complexity were it to remain competent to subsume the additional perceptual facts ; and the experimental study of the radiation from a hot body revealed a state of affairs inexplicable on the lines of classical theory, as did the investigation of the phenomenon known as the photo-electric effect.

It is unnecessary to tell in detail the story of the introduction into physical science of the revolutionary notion of quantization ; of the concept of the nuclear atom ; of the rationalization of the facts of spectroscopy by the application of quantum ideas to the nuclear atom ; of the breakdown of this latter concept when applied to atoms more complex than a single electron system ; of the building up on quasi-empirical lines of a vector model of the atom which should be capable of providing an explanation for the complex facts of spectroscopy ; of the further emphasis placed on that dualism of outlook which appeared so early in twentieth-century physics by the discovery of the Compton effect and by the investigation of electron-diffraction and of molecular-ray diffraction ; and of the impending disappearance of that dualism under the impact of the analysis of the last decade.

Atomum expellas furca—and there is something appropriate in giving such a designation to a Ψ-function—*tamen usque recurret.* If two of the high lights of twentieth-century physics are provided by the introduction of quantum ideas and by the identification of mass and energy, a third is provided by that remarkable rain of sub-atomic particles which has increased incredibly in intensity since the discovery of the electron more than a generation ago, and has provided opportunities for nucleus-building of which theorists have not been slow to make use.

By nothing has the world-picture of to-day been so transformed from that of a generation—nay of a decade—ago than by the introduction of the uncertainty principle and by its effect on our notions of causality.

It can be shown that of two conjugate quantities —time and energy, or position (x) and momentum (p)—the product of their uncertainties of determination can never be less than the quantum h. Thus an increase in the accuracy of the determination of one quantity necessitates a corresponding decrease in the accuracy of the conjugate quantity, and in particular the exact determination of one quantity leaves the other completely undetermined. An attempt to determine the position of a particle involves its illumination by light of suitable wave-length, and decrease of the wave-length in order to improve the definition of its position involves an increase in the magnitude of the recoil due to the Compton scattering process.

Following a suggestion of Dr. H. T. Flint, let us fix our attention on the quantities position and momentum, and consider a co-ordinate system in which momentum (p) is plotted along one axis and position (x) along the other. The co-ordinate space gives us the possible simultaneous values of x and p. Suppose this space divided into rectangles each of area h. Then the uncertainty principle, which asserts that the product ($\delta x \delta p$) of the uncertainties of the determination of position and momentum can never be less than h, may be illustrated by resuscitating Maxwell's demon and permitting him to push a point about at will within any one of the rectangles. The movement of the point, that is, the corresponding changes of position and momentum, will not be detected, for they do not correspond to any detectable change in the world of sense.

Unfortunately the word 'indeterminism', which has other connotations, has become associated with the statement of the principle. Many will recollect Clerk Maxwell's immortal account of the proceedings of Section A at the Belfast meeting of the British Association sixty-two years ago, when Mr. Herbert Spencer regretted "that so many members of the Section were in the habit of employing the word Force in a sense too limited and definite to be of any use in a complete theory of evolution. He had himself always been careful to preserve that largeness of meaning which was too often lost sight of in elementary works. This was best done by using the word sometimes in one sense and sometimes in another, and in this way he trusted he had made the word occupy a sufficiently large field of thought".

Is it heresy to suggest that some of us who have sung canticles in praise of indeterminism and the disappearance of causality have given a similar generousness of meaning to these words ?

Similar considerations apply to the term *observable*, which has suffered a sea-change in transference from its ordinary usage in the realms of perception. There is quite as much complicated physical theory lying between the perceptually observable marks on a photographic plate and the inferred frequencies, as there is between similar perceptual observables and the non-observable electron orbit or state which was inferred in order to subsume the perceptual facts. A similar generosity of treatment is accorded to the term *observe* when it is applied to the conceptual experiment for the determination of the position of a particle such as an electron.

Which brings us round to the starting-point of this discourse. Many of us who desire to proceed with our measurements untrammelled by these philosophic doubts have asked if there is not some canon by which the plain man could test his everyday beliefs. I suggest that a starting-point at least to this end is provided by a study of Karl Pearson's work, and that, with certain reservations and additions to the method discussed in the "Grammar of Science", we may develop a canon which will serve as a guide through the jungle of additional perceptual facts which the physical science of the twentieth century has added to that of its predecessors.

Those who discuss the doctrine of causality do so with little reference to the attitude taken by the philosophers, and it may not be without interest—it certainly has some bearing on present-day thought—to consider the development of the notion of cause since the time of Newton. The views of Locke, Newton's elder contemporary, are clear and simple. He remarks: "Thus, finding that in that substance which we call *wax*, fluidity, which is a simple idea that was not in it before, is constantly produced by the application of a certain degree of heat, we call the simple idea of heat in relation to fluidity in wax the *cause* of it, and *fluidity* the effect. . . . So that whatever is considered by us to conduce or operate to the producing any particular simple idea, whether substance or mode, which did not before exist, hath thereby in our minds the relation of a cause and so is denominated by us".

Newton, dominated as he was by the principle of causality and ever searching for a clear physical picture of the results of his investigations, was capable of a philosophic breadth of view which needs surprisingly little modification to-day. He makes, for example, a physical picture of matter as formed in "solid, massy, hard, impenetrable, moveable particles", and assumes that they have not only a *Vis Inertiæ*, but are moved by certain active principles, such as gravity. These principles are to be considered "not as occult qualities . . . but as general Laws of Nature . . . their Truth appearing to us by Phænomena. . . . To tell us that every Species of Things is endowed with an occult specifick Quality by which it acts and produces manifest effects, is to tell us nothing; but to derive two or three Principles of Motion from Phænomena and afterwards to tell us how the Properties and Actions of all corporeal Things follow from these manifest Principles would be a very great step in Philosophy, though the Causes of those Principles were not yet discovered; and therefore I scruple not to propose the Principles of Motion above mentioned, they being of very general extent, and leave their Causes to be found out". Evidently Newton takes the view that we have made an important step forward when we have subsumed a number of perceptual facts under a general formula.

It is to Hume, though he may owe something to Glanvil and other predecessors, that we are indebted for a clearly ordered statement of the experientialist doctrine of causation. The generalization, for example, that the earth attracts a stone is explained as a generalization from thousands of observations. "Adam . . . could not have inferred from the fluidity and transparency of water that it would suffocate him, or from the light and warmth of fire that it would consume him. No object ever discovers by the qualities which appear to the senses, either the causes which produced it or the effects which will arise from it; nor can our reason, unassisted by experience, ever draw any inference concerning real existence and matter of fact".

Mill further developed the experientialist doctrine in the statement that the law of causation "is but the familiar truth that invariability of succession is found by observation to obtain between every fact in nature and some other fact which has preceded it, independently of all considerations respecting the ultimate mode of production of phenomena, and of every other question regarding the nature of things in themselves". To the doctrine of succession in this simple form the objection has been urged that day may be regarded as the cause of night and conversely. Mill meets this objection by pointing out that invariable sequence does not necessarily involve causation. To involve causation the sequence must not only be invariable but also *unconditional*. The day-night sequence is conditioned by the sun and so does not conform to this test. "We may define, therefore, the cause of a phenomenon to be the antecedent, or the concurrence of antecedents, on which it is invariably and unconditionally consequent".

It is difficult to sum up Pearson's attitude to the problem of causality and to the general problem in a few sentences. Perhaps Kirchhoff's dictum concerning mechanics: "Die Mechanik ist die Wissenschaft von der Bewegung; als ihre Aufgabe bezeichnen wir: die in der Natur vor sich gehenden Bewegung *vollständig* und *auf die einfachste Weise* zu beschrieben", touches very nearly the root of the matter.

We live, in fact, amid a mass of perceptions; and it is the business of physical science to correlate, in as simple a fashion as may be, a certain section of these facts. To this end the physicist devises a *conceptual* world of atoms and molecules, from which he builds up a system—a world-picture—of molar masses whose motions correspond to the routine of our sense impressions. Given a frame of reference, we can formulate laws of motion for two isolated particles in a conceptual world which may be summed up in the statement that whatever be the positions and velocities of the particles the ratio of their accelerations is always constant; this ratio is defined as the inverse mass-ratio of the particles; and in virtue of this we have the relation that—

Mass of A × acceleration of A = mass of B × acceleration of B.

We give the name *force* to this product, and hence obtain the law that action and reaction are equal and opposite. On the basis of such definitions we can build up a structure of bodies in the conceptual world the motions of which, predictable under the descriptive laws formulated, will agree with the routine of our world of sense perceptions. We have, in fact, *explained* certain phenomena.

There is, of course, no logical reason why, in this description, we should stop short at the second derivative—acceleration—or go forward to it for that matter. We are concerned to find the simplest and most consistent explanation, and this procedure provides it. Indeed something of æsthetics may also influence our choice.

The atom, whatever its complexity, whether the concept remains sharp as that of a billiard ball or a miniature solar system, or whether its outlines disappear in a probability-smear, remains a *concept* outside the realm of perceptual happenings which it is the business of the concept to correlate. It may or may not emerge into the perceptual world; unless and until it does, discussion of its reality is beside the mark.

Planck, defining the causal condition in the statement that an event is causally conditioned if it can be predicted with certainty, goes on to remark that the possibility of making a correct prediction has not to be interpreted as anything more than a criterion for a causal connexion, but that the two do not mean one and the same thing. Day is not the cause of night, although we may be able to predict the advent of night in the daytime. Day is, therefore, a causally conditioned event.

Taking the definition as it stands, we find that in the realm of quantitative physical events we cannot, purely as a matter of measurement, predict *accurately* in advance any one physical event—this, without introducing quantum considerations. Prof. Planck escapes from the indeterminist position by transferring the definition to a conceptual world in which exact measurements may be made and events correctly predicted. He assumes, in fact, in its broad outlines, the thesis of the "Grammar of Science". He thus retains the principle of causality, as defined above, in the happenings of the conceptual world, remarking that the relation between events in the perceptual and conceptual worlds is subject to a slight inaccuracy.

The introduction of Heisenberg's uncertainty principle necessitates a corresponding process in dealing with perceptual problems from the point of view of quantum physics. A conceptual world of quantum physics is framed in which a strict determinism reigns. True, the world has not so many points of resemblance to the perceptual world as had the older schemes—billiard-ball and solar-system atoms have disappeared, and the wave-function, which does not refer to ordinary space, is not so easily interpreted in terms of the world of sense. But the philosophical problem of the transfer is the same.

Whatever the form of the picture, the hard-pressed physicist of to-day remains on firm ground if he refuses to confuse the concept—the world-picture—with the percept; if, making this distinction, he studies the question of the reality underlying phenomena as philosopher rather than as physicist; if he is as ready to discard outworn models as ever Maxwell was.

There is no finality in these matters, and solutions of these difficulties are solutions for a day; but it is interesting and heartening to know that Planck, the initiator of the movement which has revolutionized physical thought, has, a generation later, pointed a way to a resolution of the fundamental doubts and difficulties which his genius has raised.

. . . . .

Of recent years the British Association has concerned itself more and more with a study of the repercussions of the advancement of science on the fabric of our society. Never in the history of mankind have more powerful weapons for good and for evil been placed in the hands of the community as a direct result of the growth of scientific knowledge; and never has it been more necessary for the scientist to develop some awareness of the effects of his activities on the well-being of that community of which he himself is a responsible member.

We are most of us ready enough to discuss the "Impact of Science on Society", so long as we restrict ourselves to an enumeration of the benefits which science has bestowed upon mankind; and on occasion we may make a rather snobbish distinction between cultural and vocational values. But we have to remember actively that there are dysgenic applications of scientific knowledge, and if the scientist claims, as he rightly does, that place in the counsels of the nation which the importance of his work warrants, he must cease his worship of what Prof. L. Hogben calls the "Idol of Purity", must be prepared to discuss all the social implications of his work and to educate himself, as well as his less fortunate brethren trained in the humanity schools, in a knowledge of these implications.

The British Association is peculiarly fitted to develop and discuss such knowledge ; in Section A we have made a beginning, but we have as yet touched on but few of these interactions. Our steps are naturally at first a little halting, but with increasing knowledge there will come, I trust, an increased power in elucidating those complex and difficult social problems which the astonishing developments of the last generation have forced on the civilized world.

Science and the Poultry Industry

THE claim of the poultry industry to rank as the third largest branch of British agriculture, when judged by the value of its output, will scarcely be questioned by the visitor to Blackpool for the recent meetings of the British Association. Over the greater part of the County Palatine through which he travelled, the fortunes of farming are based largely upon cows, poultry and pigs, mainly in the order given, whilst the more immediate hinterland of Blackpool is thickly studded with specialist poultry farms. On arrival he would not have been surprised, therefore, to find from his programme that two sections of the Association had thought it worth while to devote a whole afternoon to a joint session for the discussion of problems of the poultry industry, and that further, provision had been made for an external lecture at a rural centre, Poulton-le-Fylde, on the same subject.

For this latter purpose no choice could have been happier than that of Mr. Percy A. Francis, the Poultry Commissioner of the Ministry of Agriculture, who combines unique opportunities of observing the progress of the application of the various sciences to the practice of poultry husbandry with a flair for the exposition in simple terms of his observations that is widely appreciated throughout the industry.

Mr. Francis' survey of the applications of science to the poultry industry necessarily covered a wide field, since in no branch of livestock husbandry are the needs of scientific guidance so varied as in the poultry industry of to-day, with its systems ranging between the two extremes of the open pasture and the intensive 'battery'. At every stage—mating, incubation, rearing, laying, fattening—and in every phase of management—feeding, housing, hygiene, disease control—the keys to success have scientific wards, and the ultimate result is largely affected by the degree to which fundamental scientific postulates have been respected or ignored.

In view of the popular conception of the farmer as being too slowly responsive to the aid of science, it will come as a surprise to many to learn that Mr. Francis is inclined to suggest that some part of the present troubles of the industry on its production side may be traceable to over-haste and ill-informed zeal on the part of the poultry farmer in the incorporation of scientific discoveries into his practice. That there is substance in this suggestion can scarcely be doubted. In the application of new ideas to the development and management of the animal, an immediate improvement can only be accepted as desirable if it is not offset by an ultimate disadvantage of more serious import. Where the animal is used as a breeder, this disadvantage may not be evident until the third or fourth generation or even later. With an animal that grows and multiplies slowly, like the bovine or the human being, the deterioration may indeed cover so long a period of years as to escape detection unless the most careful and prolonged records are kept ; but with a species that grows and multiplies so rapidly as the fowl, the penalty is likely to fall more swiftly, and moreover to be far more widespread in its incidence.

For any errors committed by the poultryman in this respect, the scientific investigator must accept a share of blame, in that all too often he has not made sufficiently clear to the layman that his new discovery, though the latest, is almost certainly not the last word on the subject, and therefore does not justify the poultryman in dissolving completely the partnership with Nature, which hitherto has helped to make good the defects of the combined knowledge of farmer and scientific adviser.

Nowhere has the great advance in our knowledge of animal nutrition furnished by the discovery of vitamins and the study of mineral requirements been more strikingly exemplified than on the poultry farm ; nowhere has the incompleteness of our extended knowledge been more clearly demonstrated.

The major problem with which the industry on its production side is now faced is that of the rising rate of mortality amongst adult stock. There can be little doubt that this is in part only a manifestation of the general tendency for increasing loss to occur from diseases and other causes when a population is allowed to grow very rapidly without the coincident development of an efficient 'public health' service. The major causes must probably, however, be looked for in other directions, since the great increase in the poultry population between 1918 and 1928 was not accompanied by any serious rise of mortality. Some are inclined to look upon the present troubles of the industry as the harvest of seed sown in that earlier boom period, when possibly the industry expanded faster than its capacity to supply itself with sound breeding stock ; others place the major blame upon excessive resort to 'intensive' methods—too much science ! Still others find a partial explanation in the all too easy dissemination of stock from uncontrolled breeding centres. Wherever the cause may lie, be it in breeding, incubation, management, disease control, or any other part of the field of the poultryman's activities, the need for a combined attack upon the problem is now clamant. Practice alone is unlikely to prove capable of finding a solution ; to the scientific investigator, a vast field of service is open in which the rewards, both to the individual and to the nation, are great and certain. C. C.

Obituary

Prof. R. C. J. Howland

RAYMOND CLARENCE JAMES HOWLAND was born in Fulham on June 5, 1896, and was educated at Latymer Upper School, Hammersmith (1907–15). In December 1914 he won an open scholarship at Emmanuel College, Cambridge, and went into residence in October 1915. After two terms, an attempt to join the O.T.C. having failed on account of defective eyesight, he nevertheless succeeded in enlisting as a gunner in the R.G.A. in March 1916, went to France and served through the rest of the War, returning to Cambridge at the beginning of the Easter term 1919. Although he obtained a first class in Part I of the Mathematical Tripos and was a wrangler in 1920, the handicap due to the interruption of his studies by the War prevented him from taking Schedule B, and debarred him from opportunities which should normally have been open to one of his mathematical ability. In consequence, he went down from Cambridge after taking his degree in 1920 and spent a year in school-teaching at Berkhamsted.

While in Cambridge, however, Howland had prepared for the London external degree, and took his B.Sc. in 1921 with first class honours ; this was followed later by the M.Sc. (1922) and by the D.Sc. (1930).

Fortunately, the openings not available to him in Cambridge were found elsewhere, and, in September 1921, Howland was appointed lecturer at the City and Guilds Engineering College, where he remained for two years. It was there, working under the influence of Prof. H. Levy, that he completed his first piece of mathematical research on "Vortex Motion behind a Circular Cylinder", published in the *Journal of the Royal Aeronautical Society* (1925). His first work to be actually published, however, was a paper on "Transverse Oscillations in Girders" (Institution of Civil Engineers, 1924).

By this time, Howland had obtained (October 1923) a senior lectureship at University College, London, where, although more specially in charge of the teaching to engineering students, he shared in the general work of the Mathematics Department. That he found the atmosphere congenial is shown by the fact that, during the eight years he was at University College, he produced no less than eleven papers, some of outstanding importance.

Howland's scientific interests were almost exclusively directed to problems of classical mechanics, particularly hydrodynamics and elasticity, with engineering applications. Several of his papers deal with rotating shafts, a subject to which he made serious contributions. Here and there we find papers, for example, on determinantal equations and on harmonic and biharmonic periodic functions, which prove that his abilities would have found scope equally on the side of pure mathematics. The work for which he will be best remembered, however, is his solution for an elastic strip of finite width with one or more circular holes, to which he devoted a series of papers in the *Transactions* and *Proceedings of the Royal Society*, either alone or with co-workers. His last paper on this subject was published in 1935, but the fundamental step, namely, the discovery that he could evaluate the troublesome double integrals occurring in the investigation by changing the order of integration, will be found in the first paper of the set (*Proc. Roy. Soc.*, A, **124** ; 1929).

Shortly after publishing this, Howland was appointed (October 1931) to the chair of mathematics at University College, Southampton. There he threw himself into the work with his accustomed energy. He had the rare gift of inspiring others to do research, and when he died he had developed a flourishing mathematical school, which he hoped would deal successfully with the problems of local industries, such as shipbuilding and aircraft construction. He was taken ill somewhat suddenly, while travelling in Wales, and died on August 16 of this year. His premature death at the age of forty years not only is a cruel blow to his family and his many friends, but also deprives modern engineering of one of its most able and sympathetic mathematical helpers, one who would undoubtedly have made further notable advances in the science of applied mechanics.

As a man, Howland was of a modest and retiring disposition, and it was almost impossible to get him to talk about himself. Behind his reserve, however, lay many wide and human sympathies. In his undergraduate days he was constantly writing both prose and verse, and the choice between literature and mathematics hung for some time in the balance. He was a keen musician and took a full share in musical activities at Southampton. The subjects of various addresses he gave to more popular audiences, on "The Mystery of Number", "Mathematical Wit and Humour" and "Greek Mathematics" are enough to indicate the catholicity of his interests, even in the mathematical field. He married, on November 10, 1923, Lucy Jane Bullock, and his happy life at home contributed in no small measure to the full development of his scientific powers. L. N. G. F.

Prof. Alexander Larmor

THE death, on October 10, of Alexander Larmor, emeritus professor of natural philosophy at Magee College, Londonderry, has removed one who rendered very valuable services to scientific education in Northern Ireland. His published work, though important, gives a very inadequate idea of his powers of mind and his wide knowledge; his friends and correspondents know that, if he wrote comparatively little, he thought deeply on the subjects which interested him.

Larmor's first paper, published in the *Quarterly Journal of Mathematics* in 1886, was on the geometrical theory of perspective, and his last, which appeared in 1933, treated of the FitzGerald contraction. These titles indicate the early and the later interests of a man who, at the beginning, studied under Purser and Everett at Queen's College, Belfast, and who took both the Mathematical and the Natural Science Tripos before becoming fellow of Clare College, Cambridge. He began by working at pure geometry; a taste for this subject and great expertness in it were, in his day, imparted to mathematically gifted boys in Irish schools. His most important geometrical paper, contributed to the London Mathematical Society in 1892, was on the contacts of systems of circles. In later years he became absorbed in the fundamental problems of space and time; he kept himself abreast of recent speculations in this region, and brought to them a mind philosophical and acutely critical.

During his tenure of his chair at Londonderry, Larmor gave himself with his whole heart to the work of teaching and administration, and won the regard and gratitude of pupils and colleagues alike. His lectures were admirable, his sympathetic interest in his students unfailing. He took his full share in the politics of the college in a critical period in its history, and helped greatly in the solution of its difficulties.

Larmor was quiet and reserved in manner, but his obvious sincerity and friendliness exercised a strong attraction upon those who had the privilege of knowing him. To younger men, in particular, he was continually showing kindness, and very many will feel for him life-long affection and gratitude.

W. B. M.

Prof. L. M. Ugolini

WE regret to record the death of Prof. Luigi M. Ugolini, the well-known Italian archæologist, which took place at Bologna recently at the age of forty years.

Luigi Ugolini was born at Bertinoro in Romagna and served in the Alpini during the Great War, being wounded and gaining a bronze medal for valour. After the War he travelled extensively in Europe, Egypt, Roman Africa and the East in the pursuit of his archæological studies. His best known work was connected with the excavation of archæological sites at Fernice and Butrinto in Albania, where he brought to light a number of Greek and Roman antiquities. He had already published three volumes on his researches, and other material was in course of preparation. He was also the author of a work on the prehistoric antiquities of Malta. Recently he had been appointed to a chair in the University of Rome.

Prof. Victor Grignard

PROF. CH. COURTOT, of Nancy, has given an account (*Bull. Soc. Chim.*, **3**, 1433; 1936) of the life and work of Prof. Grignard, Nobel Laureate in 1912, who was best known for his researches on the use of organo-magnesium compounds in synthetic chemistry. Born at Cherbourg in 1871, professor of organic chemistry at Nancy in 1910 and of general chemistry at Lyons in 1919, Grignard carried out a large number of investigations in organic chemistry: Prof. Courtot gives the titles of 163 publications by him and his pupils. During the Great War, he rendered valuable services and was made a member of the Legion of Honour. He was elected an honorary fellow of the Chemical Society in 1920. Shortly before his death on December 13, 1935, Grignard commenced a large treatise on organic chemistry, the first two volumes of which appeared during his lifetime.

We regret to announce the following deaths:

Mr. W. J. Blenheim, American traffic manager of the Western Union Cable system, a pioneer of radio research, on October 29, aged fifty-eight years.

Prof. A. Bömer, emeritus professor of applied chemistry in the University of Münster, and editor of the *Zeitschrift für Untersuchung der Lebensmittel*, aged sixty-nine years.

Prof. T. M. Lowry, C.B.E., F.R.S., professor of physical chemistry in the University of Cambridge, on November 2, aged sixty-two years.

Dr. Sheffield H. M. Neave, known for his work in 1906–7 on sleeping sickness, on October 24, aged eighty-three years.

News and Views

The Nobel Laureates in Medicine

THE Nobel prize for medicine for 1936 is divided between Sir Henry Dale and Prof. Otto Loewi. Sir Henry Dale must have had more influence on medical research than anyone else alive to-day. In the years before the Great War, the Wellcome Physiological Research Laboratories, with him as director, were making discoveries such as had never before been made by a laboratory connected with a pharmaceutical firm. More recently, the National Institute for Medical Research has grown under his guidance until it has become the leading centre for medical research in Great Britain, if not in the world. Sir Henry has been largely responsible for the success of the Commission of the League of Nations on Biological Standards, and it is because of him that a large proportion of the International Biological Standard Preparations are kept in Great Britain. He has been secretary of the Royal Society, and a member of the General Medical Council and numerous committees, but his influence has extended over a much wider field than that covered by these public activities. For many years, he has been consulted, with affectionate respect, by people from all over the world, on questions ranging from general policy to experimental detail. Among all these activities, he has found time to make important discoveries in many fields. He has shown an unusual prescience in working out problems which must have seemed trivial at the time, but have since turned out to be fundamental. Prof. O. Loewi's direct influence has covered a narrower field. Working with simple apparatus, for many years now in Graz, he has shown an uncanny genius for paradoxical discoveries which were not at first believed, but were later confirmed and extended by other, and more elaborate, methods, and formed the basis of one of the most interesting fields of scientific advance. His work has touched many problems, and he is one of the best known and most beloved of German-speaking pharmacologists.

Transmission of Nervous Impulses

THE Nobel prize has been awarded to these two men of science for work on the chemical transmission of nervous impulses. It was known that the effects produced by stimulating sympathetic nerves were also produced by adrenaline, and that the effects of stimulating the vagus were also produced by muscarine and various other drugs. Elliott had hinted, in 1904, at the possibility that sympathetic nerves might produce their effects by actually liberating adrenaline, and Dixon and also Howell had tried to show that some substance was liberated by vagus nerve endings. Dale found that extracts of ergot contained a substance like muscarine, but unstable. This substance turned out to be acetylcholine, and in 1914 Dale, realizing its possible importance in connexion with the vagus, made a detailed study of its effects in the body, in which he showed that it not only reproduced the effects of muscarine, but also those of nicotine. In 1921 Loewi published the first evidence that nerve endings liberate active substances. Under appropriate conditions, the vagus and sympathetic nerves to a frog's heart were shown to liberate two substances, detected by their action on a second heart, and called by Loewi *vagusstoff* and *acceleransstoff*. A dozen papers from Loewi's laboratory answered criticisms of this work and filled in details.

Acetylcholine and Adrenaline

ALL the facts were compatible with the view that the two substances detected in this work were acetylcholine and adrenaline, but Loewi was too cautious to jump to this conclusion. In 1929 Dale and Dudley, working with large-scale apparatus, isolated acetylcholine for the first time from animal tissues, and came to the conclusion that *vagusstoff* could now be definitely identified as acetylcholine. New evidence has justified this conclusion. The pharmacological methods for identifying small quantities of acetylcholine were improved in Dale's laboratory until it was possible to distinguish acetylcholine from such nearly related substances as propionylcholine, and, with these improved methods, it was shown that a substance which could be definitely identified as acetylcholine was liberated, not only by nerves with muscarine-actions, but also by nerves with nicotine-actions. This year, Loewi, working with a method developed in Dale's laboratory, has obtained evidence which enabled him to identify *acceleransstoff* as adrenaline. Though many have worked in this field, these two men have thus obtained all the vital evidence for the modern view that most, if not all, mammalian motor nerves produce their effects by the local liberation of either acetylcholine or adrenaline.

Dr. W. T. Calman, C.B., F.R.S.

THE retirement, at the end of this year, of Dr. W. T. Calman from the keepership of zoology in the British Museum (Natural History) will deprive the Museum and its visitors of the official services of a distinguished carcinologist. Dr. Calman went to the Museum in 1904 from Dundee, where he had graduated and had been assistant lecturer and demonstrator in zoology in the University College. In 1921, he was appointed assistant keeper of zoology at the Museum, and it was in that year that he was elected a fellow of the Royal Society. In 1927, he succeeded Dr. Tate Regan in the keepership. In 1930, he was president of Section D (Zoology) of the British Association, and he is now president of the Linnean Society of London. Dr. Calman's services to carcinology are well known to all zoologists. His morphological studies are at once shrewd and sound, and the same qualities of insight and judgment are combined with accuracy in his extensive contributions to the systematics of the Crustacea. His volume on this class in Lankester's "Treatise on Zoology" reveals the width of his erudition and is still indispensable to all students of the Crustacea. Dr. Calman's services to zoology have, of course, not been limited to the group in which he has specialized. His address to Section D revealed his interest in the contribution of taxonomy to the greatest zoological problems, and his work at the Museum has shown grasp of and sympathy with the study of all parts of the animal kingdom. In retiring, Dr. Calman takes with him the best wishes of all those to whom his friendly help has been extended, and their hope for much further contribution from him to his science. Mr. M. A. C. Hinton, assistant keeper of zoology in the Museum, will succeed Dr. Calman.

Opening of B.B.C. Television Service

ON Monday, November 2, the high definition television service of the British Broadcasting Corporation was officially inaugurated by Major the Right Hon. G. C. Tryon, H.M. Postmaster-General. This event marks the end of the first experimental period of the television service from the Alexandra Palace, which began during the radio exhibition at Olympia last August. During this experimental period considerable progress was made in the technique of transmitting both direct scenes and cinematograph films, using alternately the Baird and the Marconi-E.M.I. systems of transmission. During the opening ceremony, the Postmaster-General and others had to address themselves not only to listeners but also to viewers within a radius of some 25 miles. As reported in *The Times*, Mr. R. C. Norman, chairman of the B.B.C., was the first to use the word 'viewers' in its new meaning on this occasion. He recalled the fact that almost exactly fourteen years ago, the British Broadcasting Company, as it was then called, transmitted its first broadcasting programme from Marconi House. Following the formal speeches, Monday's programme included a variety item and an excerpt from British Movietone news. As Mr. Norman pointed out, this simple ceremony and programme may possibly seem rather primitive a few years hence to those who are able to recall it; at the present time, however, there is cause for satisfaction on the part of those responsible for the development of this new technique in radio broadcasting.

The Steam Locomotive

AT a meeting of the Institution of Mechanical Engineers on October 23, Sir H. Nigel Gresley was installed as president and delivered an address in which he took, as his main theme, the recent developments in steam locomotives. Forty years ago, the late Mr. Samuel Johnson, in the same position, gave a comprehensive address on the mechanical equipment of British railways, and Sir Nigel pointed out that at that time there were no British locomotives weighing, with tender, 100 tons, no engine with a higher steam pressure than 175 lb. per sq. in., none with a grate area exceeding 27 sq. ft. and no express engine with a higher tractive effort than 19,400 lb. To-day, weights of 165 tons, steam pressures of 250 lb. per sq. in., grate areas of 50 sq. ft. and tractive efforts of more than 40,000 lb. have been attained in Great Britain. In these forty years, the power of British locomotives has increased by a hundred per cent, and the remarkable fact is that these increases have been effected within the limits of the standard track and the even more restrictive limits of the British loading gauge. On American and Continental railways having the same 4 ft. 8½ in. track, locomotives can be built so much higher and wider that engines of double the weight and power of the most modern English engines are quite common. To show the present relative position of steam, Diesel and electric methods of propulsion, numerous figures were given of locomotives and their performances in service, in particular those relating to the *Flying Hamburger*. After prolonged trials, this train was put into operation between Hamburg and Berlin in May 1933. It consists of two articulated coaches on three bogies, is driven by two Maybach 410 h.p. Diesel engines directly coupled to electric generators, and does the journey at an average speed of 77·4 m.p.h. Its smooth running over long distances at a speed of 100 m.p.h. suggested an inquiry as to the possibility of experimenting with extra high speed travel on the London and North Eastern Railway in Great Britain.

THE curves, gradients and speed restrictions on the 268-mile line from King's Cross to Newcastle constitute a more difficult problem than that of the Berlin-Hamburg route, and the makers of the Diesel-electric train estimated that the time required would be 4 hours 15½ min. on the down journey and 4 hours 17 min. up. On the other hand, it was ascertained that a steam locomotive of the "Pacific" type could accomplish it in four hours, and so it was that *The Silver Jubilee* train came to be designed. The engine was made sufficiently powerful to maintain a good speed on the up gradients, for the saving of time in increasing speed from 60 to 90 m.p.h. on a downhill run of 15 miles is only 5 minutes, whereas by maintaining 60 m.p.h. instead of dropping to 30 on the uphill run, 15 minutes are gained. This locomotive exerts a total of 1,750 h.p. when taking a rising gradient of 1 in 200 at 80 m.p.h. It was also mentioned that scale models of the stream-lined engine of *The Silver Jubilee* and of the ordinary "Pacific" type have been under test at the National Physical Laboratory to determine the head-on wind resistances in each case. The horse-power required to overcome these wind resistances has been found to vary from 56·39 and 97·21 respectively at 60 m.p.h. to 881·48 and 1,520·8 at 120 m.p.h., and a remarkable result indicated by the table of figures given is that, within these limits of speed, the saving of power effected by stream-lining is a practically constant proportion, namely 42·1 per cent.

Development of Transport

Sir Alexander Gibb devoted the main part of his presidential address to the Institution of Civil Engineers, delivered on November 3, to an account of some of the works of civilization for which engineers and engineering—in the widest sense—have been responsible. Dealing first with means of transport, he said that the age of roads has now returned. More than 1,000,000 miles of modern roads serve the Empire; that this is still only the beginning is clear from the fact that in Kenya, out of 10,500 miles, only 723 have a metalled surface, the remainder being earth-roads impassable after heavy rain, and in the 370,000 square miles of Nigeria, more than half the 15,000 miles of road are fair-weather roads only. What is required is road planning on really Imperial lines, and the social and political effects would be tremendous. Railway construction in the Empire dated from the middle of the last century. In 1850 Canada had 66 miles of railway; she has now 43,000 miles. With the railways came the steamship era. While the commercial application of the aeroplane has not yet been developed very far, Sir Alexander mentioned that it was almost wholly by air transport that the New Guinea goldfields and various gold and copper mines in northern Canada were opened up. In New Guinea, all the machinery and parts for two large dredgers and a hydro-electric plant of several thousand horse-power were carried wholly by aeroplane over a range of mountains 5,000 ft. high into the interior, and then assembled and put to work within a year.

Engineers and Empire Development

Engineering, or turning to practical account the discoveries of science, Sir Alexander said, is the foundation of civilization. In his opinion, the opportunities of the future are vastly greater than any that the past offered, but he regards with some anxiety the years to come. The machine sometimes seems to be taking control; inventions and developments succeed one another with bewildering speed, and there seems to be no limit to the possible results of uncontrolled and misapplied ingenuity. Engineering provides directly or indirectly the livelihood of about a seventh of the working population of Great Britain. To-day is an age of ever-increasing specialization, and it has inevitably resulted in engineering being split up into many different categories and groups. If the great problems of the future are to be adequately dealt with, an attempt should be made to co ordinate and unite engineering activities in the broadest sense. The Institution of Civil Engineers is taking steps in this matter, and useful work has already been done in the wider question of co-operation with engineering institutions. Sir Alexander thinks that one broad policy should inspire and guide all classes of engineers; there might then arise a body of engineering opinion so weighty, so sane, that it would prevent waste of energy and misplaced enterprise, and would inevitably command attention in the politics, administration and life of Great Britain and the Empire.

Kincardine-on-Forth Bridge

The Kincardine-on-Forth Bridge which was opened to traffic on October 29 will be a great boon to motorists. Hitherto, traffic from Edinburgh to the north bank of the Forth had to cross either by the ferry at Queensferry or by the bridge at Stirling twenty-five miles to the west. The new road bridge is situated nine miles down stream from Stirling. The bridge is half a mile long, and its most interesting feature is the electrically operated swing span in the centre. This span, which rotates on a central pier, weighs 1,600 tons and has a length of 364 ft.—probably the longest span of this type in the world. It provides two clear openings for shipping each 150 ft. wide. A roadway 30 ft. wide with two 5-ft. footpaths goes over the bridge. The whole of the equipment is controlled from a cabin at the top of the span. The saving in mileage between Edinburgh and Dunfermline by this bridge amounts to 20 miles. The cost of the bridge was £350,000; the consulting engineers are Sir Alexander Gibb and Partners.

The turning gear of the swing span of the new bridge is driven by two fifty horse-power motors, but only about a fifth of the full power is required. The main position indicator on the control desk gives an alignment with an accuracy not greater than a few inches. But an inaccuracy so large as this would prevent the wedges and bolts being shot. To overcome this difficulty, two independent aligning systems have been installed, one employing photo-electric cells and the other using a target sight lighting principle. As the end of the swing span approaches its aligning position, the first photo-cell passes across a beam of light. This causes one of three lamps on the control desk to light up and a bell to give one stroke. As the span continues to move, the photo-cell crosses other light beams giving a total of three distinct light and sound warning signals. When another photo-cell arrives opposite a narrow slot, the middle lamp on the control desk indicates correct alignment.

The Heat Engine in the Seventeenth Century

It is generally known that Newcomen was the first to produce a practical cylinder and piston steam engine, but there is a singular lack of evidence to show where he obtained his ideas. Various statements, some of them quite unsubstantiated, about the matter have been made, but little is known with certainty. No one has examined the subject with greater care than Mr. Rhys Jenkins, who at a meeting of the Newcomen Society on October 21 read a paper entitled "The Heat Engine Idea in the Seventeenth Century". In this he impartially reviewed some of his own previous views and endeavoured to trace how the idea of applying heat for motive power might have been handed on from one projector to another in the course of the period 1612–1712. In turn, he referred to the writings and experiments of de Caus, David Ramsay, the Marquis of Worcester, Morland, Papin and Savery. To Papin certainly appears to belong the honour of producing a vacuum under a piston in a vertical open-top cylinder by the condensation of steam, and it may be Newcomen read a review of a book by Papin contained in the *Philosophical Transactions* of March 1697. Mr. Jenkins placed no credence on the story that Newcomen had been in correspondence with Hooke, as stated by Robison in the third edition of the "Encyclopaedia Britannica", and this story must be omitted from the history of the steam engine, at any rate until documentary evidence is forthcoming.

Domestic Lighting

THE summer school of electrical housecraft recently paid a visit to the Lighting Service Bureau of the Electric Lamp Manufacturers' Association. Mr. W. J. Jones laid stress on the need for adequate light in the home for reading and for carrying out domestic tasks. Practical demonstrations were given to prove his statements. He showed how good lighting helps the eye to see quickly, and hence under favourable conditions a task can be performed with greater accuracy and in less time. When a gramophone turntable with a disk of white cardboard marked by two intersecting lines is made to revolve, its speed seems to increase as the amount of light thrown on the disk is reduced. Actually the speed is kept constant, but so effective is the maximum illumination in reducing the apparent speed of the disk that it is difficult to believe that the speed keeps constant. When the disk is brightly lit, the eye has little difficulty in following the rotation of the lines, whereas when badly lit a confused whirl only is seen. The absorption power of decorations was demonstrated and the importance of using extra light to counteract the effects of a dark colour scheme or of decorations was insisted on. A talking film entitled the "Science of Seeing" has been prepared by the Bureau for loan to schools, etc. During his lecture, Mr. Jones asked his audience to choose the amount of light for the most comfortable seeing conditions in the lecture theatre. This was done by raising and lowering the lighting. Individual members chose illuminations lying between 20 and 75 foot-candles.

Factors affecting Freedom of the Press

FOLLOWING on the broadsheet on the state of the press in Great Britain, issued by Political and Economic Planning in 1935, the Press group of P.E.P. has now issued a further broadcast on the freedom of the press. Besides the various legal factors, such as the law of libel, which restrict publication in the press, there are other equally potent influences which may act in restraint of publication, such as advertizing influence, the private policy of a proprietor, or the pressure of public or semi-public bodies may be exerted in various ways which make it more and more difficult to voice emphatically the grievance of an individual or group against authority and monopoly. While absolute freedom of the press is neither possible nor desirable, there are strong arguments for keeping restrictions and external pressure of every kind to a minimum. Moreover, the selection or rejection of news for a newspaper is still mainly determined not by external influences, however powerful, but by the character and outlook of journalists. Where they are content to follow the line of least resistance, giving prominence to trivialities, and evading or ignoring important subjects and points of view that are unpopular or likely to arouse powerful opposition, the control of the press will in fact be determined by the barriers erected against free discussion, with fatal results. Bad journalism begins by driving out good and may end by causing the imposition of restrictions so severe that good, critical, informed and independent journalism is impossible. On the other hand, independent, courageous journalism creates and commands the admiration of independent and courageous people who are powerful enough to support it and defend it. The fate of the press is bound up with the fate of democracy, and in any type of State the press will have to fight harder to justify its existence against competition and encroachments of many kinds.

Archæology in Indo-China

No little success has been achieved by the first two expeditions of archæological exploration conducted by the Greater Indian Research Committee. This Committee was founded in 1934 under the chairmanship of Sir Francis Younghusband with the object of throwing light by field exploration on Indian cultural and colonial expansion throughout south-eastern Asia. An account of the results obtained up to the present is given by Dr. H. G. Quaritch Wales, the field director, in *Discovery* of November. The first expedition began work at Takuapa on the west coast of peninsular Siam. This has been identified with the Takola Mart of Ptolemy. Here the archæological evidence has demonstrated the existence of a considerable settlement of Siva worshippers of South Indian affinities, which flourished from the fourth to the eighth or ninth centuries of our era, and was frequented by Chinese and Islamic traders. Further, a line of communication with the west coast has been traced to the Bay of Bandon, where excavations have been carried out on the site of the ancient city of Chaiya, apparently the capital of a great Indianized empire. Even more important results were obtained by an expedition to a site in eastern central Siam, where in the remote Pasak valley in the vestiges of a city were discovered relics of the vanished culture of the great Fu-nan Empire, of which this had been an outlying emporium on the trade route to the Menam valley. This culture was overwhelmed and completely destroyed by the rise of the Kmers in the sixth century A.D. Here the most important discovery was that of an Indian brick temple, which is the earliest known example of Indian colonial architecture. Previous to this discovery, all early Indian colonial temples were thought to have been built of wood. Several examples of sculpture were also found of pure Gupta style.

The Earliest Printed Book on the Magnet

THE annotated catalogues of antiquarian booksellers who deal especially in old scientific books always make interesting and instructive reading to the student of the history of science. Sometimes these catalogues form the medium for the first announcement of bibliographical discoveries of importance. A case in point is afforded by a catalogue (No. 73) recently issued by Messrs. Davis and Orioli, of 37 Museum Street, London, W.C.1. In this list, there is offered for sale a book that the vendors claim to be the hitherto undescribed first printed text of Petrus Peregrinus's treatise "De Magnete". The book in question, a small quarto of six leaves, is entitled "De Virtute Magnetis", and its title page bears the name of Raymundus Lullus as author; but no date or place of printing is indicated. The text is almost identical with that of the edition of Peregrinus's treatise published at Augsburg in 1558, hitherto regarded by bibliographers as the first printed edition. The original "Epistola De Magnete" was written in the thirteenth century, probably in 1269, and several early MSS. copies exist. In a long and interesting note, Messrs. Davis and Orioli give reasons for believing the book they describe to have been printed at Rome by E. M. Silber, not later than the year 1520. They state that, in the past, Peregrinus's treatise has been ascribed both to Raymond Lull and to Roger Bacon, and it is suggested that these authors' names may have been used in a general way during the Renaissance as possible authors of any scientific works. While the 1558 edition is a book of extreme rarity, Messrs. Davis and Orioli have so far only been able to trace one other copy of "De Virtute Magnetis", that in the Bibliothèque Nationale, Paris.

South African Marine Fishes

IN a recent descriptive account of "The South African Marine Fishes of Commercial and Angling Importance" by J. M. Marchand (Dept. of Commerce and Industries: Fishery Bulletin No. 2), an attempt is made to provide a handbook for the convenience and use of persons interested in South African sea fishes from the commercial point of view, for sportsmen, and for teachers of biology in South African schools. It is pointed out in the introduction to this work that it is "not intended for the pure scientist, and will be of small if any value to such individuals, due to the limited number of species dealt with, the total lack of classification keys and the brevity of the descriptions". Owing to the brevity of the descriptions, much reliance will have to be placed on the photographic illustrations in making identifications of fishes not already known. This is most unfortunate, for the great majority are so lacking in detail as to be almost useless for this or any other purpose. Some of them, for example, the photograph of *Raia clavata* on p. 52 and of *Arnoglossus pectoralis* on p. 67, are little more than dark blotches on the paper. When, for any reason, detailed drawings cannot be used, simple but accurate outline sketches are infinitely preferable to poorly reproduced photographs for the illustration of a handbook of this kind.

Indian Industrial Publications

THE Indian Industrial Research Bureau has issued a bibliography of industrial publications published in India since 1921 (Bulletins of Indian Industrial Research. No. 1: Bibliography of Industrial Publications published in India from 1921. Pp. iii+257. Delhi: Manager of Publications, 1936. 4.6 rupees; 7*s.* 3*d.*). The first part consists of a list of papers arranged chronologically according to publications, which enables readers readily to ascertain the papers published by each local government, government department, society, etc. Publications available in the Library of the Industrial Research Bureau are indicated. The second part is a classified subject bibliography arranged according to the Universal Decimal Classification. The third section of the bibliography comprises a combined alphabetical author and subject index.

Natural History Magazine

THE October number of this British Museum publication contains an interesting account of the remounting and preservation of the famous Cranbourne meteorite, the conclusion of a long description of the Museum's East African Expedition, and a paper on vermin, based upon Steele Elliot's Bedfordshire records. We record with regret the concluding paragraph of the number: "The Trustees of the British Museum have decided to cease the publication of the *Natural History Magazine* after the issue of the present number, which completes the fifth volume". The experiment has not been long-lived, and as members of the reading public we should attribute its failure to the price charged for what is essentially Museum advertisement and propaganda, and to the tendency of contributors to forget that lightness of hand as well as solid fact is a necessary ingredient in attractive writing.

Index to the *Geographical Review*

THE *Geographical Review* (the quarterly journal of the American Geographical Society) for the ten-year period from 1926 to 1935 contains 7,000 pages of articles, record items, and book reviews, including more than fifty articles on the geographical results of important expeditions, most of them written by the expedition leaders themselves. To make this great mass of geographical material available in organized form, the Society has now prepared an analytical index of 373 pages covering this ten-year period. The price of the index is: unbound, 4.50 dollars; bound, 5.25 dollars. The index to vols. 1–15, 1916–25, of which there are still a limited number of copies available, is offered along with the index to vols. 16–25, at a special price of 8.00 dollars unbound, or 9.50 dollars bound, for the two indexes. These may be obtained from the American Geographical Society, Broadway at 156th Street, New York, N.Y.

Medical Peace Association

A MEETING of medical practitioners and other scientific workers to consider the subject of aerial warfare and means of defence against it will be held in the Hastings Hall, British Medical House, on Wednesday, November 25, at 8.30 p.m. The chair will be taken by Dr. E. P. Poulton, and speakers will include Dr. Stella Churchill, Dr. Robert Edbrooke, Mr. R. Makinnon Wood and Dr. L. A. Rawlings. It is hoped that there will be a full discussion of the whole subject, and particularly of the attitude which the medical profession might reasonably adopt towards it. Information about the Medical Peace Association may be obtained from the Hon. Secretary, Dr. Cecile Booysen, 12 Kent Terrace, N.W.1.

Nutrition in the Colonial Empire

THE Prime Minister has appointed a Committee of the Economic Advisory Council with the following terms of reference: "(1) To survey the present state of knowledge in regard to nutrition in the Colonial Empire in the light of the replies received to the circular dispatch addressed by the Secretary of State for the Colonies on April 18, 1936, to the Officers Administering the Governments of Colonial Dependencies. (2) To advise from time to time as to the measures calculated to promote the discovery and application of knowledge in this field." The Committee is constituted as follows: Earl De La Warr (chairman), Prof. E. P. Cathcart, Mr. G. L. M. Clauson, Dr. Philippa C. Esdaile, Prof. Noel Hall, Dr. J. M. Hamill, Mr. Francis Hemming, Mr. E. M. H. Lloyd, Prof. Edward Mellanby, Sir John Orr, Dr. Audrey Richards, Mr. H. S. Scott, Sir Thomas Stanton, Mr. F. A. Stockdale, Mr. Hans Vischer. The secretaries to the Committee are Mr. D. H. F. Rickett (Economic Advisory Council) and Mr. C. G. Eastwood (Colonial Office).

Announcements

MME. JOLIOT-CURIE has resigned her appointment of Under-Secretary for Scientific Investigation in the French Cabinet to occupy a chair in the Faculty of Natural Science at the Sorbonne, and has been succeeded by Prof. M. Jean Perrin, For.Mem.R.S., known for his work on atomic chemistry, and Nobel prizeman for physics in 1926.

DR. WOLFGANG HEUBNER, professor of pharmacology at the University of Berlin, has been elected an honorary member of the Biological Society of Vienna and of the Imperial Leopold Caroline German Academy of Natural Philosophers at Halle.

PROF. FERDINAND HUEPPE, of Dresden, emeritus professor of hygiene in the German University at Prague, has been awarded the Goethe Medal for Science and Art by the Chancellor of the Reich in recognition of his services in connexion with physical training.

AT the thirty-ninth Congress of the International Law Association for the Protection of the Civilian Population against Modern Warfare, recently held in the Cour de Cassation of the Paris Palais de Justice, a committee was formed to consider the question of the protection of the civilian population against the new engines of warfare, and especially aerial bombardment. The work of the Committee will be carried on in close association with the International Committee of the Red Cross and the International Association for the Protection of Humanity recently founded at Monaco.

ADVISORY LEAFLET No. 272 of the Ministry of Agriculture directs attention to the disease fowl paralysis, which is unfortunately becoming more common. The cause is not known, and no treatment of proved value is available, but the disease can be minimized by removing weak birds, and by not breeding from infected stocks.

CULTIVATION and distillation of peppermint form the subject of Advisory Leaflet No. 98 of the Ministry of Agriculture. Two varieties of this fragrant herb are recognized, namely, black mint, *Mentha piperata* var. *officinalis*, and white mint, *M. piperata* var. *vulgaris*. Harvesting and distilling are described in detail, and the effects of the fungus disease, *Puccinia menthæ*, are considered. Peppermint might be grown with advantage on a larger scale in Great Britain.

THE resumption of work in the technical schools and colleges gives special value to the issue of Foyle's Technical Catalogue (London: W. and G. Foyle, Ltd.) which contains particulars of new and second-hand books on more than 450 subjects coming within the range of applied science.

THE latest catalogue of old scientific books issued by E. P. Goldschmidt and Co., Ltd., of Bond Street, W.1 (No. 40. Old Science and Medicine) includes 216 items, many of great interest, on a variety of subjects, and contains a number of facsimile and other illustrations. Among the books offered for sale are copies of the first edition of Gilbert's "De Magnete", and of an edition of this work printed at Stettin in 1633.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

Assistants, Grade II and III (engineering) in the Admiralty Technical Pool—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (November 2).

A heating and ventilating engineer in the Directorate of Works and Buildings of the Air Ministry—The Secretary (W.B. 9), Air Ministry, Adastral House, Kingsway, W.C.2 (November 14).

A research assistant in the Department of Oil Engineering and Refining, University of Birmingham—The Secretary (November 18).

A junior lecturer in civil engineering in the University of the Witwatersrand—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, London, W.C.2 (December 2).

Structural engineering assistants in the Designs Branch of the Directorate of Fortifications and Works at the War Office—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (Quote Appts./2).

An acting editor to the Royal Scottish Geographical Society—The Secretary, Synod Hall, Edinburgh.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 804.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Vitamin Nature of Flavones

IN a previous note[1] we reported on the favourable effect of flavones upon the resistance and permeability of the capillary wall in certain pathological conditions.

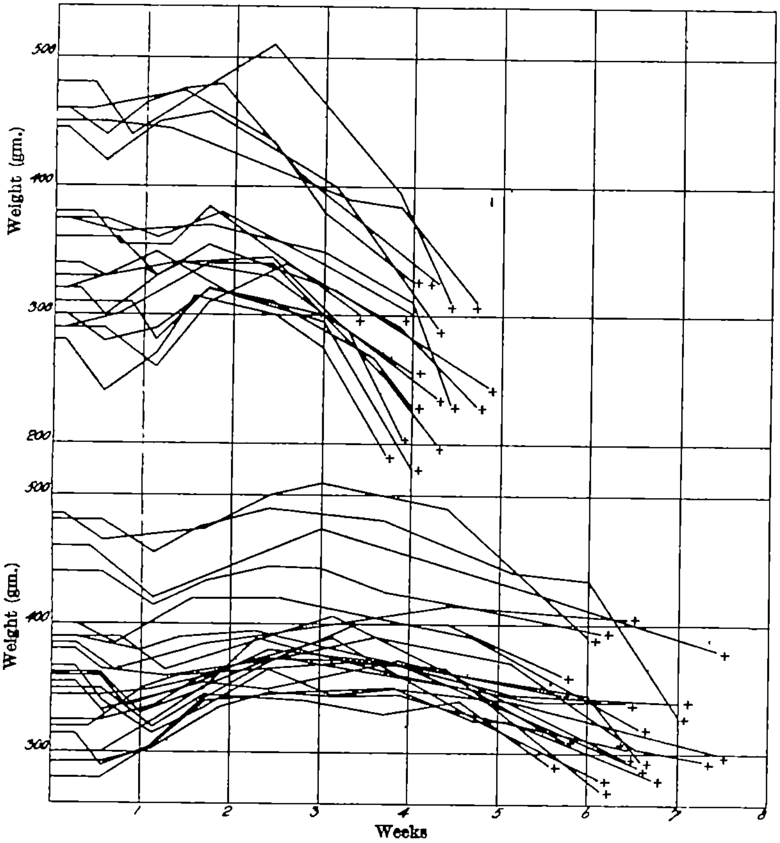

FIG. 1. Weight curves of guinea pigs receiving a scurvy diet without (above) and with (below) the addition of 'Citrin'.

The substances responsible for this activity were tentatively termed 'vitamin P'. The acceptance, however, of the vitamin nature of these dyes depended on the experimental demonstration of the symptoms of deficiency.

Thirty-eight guinea pigs, weighing 280–485 gm., were placed on the Sherman - La Mer - Campbel scurvy diet. The components of the food were autoclaved for one hour and a half at 120° C., ammonia being added to the water of the autoclave. Twenty-one of the animals received 1 mgm. 'Citrin'[2] daily, this substance being the crystalline flavone fraction of lemon juice. A smaller additional group of animals received mixed food.

The weight curves of the animals (17), receiving the scurvy diet only, are represented in the upper part of Fig. 1. The curves of the animals end with death. They show the usual rapid fall after the second week of the experiment, death occurring on average at 28·5 days. The weight declines on the average from 359 gm. to 242 gm.

The data of the second group, receiving 'Citrin', are represented in the lower part of Fig. 1. The administration of flavone was discontinued at the end of the sixth week. Compared with the first group, these animals live distinctly longer, on the average 44 days. At 34-38 days no animal from this group had died, while all animals in the first group were dead. There is also a marked difference in the weight curves, which fail to show the pre-mortal rapid decline, the average weight of 365 gm. falling to 342 gm. only.

Since the food contained no ascorbic acid, the animals could not be expected to live indefinitely. All the animals of both groups showed the typical clinical symptoms of scurvy. On autopsy all the animals showed the typical fragility of bones, looseness of teeth and swelling of joints. There was, however, a very marked difference in the intensity of hæmorrhages in both groups. In our protocols the hæmorrhages were noted, according to their extent, by one, two or three crosses. The relation of the number of crosses given per 100 animals in the first and second group was 212 to 68 for hæmorrhages of the costal joints, 77 to 14 for intestinal hæmorrhages, 224 to 71 for different articular hæmorrhages, and 178 to 33 for hæmorrhages in the muscles. The vitamin P seems thus to have a marked and somewhat specific influence on the capillary system. This agrees with our clinical observations.

A third and smaller group of animals, receiving mixed food, showed normal growth. A preliminary experiment with half the number of animals gave identical results.

These results suggest that experimental scurvy, as commonly known, is a deficiency disease caused by the combined lack of vitamin C and P.

This research was sponsored by the Josiah Macy, Jr., Foundation, New York.

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[1] NATURE, 138, 27 (July 4, 1936).

[2] *Deut. Med. Wochsch.*, Nr. 33, 1325 (1936).

occurs; they are as pronounced with pepsin, which does not dissociate, as with hæmoglobin which does. The specificity of amides for both effects and the repeated occurrence of the amide bond in proteins suggest that the two phenomena may nevertheless have related causes. They do not appear to be related to changes in dielectric constant. Urea and formamide solutions have dielectric constants greater, and acetamide solutions much smaller, than that of water. Glycine solutions, with dielectric constants still higher than those in urea, are without effect on dissociation, and have relatively small influences on solubility.

These measurements were made possible by the facilities provided by Prof. The Svedberg at Uppsala, and by Sir Joseph Barcroft at Cambridge. They owe much to the advice and assistance rendered by Dr. K. O. Pedersen at Uppsala, and by Dr. G. A. Millikan and Prof. D. Keilin at Cambridge. Full details will be published elsewhere.

JACINTO STEINHARDT.
(General Education Board Fellow.)
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Uppsala.
Oct. 8.

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[1] O. Lamm and A. G. Polson. *Biochem. J.*, **30**, 528 (1936).
[2] A. Tiselius and D. Gross, *Koll. Z.*, **66**, 12 (1934).
[3] K. O. Pedersen, unpublished, and NATURE, **138**, 363 (1936).
[4] N. F. Burk and D. M. Greenberg, *J. Biol. Chem.*, **87**, 197 (1930).
[5] D. B. Hand, *J. Biol. Chem.*, **109**, xi (1935).
[6] W. H. Forbes and F. J. W. Roughton, *J. Physiol.*, **71**, 229 (1931). L. Pauling, *Proc. Nat. Acad. Sci.*, **21**, 186 (1935).

Inhibited Deposition of Stearin from Chilled Olive Oil

WE have observed that the addition of very small amounts of air-blown cacao-butter (Iodine No. = 20) to olive oil permits such oil to remain liquid and free from stearin deposit on storage at temperatures between 2° C. and 4° C. Untreated olive oil in such storage sets solid within 12 hours, whereas we have found the inhibition effect to persist after even four years storage at 2° C. (Fig. 1).

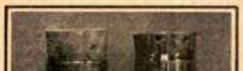

FIG. 1.

The amount of blown cacao-butter required varies from 0·1 to 0·5 per cent, depending on the technique of its oxidation, and the length of time the olive oil is to be stored cool. The inhibition effect is highly specific in that: (*a*) no other blown oil or fat serves so well, and (*b*) protection is not afforded to other oils such as arachis, or cotton-seed.

This inhibition phenomenon has been found to furnish a quantitative guide to the very remarkable property of blown cacao-butter to prevent fat-bloom in stored chocolate, in which respect it is greatly superior to lecithin or other anti-bloom agents.

Our investigations will be fully reported elsewhere.

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Increase of Diamagnetic Susceptibility on the Death of Living Cells

ACCORDING to E. Bauer's theory, the lack of equilibrium in living systems is due to an excited state of the protein molecules of the protoplasm. The maintenance of this state is operated through the process of metabolism, collisions of the second kind between the molecules of the protoplasm and those of the food substance leading to an activation of the latter, and their chemical energy, set free in the reaction, being used to maintain the active, excited state of the molecules of the living substance[1].

If now this active state of the molecules of the living substance consists in an electronic excitation or—what seems more probable—in the existence of free valencies, which on death are saturated within the protein molecule, then the living and dead substance must differ with respect to its magnetic susceptibility, since, owing to the falling out of the paramagnetic component, the resulting diamagnetic susceptibility must increase on death.

Measurements to check this point were carried out by us with the assistance of the magnetic laboratory of the Ural Physico-Technical Institute (formerly at Leningrad, now at Sverdlovsk). They gave a positive result. In the case of yeast and suspensions of bacteria (*B. coli*, *B. proteus*) we found an increase of diamagnetic susceptibility on death amounting to 4 per cent, the maximum possible error not exceeding 0·7 per cent. This result was independent of the way the cells were killed: beating or cooling down with liquid air produced the same effect as spontaneous death. It is important to note that denaturation of native protein did not affect the magnetic susceptibility.

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[1] A detailed presentation of the theory has been given in E. Bauer's "Theoretical Biology" (Russian), 1935. A brief sketch and a few applications in *Biodynamica*, No. 14, 15 (1936).

Nitrogen Losses in Green Plants

A FEATURE of the nitrogen metabolism of plants which has received little attention is the possibility of considerable losses of nitrogen during the process of nitrate reduction. It is generally agreed that this process leads first to the production of nitrites, and the presence of nitrites in plants actively engaged in nitrate reduction has been shown by Eggleton[1]. As plant tissues are normally acid, nitrous acid should be present, and this should combine with mono-amino nitrogen to give elementary nitrogen. It is well known that this reaction is rapid *in vitro*[2]. It has been shown by Irving and Hankinson[3] that *Elodea* produces elementary nitrogen when immersed in solutions containing nitrates and asparagine as a source of amino-nitrogen.

Two examples in which such losses of nitrogen occur have recently been observed by us and studied in some detail. In one of these, pure cultures of *Chlorella vulgaris* growing (in the dark) in a nutrient medium (*p*H 5·8) containing glucose (10 gm. per litre) and sodium nitrate (0·26 gm. per litre), retained in the cells 3·4 mgm. of nitrogen out of 13 mgm.

in each culture flask. The external medium at this time contained only 1·1 mgm. of nitrogen (Kjeldahl-Gunning) of which 0·6 mgm. was nitrate nitrogen. Thus 8·5 mgm. of nitrogen were lost, presumably in elementary form.

Similar losses of nitrogen have been observed when daffodil leaves were floated aseptically on glucose media (3 per cent, buffered by phosphate mixtures to *p*H 5·4) containing an inorganic source of nitrogen such as ammonium or potassium nitrate. Of the nitrogen absorbed from the medium, about half is normally lost, the remainder being retained in the leaves. In contrast, if organic sources of nitrogen (such as asparagine, alanine or urea) are used, the whole of the nitrogen absorbed can be recovered in the leaves. It may be noted that considerable losses of nitrogen are always associated with low amino-nitrogen content of the leaf tissues.

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M. C. BILLIMORIA.

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University, Leeds.
Oct. 20.

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[1] *Biochem. J.*, **29**, 1389 (1935).
[2] Van Slyke, *J. Biol. Chem.*, **12**, 375 (1912).
[3] *Biochem. J.*, **3**, 87 (1907).

Route of Migrating Parasites in Ruminants

MR. W. M. WEBSTER, veterinarian of this College, has shown me an adult specimen of the lungworm *Dictyocaulus filaria* that he found in an undamaged condition in the small intestine of a hogget.

This observation, it appears to me, reveals something of the movements of parasites that undergo the lung journey in ruminants.

In the first place, the specimen must have been coughed from the lungs and then swallowed. It does not seem possible that it could have been involved in the process of rumination for, on account of its relatively large size, it would have been crushed The conclusion therefore follows that the worm during its journey to the small intestine could not have spent a period in the rumen.

Perhaps the eggs or larvæ of the various lungworms and other worms, in their passage from the lungs, behave in a similar manner, and proceed directly from the gullet to the reticulum.

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Palmerston North,
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Aug. 2.

Resonance Structures of Carbon Dioxide, Carbonyl Sulphide and Carbon Disulphide

BY comparing experimental heats of formation with bond energies derived from compounds without alternative Lewis structures, Pauling and Sherman[1] deduce resonant structures for carbon dioxide, carbonyl sulphide, and carbon disulphide, of the type :

$$\overset{+}{:}O:::C:\underset{\cdot\cdot}{\overset{\cdot\cdot\,-}{O}}:\rightleftharpoons:\underset{\cdot\cdot}{\overset{\cdot\cdot\,-}{O}}:C:::O:^{+}$$

but the impossibility of obtaining a valuation of the bond energies of partially ionic bonds from thermal data does not permit of a more penetrating analysis of the resonance of these compounds along these lines.

Gray and Cruickshank[2] have demonstrated the presence of resonance in certain compounds by considering diamagnetic susceptibilities. As partially ionic bonds can be evaluated magnetically, a greatly increased number of theoretically possible structures can be considered.

The diamagnetic susceptibilities of the above compounds are :

$$CO_2\ -20{\cdot}80^3\ ;\ COS\ -32{\cdot}36\ ;\ CS_2\ -42{\cdot}29,$$

and these experimental susceptibilities can be compared with the theoretically possible states of the molecules and with Pauling's resonance energies.

	E	Reson. *E*	Susceptibility of		Expt. suscept.
			$X{=}C{=}X$	$:\underset{\cdot\cdot}{\overset{\cdot\cdot\,-}{X}}:C:::X\overset{+}{:}$	
CO_2	16·79	1·37 ve.	−2·73	−20·80	−20·80
COS	14·55	0·84 „	−12·31	−38·00 −42·79 } *	−32·36
CS_2	12·46	0·46 „	−22·54	−59·84	−42·29

* The two states $:\underset{\cdot\cdot}{\overset{\cdot\cdot\,-}{O}}:C:::S\overset{+}{:}$ and $:O\overset{+}{:}::C:\underset{\cdot\cdot}{\overset{\cdot\cdot\,-}{S}}:$ do not have identical susceptibilities. All susceptibilities are × 10^{+6}.

Neither of the calculated values for the structures O=C=O, O=C=S, S=C=S, agrees with the experimental value, this being what one would expect from the suggestions of Pauling and Sherman, but in the case of carbon dioxide a resonance

$$\overset{+}{:}O:::C:\underset{\cdot\cdot}{\overset{\cdot\cdot\,-}{O}}:\rightleftharpoons:\underset{\cdot\cdot}{\overset{\cdot\cdot\,-}{O}}:C:::O:^{+}$$

would give for the susceptibility −20·80, which is exactly what is found experimentally (−20·80), a convincing demonstration of resonance in the carbon dioxide molecule.

The introduction of one sulphur atom is accompanied by a fall in resonance energy. In carbonyl sulphide two ionic states are possible. Direct resonance between these states gives too high a calculated susceptibility, but the existence of an intermediate state O=C=S enables the experimental value to be accounted for.

$$:S\overset{+}{:}::C:\underset{\cdot\cdot}{\overset{\cdot\cdot\,-}{O}}:\rightleftharpoons S{=}C{=}O\rightleftharpoons:\underset{\cdot\cdot}{\overset{\cdot\cdot\,-}{S}}:C:::O:^{+}$$

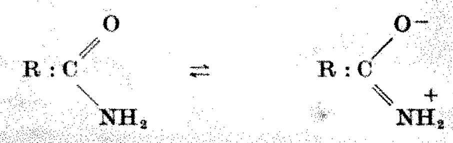
If equal times were spent in these three states, the calculated susceptibility would be −31·02, compared with the experimental value −32·36.

A further fall in resonance energy takes place on passing to carbon disulphide, and in agreement with this, resonance between

$$:\underset{\cdot\cdot}{\overset{\cdot\cdot\,-}{S}}:C:::S\overset{+}{:}\rightleftharpoons S{=}C{=}S$$

is suggested by the diamagnetic susceptibility of carbon disulphide (calculated −41·19 ; experimental −42·29).

The resonance in amides suggested by Pauling is also confirmed magnetically :



If equal times were spent in each state the calculated susceptibility would agree closely with the experimental.

	Calculated	Experimental
Formamide	$-22\cdot39$	$-21\cdot87$
Acetamide	$-34\cdot29$	$-33\cdot75$

In thioacetamide, however, there is not the same resonance, as the experimental susceptibility indicated a stable doubly bound structure.

These results show that the study of diamagnetic susceptibilities can be applied to problems involving quantum mechanical resonance, and allowing for relatively small experimental errors, seem to indicate a distinct tendency for molecules to spend nonfractional times in the possible states.

The deduction of the theoretical values for sulphur bonds which were not given by Gray and Cruickshank will be published elsewhere.

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J. M. C. THOMPSON.

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Sept. 28.

[1] Pauling and Sherman, *J. Chem. Phys.*, **1**, 606 (1933).
[2] Gray and Cruickshank, *Trans. Far. Soc.*, **31**, 1491 (1935).
[3] Stoner, "Magnetism and Matter" (Methuen, 1934), p. 274.

Constitution of Phosphorous Acid and the Phosphites

MENZIES[1] and Bär[2] showed that it is possible to obtain Raman spectra with crystal powders in which at least some of the stronger lines of the substances are recorded. I have shown[3] that the technique of obtaining the spectra with powders is vastly improved if a pair of complementary filters is used, one having a sharp cut-off on the longer wave-length side between the source and the scattering substance to isolate a definite exciting line from the exciting source of light, and the other having a sharp cut-off to the shorter wave-length side in the path of the scattered light in order selectively to weaken or absorb the exciting wave-length. Using this device, it is now possible to record the faintest lines and bands in the spectra of crystal powders and even of amorphous solids by giving suitably long exposures.

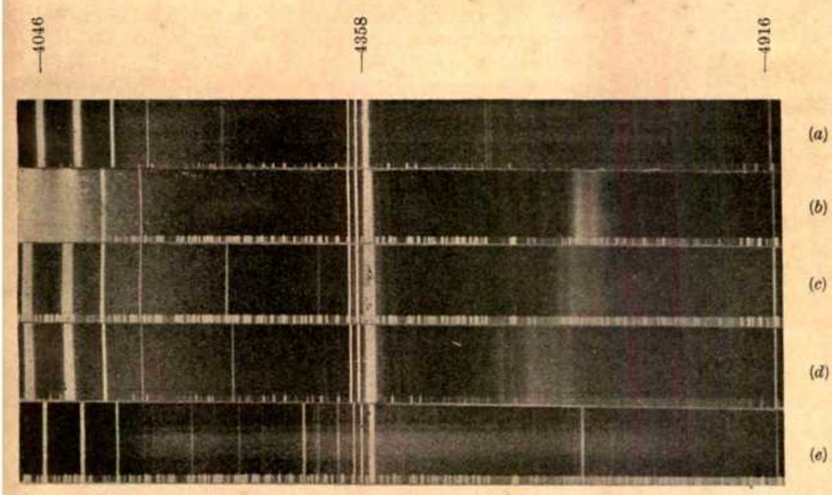
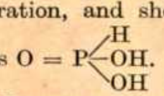


FIG. 1. Raman spectra of (*a*) crystalline phosphorous acid, (*b*) ammonium chloride, (*c*) hydroxylamine hydrochloride, (*d*) hydrazine hydrochloride, and (*e*) naphthalene.

Illustrations of the power of the new technique are furnished by Fig. 1 in which are reproduced the Raman spectra of crystalline phosphorous acid, ammonium chloride, hydroxylamine hydrochloride, hydrazine hydrochloride, and naphthalene, λ 4046 being the exciting wave-length in all cases. While Bär was able to record only five Raman frequencies in the spectrum of naphthalene crystals, not less than twelve frequencies can be identified in the above photograph. The N—H bands in the solids of the ammonium group have been recorded clearly and distinctly for the first time.

One of the interesting results furnished by the new technique relates to the constitution of phosphorous acid. The Raman spectrum of this acid shows a pair of sharp and intense lines with the frequency shifts 2,486 and 2,509 cm.$^{-1}$. These frequencies presumably arise from a P—H vibration, and show that the constitution of the acid is  $O = P\begin{cases} H \\ OH \\ OH \end{cases}$ This conclusion is supported by the Raman spectrum of sodium phosphite, Na_2HPO_3, which shows a strong Raman frequency at 2,335 cm.$^{-1}$.

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Indian Institute of Science,
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Sept. 27.

[1] A. C. Menzies, NATURE, **124**, 511 (1929).
[2] R. Bär, NATURE, **124**, 692 (1929).
[3] R. Ananthakrishnan, *Current Science*, **5**, 131 (1936).

Water under the Western Ice Cap in North-East Land

AT the station maintained from September 1935 to June 1936 near the centre of the Western Ice Cap in North-East Land (80° N., 20° 30′ E., approximately) by the Oxford University Arctic Expedition 1935–36, it has been found that, contrary to expectation[1], the ice-cap is not frozen to any great depth. While a shaft was being excavated in the *firn* beneath the station, a *concealed* crevasse was discovered—there was absolutely no trace of it at the surface, even during the period of summer thaw—and investigated to a distance of some hundreds of feet in the horizontal direction. At a depth of some 70 ft. below the surface was a lake of *water* varying in depth from 3 ft. to 6 ft. The bed of the lake was of ice.

There is reason to believe that this water remains in the liquid state throughout the year, and preliminary calculations give an estimate of the order of fifty years for the age of the crevasse at water-level.

It is hoped to publish fuller results, with detailed figures, later.

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Oxford.

[1] J. E. Fjeldstad, *Geografiska Annaler*, **15**, 314 (1933).

Transition Curve for the Destruction of Supraconductivity by an Electric Current

In former experiments with a tin ring[1] we found that, when supraconductivity is destroyed by an electric current, the field-strength H_{kj} corresponding to the critical current is equal to the critical magnetic field-strength H_k. In order to measure H_{kj} we have now employed the exceedingly high thermal conductivity of He II. Through a tin wire of radius 0·0056 cm. immersed in He II, we were able to send an enormous current ($1 \cdot 5 \times 10^5$ amp./sq. cm.) without noticeably heating the wire or the helium, which enabled us to determine the entire transition curve.

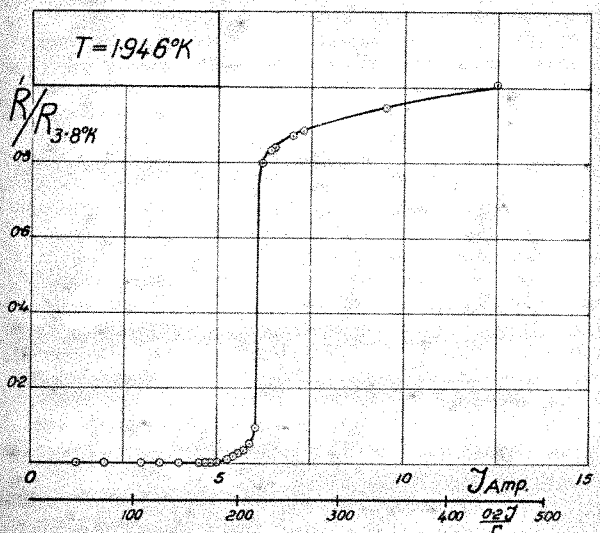

Fig. 1.

The relation between R and I—the second scale is for $H_{kj} = 0 \cdot 2\ I/r$—is depicted in Fig. 1. The resistance unit is taken as $R_{3\cdot 8°\text{ K}}$, that is, the resistance at 3·8° K.

Results : (1) We found that the sharp jump in the resistance corresponds to $H_{kj} = 219$ gauss, which within the limits of experimental error—a few per cent—coincides with the field-strength formerly observed[2], which was 218 gauss.

(2) The resistance rises steeply only up to $0 \cdot 8\ R_{3\cdot 8°\text{ K}}$. Afterwards it rises gradually to the normal value for the non-supraconducting metal.

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N. E. Alexejevski.

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Kharkov.
Oct. 6.

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[1] L. Shubnikov, Nature, **138**, 545 (Sept. 26, 1936). L. W. Shubnikov and W. J. Chotkewitsch, *Sow. Phys.*, in the press.

[2] Shubnikov, Chotkewitsch, Schepelew and Rjabinin, "Arbeiten auf dem Gebiete tiefer Temperaturen", *Sow. Phys.*, Sondernummer, June 1936, p. 48.

Points from Foregoing Letters

Curves showing the effect of 'Citrin'—the crystalline flavone fraction of lemon juice—in prolonging the life of guinea pigs fed on a scurvy diet are submitted by A. Bentsáth, St. Rusznyák and Prof. A. Szent-Györgyi. The active principle (vitamin 'P') appears to have a marked influence upon the capillary system.

A method of estimating ascorbic acid (vitamin C), depending upon the addition of excess of methylene blue and titrating the excess with titanium trichloride, is described by Dr. Imre Gál. On the same subject, H. Cheftel and M.-L. Pigeaud state that by cooling the ascorbic acid solution to 0° C. it is possible to slow down its rate of oxidation and to obtain more consistent results by the method of Harris and Ray (titration with 2 : 6 dichlorphenol indophenol in acid solution).

By means of diet experiments on mice, Drs. A. and M. Lasnitzki have investigated the question whether 'mineral' and 'biological' potassium are equivalent, in view of the possibility that the isotopic constitution may be different. Body-weight and duration of life are affected, but the results are complex.

From the change in the diffusion constant and the rate of sedimentation in the supercentrifuge, it has been deduced that horse hæmoglobin in concentrated solutions of urea, acetamide and formamide, is partly dissociated into particles of half the original weight. Dr. J. Steinhardt puts forward further support for this view and finds that there is no denaturation in the process. He has investigated the properties of methæmoglobin and hæmochromogen prepared from the dissociated hæmoglobin, and he discusses their bearing on current theories of the equilibrium between hæmoglobin and oxygen.

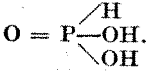
Small quantities of air-blown cacao-butter added to olive oil have the specific property of preventing cloudiness and deposition of stearin on storage at 2° C., according to Dr. W. Clayton, S. Back, R. I. Johnson and J. F. Morse.

A difference in the diamagnetic susceptibility of living and dead bacteria is reported by Prof. E. Bauer and A. Raskin. This, they claim, supports Bauer's theory that the lack of equilibrium in living systems is due to an 'excited' state of the protein molecules of the protoplasm.

Two cases of loss of nitrate (due probably to formation of free nitrogen), one in a culture of the unicellular freshwater alga, *Chlorella*, and another in the presence of daffodil leaves, are reported by Dr. W. H. Pearsall and M. C. Billimoria.

Dr. A. Clow and J. M. C. Thompson find that the diamagnetic susceptibility of carbon dioxide agrees with that calculated from the 'resonance' energy according to the formula of Pauling and Sherman. In the case of other compounds, differences occur between the calculated and the experimental values, and the authors suggest certain possible interpretations.

Using an improved device for obtaining Raman spectrograms with crystal powders, R. Ananthakrishnan has obtained evidence indicating that the constitution of phosphorous acid should be represented by



$$O = P\begin{matrix} \diagup H \\ -OH \\ \diagdown OH \end{matrix}.$$

Research Items

Garments from Yunnan

The late Prof. Augustine Henry, well known as an authority on forestry, was stationed in southern Yunnan as an officer of the Chinese Customs in the last decade of last century. He then made a study of the little-known peoples of the country, including the Lolo, more correctly known as the Nosu. A small collection of clothing which he brought back to England, described as 'Lolo', but now shown to be Miao, was presented to the Manchester Museum by Mrs. Henry. It has since been studied and described by the Misses Laura E. Start and Mabel C. Wright (*Notes from the Manchester Museum*, No. 37 : Repr. *Mem. Manchester Lit. and Phil. Soc.*, 80 ; 1935–36). The garments consist of four coats—a short-waisted pullover with long sleeves and the chief embroidery at the waist, two linen coats, sleeveless and short-sleeved, with shoulder and collar decoration, and a Chinese derivative, little worn by Miao women—and lastly a short skirt. All differ in technique and style from Chinese work. The description 'Lolo' is shown to be incorrect, as Lolo women wear jackets and long petticoats (which are rarely heavily embroidered) silver ornaments and a long felt cloak. This last is a prominent feature in the clothing of both sexes. The Miaos, who are tenants or serfs of the Lolo, call themselves *mp'eo*, a sound which means "embroidery". The amount of embroidery on the clothing of a Heh Miao young woman is astonishing ; and it takes them years to embroider the jackets or skirts, in which they hope to be married. The embroidery on the garments now in the Manchester Museum, the only ones of their kind in an English museum, clearly indicates their origin. They belonged either to the concubine of a Nosu chief or to serfs on a Nosu estate. The materials used are local cloths made from flax or wool, with trimmings of silk, cotton and wool. Cotton cloth is obtained from the Shan, the only people of the region who now weave cotton. The ornament, hand sewn, is mainly geometric, and well placed. Possibly Chinese influence can be traced ; but Shan influence is more marked, for example, in the use of coloured cloths applied in strips and small pieces, in borders, and joined in large pieces to give variety of colour. Two unusual methods employed in making patterns are folding to produce a strip effect, and a stitching giving a brocade texture.

Mound Builders in Louisiana, U.S.A.

An examination by Mr. Winslow M. Walker in 1931–32 of the remains of a group of mounds in Louisiana has preserved evidence relating to early indigenous culture, which was in danger of being lost entirely. The mounds, upon which now stands the township of Jonesville (formerly Troyville) in Catahoula Parish, near the junction of the Tensas, Black, or Ouachita, and Little Rivers, eighteen miles west of the Mississippi, are thought to be identical with the capital city of the Province of Anilco visited by de Soto in 1542. They were seen by Duncan and Hunter in 1804. The remarkable feature of the group was then a conical mound raised on a pyramidal platform with two terraces, and there is evidence to show that it had a total height of eighty feet. This would make it second in height only to the Cahokia mound in Illinois. It was partially destroyed in the American Civil War, and finally levelled in 1931, when great sheets of cane, pottery, bones and variously coloured clays were brought to light. The neighbouring mounds have been used for house sites, but enough remained of the great mound beneath the levelled surface to yield to Mr. Walker's excavation something of the cultural history and evidence of the method of construction (*Bull.* 113, *Bureau of American Ethnology*). Excavation of part of a burial ground near the river brought to light a number of burials ; but there was no certain indication of a connexion between the human remains and the former inhabitants of the mounds. The artefacts found in the remains of the mound were not numerous, the most important being the pottery, which though extremely fragmentary, afforded material for a classification into a number of types. The most remarkable feature was the constructional use of cane in layers of some thickness. There is evidence of at least two periods of occupation or construction, of which the earlier resembles that of the Hopewell Mound builders of Ohio, and the second inaugurated important structural changes. The last inhabitants of the site may have been the Taensa or the Avoyel, both related to the Natchez, who were broken up by the French in the eighteenth century.

Inheritance of *l*-Xyloketosuria

There are known to be at least two types of the rare chronic pentosuria, differing in the nature of the pentose sugar found, one being optically inactive *dl*-arabinose and the other *l*-xyloketose. The latter—a quite abnormal sugar—is now well authenticated, and a simple new test devised by Lasker and Enklewitz facilitates its identification. The same authors have adduced evidence that *d*-glucuronic acid is the precursor of the pentose, though on theoretical grounds the conversion is difficult to follow from the formulæ of the two substances. At any rate the administration of glucuronic acid causes a greatly increased elimination of this pentose in the urine. What is more interesting is the observation (*Human Biology*, 8, No. 2 ; 1936), based on the study of twenty pentosuric families, as to the inheritance of *l*-xyloketosuria. The urine pentose of thirty-seven individual members has been identified as this sugar. The disease is very rare in the general population, but is frequently found in the families of known cases. Most cases are among Jews. The disease was present in children of ten families in which neither parent shows evidence of it. One case was a child of first cousins. These facts are regarded as indicating strongly that *l*-xyloketosuria is inherited as a recessive character and controlled by a single recessive gene.

Shore Fauna of the Arctic

THE East Greenland Polar Current bathes the shores of east Greenland in low-temperature water and gives rise to much more severe conditions there than obtain on the west coast. Holger Madsen has surveyed the area 70° 29′ N. to 74° 05′ N., and finds that life in the littoral and supralittoral zones is limited to comparatively few species ("Investigations on the Shore Fauna of East Greenland with a Survey of the Shores of other Arctic Regions". *Medd. Grønland*, 100, No. 8; 1936). *Fucus vesiculosus*, *Balanus balanoides*, and *Littorina saxatilis* var. *grœnlandica*, all of which occur in the same longitude on the west coast, are absent here, and the common forms are oligochætes, dipteran larvæ, and certain mites and nematodes. The first two may be present in numbers as great as 18,000 and 27,000 per square metre respectively. In the first part of this paper, a detailed account is given of the faunas of the different types of facies—rocky, gravel, clay, etc., and in the second part the area is compared with the west coast of Greenland and with the other known arctic and subarctic shores. The survey of the scattered literature on this subject is of particular value.

Fishes from West Borneo

Treubia (Deel 15, Aflevering 3 ; 1936) contains a paper by Dr. J. D. F. Hardenberg (Laboratorium voor het Onderzoek der Zee, Batavia) "On a Collection of Fishes from the Estuary and Lower and Middle Course of the River Kapuas", in which he describes a large number of interesting species, adding many records to the fauna of Borneo. These were to a large extent collected from the fish-market at Pontianak, caught in an affluent of the River Kapuas and on the adjoining coast. Others came from streams connected by numerous water courses with the Kapuas, and from the Peniti River, the last coming from farther up the river and from some of the great lakes near. The author gives notes wherever possible on the various species used as food, their local names and feeding habits besides the morphological descriptions.

Anatomy of a Nyphomyiid Fly

IN 1932, Mr. M. Tokunaga announced the discovery of a new dipterous insect in Japan, which he described as *Nymphomyia alba* gen. et sp. nov. It exhibited a combination of peculiar features which led him to establish the family Nymphomyiidæ for its inclusion. He now discusses the nervous, tracheal and digestive systems of this insect (*Philippine J. Sci.*, 59, No. 2, 189 ; 1936). As regards the nervous system, he describes the ventral nerve cord as consisting of three thoracic and eight abdominal ganglia. The presence of eight separate ganglia in the abdomen is frequent among dipterous larvæ but very rare in the adults of the higher Pterygota. In the tracheal system there are only two pairs of functional spiracles, namely, meso- and metathoracic, while vestigial closed spiracles are present in the abdomen. The tracheal system itself is very simple, consisting of two main longitudinal trunks with very few transverse anastomoses. The alimentary canal is of relatively simple structure : there is no trace of crop or sucking stomach, and histologically the gut shows no evidence of serving a digestive function. The Malpighian tubes are only two in number and open into a common ventral excretory chamber. The structure of the cells of the tubes are peculiar in that small intracellular tubuli open into a common central canal.

Studies of Frost Hardening

IN a very suggestive investigation upon this subj (*Canadian J. Res.*, 14, Sec. C, Aug. 1936) by Levitt and G. W. Scarth, comparisons were made the plasmolytic method of the permeability of cells of corresponding tissues of various herbace and woody plants in the unhardened and harde state. Frost hardening of herbaceous seedlings carried out by keeping them for some days in a c chamber, in the case of the woody plants ; in addit to twigs thus artificially hardened, comparis were made with tissues brought in from the o country where they were undergoing the nor seasonal hardening during winter. The result been to show an unexpectedly definite effect, a mar increase in permeability with hardening. It is c cluded that cell permeability in the hardened st shows a better correlation with ability to resist fr than any other character so far examined. permeability change is most marked towards a like potassium nitrate ; the change is less mar towards polar non-electrolytes with small molec such as urea ; there is no change towards an apo substance such as urethane. The authors sugg that these phenomena point to an increase in of the aqueous pore surface in the plasma membr as a result of the exposure of the living tissues to c

Hudson Strait Survey

THE sixty-ninth annual report of the Canad Department of Marine for the fiscal year 1935 (Ottawa : J. O. Patenaude, price 25 cents) conta interesting information respecting the explorat survey work now in hand in connexion with development of navigation in Hudson Bay to from the recently established port of Churchill. principal feature of the season's operations was charting of a deep-water channel inside the Dig Islands and close to the continental coast, and tending for a distance of twenty-two miles fr Wolstenholme to the westernmost islet. It is m than a hundred fathoms in depth and so strai that two courses only are required. The new chan called Digges Island Sound, is reported as being free in the late fall for some ten days after the us ship's route, north of the Digges Island, and shortens considerably the distance from the sea places on the eastern side of Hudson Bay and Moosonee in James Bay. The newly charted chan possesses a bleak grandeur. At the eastern entra of the Sound on the mainland side stands C Wolstenholme, with perpendicular walls rising thousand feet from the water's edge. From t great headland, the Sound is walled for several m by enormous cliffs. Thousands of guillemots murres come yearly to these cliffs to breed and, the summer months, the place is alive with th clamour.

Silting of Reservoirs

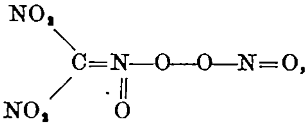
THE problem of the silting of reservoirs by stre carried material and the means of reducing the pro are being widely studied in the United States by Soil Conservation Service of the Department Agriculture. The first report dealing with re sentative reservoirs in the southern areas has b published (Silting of Reservoirs. By H. M. Eal Washington, D.C.). The rapid silting would app to be due to the broad prevalence of soil eros induced by human occupation. The highest r go with agriculture: the lowest with forest cover. In other parts, particularly dry areas, silting is accelerated by over-grazing and the consequent reduction of the plant cover. The prevention therefore of this growing menace seems to lie in the control of soil erosion by improved methods of agriculture, reclamation of steep slopes, extension of forest growth, and restriction of over-grazing. Fire prevention and rapid planting of burnt areas are other ways of reducing silting. The report includes full instruction for reservoir sedimentation surveys.

Scintillations of Zinc Sulphide

THE scintillations produced on a zinc sulphide screen by α-particles have served, as is well known, in counting the number of such particles emitted by a radioactive preparation. Various specimens of zinc sulphide have very different activities in this respect, and the suitability is connected with the size of the crystals, the presence of traces of impurities, etc. In a study of the phenomenon, G. Destriau (*J. de Chimie Phys.*, **33**, 587; 1936) has indicated some further interesting features. The sensitivity of a specimen of zinc sulphide to α-rays is not connected with the phosphorescent properties in relation to light, since a sulphide which is phosphorescent can give no scintillations, and vice versa. The fluorescence under X-rays, on the other hand, is closely related to the brightness of the scintillations. It was possible to produce luminescence in zinc sulphide by the action of an electric field.

Constitution of Tetranitromethane

THE constitution of the compound $C(NO_2)_4$ has recently engaged the attention of the Czechoslovak chemists, Prof. Cyrill Krauz and Dr. J. M. Štěpánek (*Chem. Obzor.*, **11**, 153 and 177; 1936). These authors conclude that none of the structural formulæ previously assigned to tetranitromethane (TNM) fully explains its chemical reactions. Not one, for example, explains its oxidizing properties. The substance can scarcely be regarded as a true tetranitro-compound since one nitro-group is more reactive than the others, and a new structure is suggested, namely:



which accounts for the formation of nitroform as an intermediate and as a decomposition product. Tetranitromethane acts most strongly as an oxidizing agent in alcoholic solution. A peroxide hydrogen atom is given up in the presence of such reducing agents as sulphides, sulphites, arsenites, hydrazine and hydroquinone, with the liberation of nitroform. Iodine is set free from iodides not only in the presence of acids but also in neutral and even weakly alkaline solutions. The above formula also indicates how guanidine, methylamine, ammonia and nitrogen can be derived from tetranitromethane, and its formation by the interaction of silver nitrite and iodonitroform is at once apparent. The compound is not decomposed by anhydrous sulphuric acid or by glacial acetic acid, and the authors obtained no evolution of gas in Lunge's nitrometer on treating tetranitromethane with concentrated sulphuric acid, although with the dilute acid the decomposition became very violent.

Electrical Prospecting and its Uses

IN a paper presented at the Second Congress of the International Commission on Large Dams at Washington on September 10, C. and M. Schlumberger show how to utilize the fact that underground formations differ largely in their electrical resistivity. The electrical current conducted by rocks varies largely with the amount of assimilated water they contain. Rocks like granite, gneiss, marble and all rocks in which the spaces of pores form only a very small fraction of the total volume have a resistivity varying between 200 and 3,000 ohms per cubic metre; for clays, marls, soft limestones, etc., it varies from 10 to 30 ohms. The large differences between the resistivities show that they can be usefully employed to foretell the nature of the foundations on given sites. Since the measurements made are at small depth, the necessary equipment is very light and easily handled. It consists of a potentiometer, a few dry-cell batteries, two reels of cable and copper pegs to make the earth contacts. If it is required to find the exact depth of the bedrock by an electrical sounding, an average of about four measurements per day can be made, but even so the cost is very small when compared to that of mechanical drilling. When a large surface has to be surveyed to determine a suitable site the technique is different, and an efficient operator can make about forty measurements per day, a different method being employed. The results obtained in four practical applications are given: one in France, two in the United States and one in Canada. In predicting the depth of the bedrock in one case, the maximum error made was nine per cent and the average error 6·4 per cent. A translation of the paper, which is in French, is given in *World Power* of September.

Discrete Space-Time

IN the course of five lectures delivered in the McLennan Laboratory of the University of Toronto in January and February 1936, and published in pamphlet form (*University of Toronto Studies, Physics Series*; University of Toronto Press, 1936), Dr. L. Silberstein examined some of the consequences of the hypothesis that both space and time are discrete instead of being continuous. This would imply, for example, that in any finite volume the number of positions that a particle could occupy would be, although very large, not actually infinite, and that in describing its motion all that could be specified would be its position at very short intervals of time, as in a cinematograph film. Such an assumption has much in common with the postulates of quantum theory. Dr. Silberstein shows that discrete space-time is compatible with the restricted relativity theory, at least to a high degree of approximation. But, as no place is left for infinitesimals and hence for covariant tensors, the general or gravitational theory is ruled out. To the ordinary physicist this seems regrettable; but Dr. Silberstein, for reasons not explained, declares that "the generalized relativity theory is far from being firmly established, and its heuristic power, its successful predictions (of which one, that relating to the perihelion motion of Mercury, seems very doubtful) seem to be nearing exhaustion, while certain rigorous conclusions recently drawn from Einstein's general-relativistic theory of gravitation by the writer turn out to disagree with some most fundamental facts of experience".

Methods in Social Anthropology*

IN opening his lecture in memory of Thomas Henry Huxley, Prof. Westermarck said that it was calculated in a peculiar way to call to his mind the first steps he ventured to take in social anthropology nearly fifty years ago, when, being concerned with the origin of marriage, and thinking with other scholars of the time that primitive man lived in a state of promiscuity, he became acquainted with the doctrine of organic evolution and drew the conclusion that the social habits of the anthropoids might throw some light on those of primitive man. It is now to be regarded as amply proved that among many of the apes the social unit is the family, and it may be concluded that the factors which necessitated marital and paternal relations among the apes also presumably operated among our earliest human or half-human ancestors. He went on to point out, however, that apart from its role in the production of instincts, the principle of natural selection does not render us much help in our search for social origins.

In his study of social origins, the sociologist is much better situated than the biologist in his study of organic evolution. Natural selection presupposes organic variation, but scarcely anything is known about the origin of these variations. The causes of social phenomena, on the other hand, are to an almost unlimited degree accessible to the sociologist; and it is his business to find them. The methods of sociology, therefore, are ultimately the methods of finding the causes of social phenomena.

One method of social anthropology is the comparative one. This method starts from the fact that there are great similarities between the products of culture. The task of comparative sociology is not so much to classify these facts as to answer the question why there is this similarity. Tylor, Huxley, Frazer, have all recognized the fact that these similarities may be due to a similarity in the operations of the human mind in like conditions, or they may be due to diffusion or borrowing; and the criticisms of Rivers, Elliot Smith and others to the effect either that the possibility of diffusion is not recognized, or if it is that this involves a contradiction, are not well grounded. It is true that the question whether a certain custom or institution has sprung up independently among the people or tribe practising it, or whether it has been introduced from some other people or tribe, is seldom discussed in comparative treatises. But this by no means implies the assumption of independent origin; on the contrary, when the custom or institution occurs among related or neighbouring peoples, there is, at least in many cases, a tendency almost to take it for granted that it has been derived from a common source. Taking the study of proverbial sayings as an example, peoples have at all times taken adages from each other. But it must always be borne in mind that the resemblance between proverbs may have another cause than diffusion, namely, the people's tendency to express themselves in apophthegmatic sayings, which, owing to their terseness, are apt to become more or less similar in similar situations. The real test of a common origin is, therefore, not the mere similarity of ideas and sentiments revealed in the proverbs, but the similarity of formal expression, with due allowance for modifications that are liable to occur when a saying is adopted from another language and transplanted into a new soil.

Another branch of cultural phenomena in which diffusion has played a prominent part is decorative art. The diffusion may not in every case refer directly to particulars in the design; it may also be an independent effect of the idea underlying it. The patterns used in Morocco were originally to a large extent charms against the evil eye. They are based on two principles, the hand, or its five fingers, and the image of an eye or pair of eyes. Both types of charm are spread all over the Mediterranean, and many of them also farther east, and are proved to have existed since very early times. This does not preclude the possibility of more or less similar representations of protective objects having in certain instances originated independently, which is illustrated by the occurrence of designs or charms on the leather bags of the mountaineers of Morocco in the form of a pair of eyes resembling the capital of an Ionic column. That the capital of an Ionic column may have its origin in a charm against evil protecting the temples of the Greeks would be no wonder; but it is extremely improbable that the Moorish charms have been copied from the Ionic capital. Their resemblance is easily explained by a common belief that the representation of the eyes serves as a protection against the evil eye. Widely distributed, the eye ornament may have a different meaning in different cases, illustrating a weakness in the method of diffusionists, who have a tendency to rely on external resemblances only.

Comparative study further may enable us to discover that certain customs are vestigial forms, so-called survivals—a custom which cannot be explained by present circumstances, but persists in isolation from its original context. In spite of the importance of this principle, there has never been any general theoretical discussion of its proper application, where historical evidence is absent. Two definite rules may be laid down. A custom must not be interpreted as a survival of something of which it cannot be a survival, and it must not be regarded as the survival of something, which is not known to have existed, or the earlier existence of which may not be assumed for some other reason, as for example in the so-called survivals of an ancient state of group marriage.

Nowadays the reaction against the evolutionary school of anthropologists has become so strong that any attempt to conjecture the origin of a social institution or of an element of culture has been pronounced to be out of place in social anthropology. It is, however, in this field that social anthropology has performed some of its most important tasks. Its results are to a large extent as well established as any reached in any sphere of research. The common complaint of the 'new anthropology' that the comparative method detaches the cultural phenomenon from the organic whole, of which it forms part, is largely due to the incompleteness of the sources at the sociologist's disposal, and can be remedied by careful monographs on particular cultures. The 'new anthropology' aims at discovering general laws, but it is doubtful whether such general laws, if discovered, would be of much service in investigating social phenomena.

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* Substance of the Huxley Memorial Lecture for 1936, delivered by Prof. Edward Westermarck before the Royal Anthropological Institute on October 27.

On the other hand, the view expressed by Prof. Radcliffe-Brown that "no insight, however genial, can fully compensate for the absence of direct personal contact with the kind of material that the anthropologist has to study and explain", is to be fully endorsed. It is borne out by Prof. Westermarck's personal experience of nine years close contact with the Moors, spread over more than three decades, and spent in investigating their customs and ideas.

Morphogenesis and the Field Concept

THE discussion on morphogenesis which was held in Section D (Zoology) during the Blackpool meeting of the British Association was concerned mainly with the use of the field concept in experimental embryology. The central problem of the causal analysis of development is to account for the production of organs, that is to say, of masses of tissue which are integrated into units. Such integration can only be dealt with in terms of something which extends throughout the whole volume of the mass, and such extended entities are now usually referred to as 'fields'.

The first problem which arises is to give a satisfactory description of the integral behaviour. The sequence of shapes which are assumed by an organ during development has been described in great detail for most animal organs, but we require now some way of summing up, for each organ, the whole assemblage of shapes in a way which expresses the unitary character underlying the series. Probably a new branch of mathematics will be necessary to deal with such unfolding of even more complicated forms, though Dr. J. Needham mentioned the application of topological analysis and Gaussian curve analysis as hopeful possibilities. Mr. C. H. Waddington gave an example of what can already be attempted in some of the simpler cases ; the shape of the notochord and somites of the early chick embryo can be expressed as the product of two damped wave functions, with the time variable in the expression for the damping of the longitudinal wave function, so that as time proceeds more waves (that is, somites) are formed. It is possible, by causing the embryonic body to develop in a bent form, to distort the co-ordinate network in which the functions are measured, and experiments of this kind may make it possible to choose, from mathematical possibilities, the particular formulation which most immediately expresses the actual forces at work.

The integrated or organized behaviour of developing organs is shown by the regulation of parts of the organ to reconstitute the whole ; such experiments make it clear that the behaviour of a part of a developing organ is a function of its position in the whole. Dr. P. D. F. Murray described some beautiful examples of this type of behaviour, taken from his own earlier work on chorio-allantoic grafts of fragments of the limb-bud of chick embryos, and from Miss H. B. Fell's recent work on tissue culture of the same material. Thus if the isolated fragment contains slightly more tissue than would normally take part in the formation of the femur, it nevertheless forms no more than a complete femur, which therefore incorporates the extra tissue. Dr. Murray also discussed the mosaic development of later stages in which regulation is no longer possible. Prof. E. A. Spaul's interesting and important communication on the hormonal control of metamorphosis in Amphibia also dealt with aspects of morphogenesis which do not come into the scope of this short note.

Regulation can only be analysed in ordinary causal terms if we suppose that the series of whole unit shapes, to which regulation occurs, is an equilibrium-series, that is, an equilibrium which is not constant but follows a definite course in time. According to this view, all the forces which at any time produce the developmental form-changes of an organ are in equilibrium with one another, and if the equilibrium is disturbed, for example, by removing part of the tissue, the same forces restore the equilibrium and thus cause the regulation of the organ. Regulation is therefore due to the interaction of forces proceeding from the different parts of the developing organ-rudiment. In so far as it is dependent on forces proceeding from different parts, it is dependent on local differences within the organ rudiment, and is in this respect similar to mosaic development, which is often and wrongly taken to be the exactly opposite type of behaviour to regulation. According to the present point of view, the differences between them are much less important ; both types of behaviour depend upon local differences within the developing mass, but in cases where regulation occurs these differences are still labile and are capable of being altered by their mutual interaction, while in the mosaic stage the differences have become fixed and stable.

Dr. Needham concerned himself mainly with the nature of the forces which are concerned in setting up such equilibria. He directed particular attention to the possibility of finding a basis for the structural differentiation of masses of tissue in the arrangement of anisomorphic micelles or molecular aggregates. We know both that such molecules exist in protoplasm and that they can be arranged into orientated masses of the nature of liquid crystals. Such facts make it possible for the biochemist to form a picture of what it is the embryologist may be referring to when he invokes a '*cytosquellette*' or an '*Intimstruktur*'. The time has not yet come, he said, for an attempt at a detailed application of such ideas. We want to know, in particular, something about the maximum size of the volumes which can be affected by such molecular structures. Can we expect the orientated arrangements to be large enough to be invoked as an immediate explanation of such phenomena as the closure of the neural plate or the gastrulation movements in an amphibian egg, or must we only expect to find them active as determining the positions of other agencies which are the immediate causes of the more large-scale changes of form ?

C. H. WADDINGTON

Dietary Standards

IN December 1935, a Commission of Experts (Technical Commission) appointed by the Health Committee of the League of Nations issued its London Report on the "Physiological Bases of Nutrition" (see NATURE, Feb. 1, p. 176). The publication of this report was followed by its communication for study to representative learned societies, social studies institutions and health administrations in various countries. Observations received from such sources indicated general approval of the purpose and content of the report. Several suggestions were made, however, regarding details which might deserve further consideration. These were examined at a further meeting of the Technical Commission at Geneva in June last, with the result that a revised edition of its report has now been published[*].

The most noticeable changes in the new edition are those which amplify the previous sections dealing with the feeding of children. The general principles of infant feeding are dealt with in greater detail. Such topics are now included as the use of heated milk to prevent milk-borne infections, the methods of preventing nutritional anæmia and the special requirements of premature infants. Dietary schemes are now included for children in the age groups 5–7 years and 12–14 years as well as for those in the younger groups. Incidentally, the energy allowances for children in the age groups 1–2 years and 2–3 years have now been slightly raised. A further alteration of note concerns the energy allowances for adults. It may perhaps be remembered that in the original report an allowance of 2,400 calories a day was suggested for men and women alike, with supplements for muscular activity varying according to the severity of the work performed. In the revised edition, the basal allowance is the same, but the supplements are increased, so that for light work the new scale allows up to 75 calories per hour of work in place of 50, for moderate work 75–100 calories in place of 50–100, for hard work 150–300 instead of 100–200 and for very hard work 300 calories and upwards instead of 200 and upwards.

Certain general principles regarding the choosing of suitable dietaries are set forth in greater detail in the new edition. The modern conception of 'protective' foods is elaborated; the term is defined as including foods which are especially rich in those nutrient principles (good protein, vitamins and minerals) in which the chief foods of any geographical area are deficient. Good protein might thus be a valuable protective food in an Asiatic diet but not in a Western diet where a scarcity of it is comparatively rare. Attention is directed to the value of lightly as opposed to heavily milled cereals as a source of iron and vitamin B_1, and to butter in preference to other common fats because of its richness in vitamin A. The consumption of excessive amounts of sugar is condemned for the reason that it tends to lessen the proportion of protective foods in the diet as a whole. Lastly, the Commission has added to its list of problems requiring serious study the investigation of the optimum amount of milk required by human beings at different ages.

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[*] "Report on the Physiological Bases of Nutrition." Revised and amplified at the meeting held at Geneva, June 4–8, 1936. *Quarterly Bulletin of the Health Organisation, League of Nations*, 5, 391 (London: George Allen and Unwin, Ltd., 1936).

Educational Topics and Events

CAMBRIDGE.—The Vice-Chancellor gives notic that the professors of physiology (Sir Joseph Ba croft), social anthropology (Prof. T. C. Hodson) an zoology (Prof. J. Stanley Gardiner) are due to reti on September 30, 1937.

Prof. Th. Von Kármán, of the California Institut of Technology, has been appointed Rouse Ba lecturer for the year 1936–37.

The following have been approved for the degre of Sc.D.: W. L. Edge, of Trinity College, and D R. G. W. Norrish, of Emmanuel College.

At Clare College, E. N. Willmer, of St. John College, University lecturer in physiology, has bee elected into an official fellowship.

At Newnham College, the Henry Sidgwick Memoria Lecture will be delivered on November 28 at 5 p.m by Lord Rutherford. The subject of the lecture i "Modern Alchemy".

The Adams Prize is open to the competition of a persons who have at any time been admitted to degree in the University. Women are also eligibl The subject proposed for the period 1937–38 is th distributional properties of functions of statistic variables.

LONDON.—The following degrees have been con ferred: D.Sc. (Economics) on R. P. Tripathi, a internal student, of the London School of Economics D.Sc. on E. E. Jelley, an external student, and D.S (Engineering) on R. W. Bailey, an external studen

OXFORD.—W. D. Hambly, of Jesus College, ha been granted the degree of D.Sc. for his work i social anthropology.

Dr. J. A. Douglas has been appointed deputy f the professor of geology during the vacancy.

THE bicentenary of the University of Göttinge will be celebrated in the last week of June 1937.

THE International Congress on Technical Educatio which was to have been held in Rome on May 28–3 but was indefinitely postponed will take place ther on December 28–30. The Congress is under th auspices of the Bureau international de l'enseign ment technique, 2 Place de la Bourse, Paris, fro which further information can be obtained.

THE following scholarships, which are tenable f three or four years, according to the length of t course at the university selected, will be offered b the Institution of Naval Architects for competiti in 1937: *Naval Architecture:* Martell, £130 p annum; Trewent, £125 per annum; Denny, £75 p annum. *Marine Engineering:* Parsons, £150 p annum; Yarrow, £100 per annum; Denny, £75 p annum. Full particulars may be obtained from t Secretary of the Institution of Naval Architect 2 Adam Street, Adelphi, London, W.C.2.

ADULT education offers to a community sufferin from the lag of the social sciences behind the advan of the natural and technological sciences and threaten by consequent social disorganization a potent remedi instrument. It has, to use a metaphor populariz by Sir Josiah Stamp *a propos* of the "impact science" in his address to the British Association, a high potential value as a 'shock-absorber'. This has been recognized in the United States, and is one of six reasons assigned by Dr. Floyd W. Reeves, professor of education in the University of Chicago, for he recent rapid expansion in adult education in the United States, the other reasons, less significant and compelling, being: activities of the American Association for Adult Education, organized in 1926; ncreased leisure; need for retraining for new occupaions resulting from technological progress; Thorndike's exposure of the fallacy that adults rapidly lose ability to learn; and the success of a widespread drive to promote parent-education so as to facilitate the introduction of reforms in school-teaching methods, notably in methods of teaching how to read. Dr. Reeves is consultant and was director of personnel to the Tennessee Valley Authority, and he has contributed to *School and Society* (Aug. 29) a paper on adult education as related to the T.V.A. In the co-operative commonwealth administered by his body, its adult educational programme holds a key position. In the systematic employment in this field of four new instruments—the public library, radio, visual education and public affairs forums—the authority is pre-eminent among educational agencies. A three-weeks observational tour revealed great keenness among the learners, numbering more than 25,000, and a high standard of efficiency among the teachers, more than half of whom give their services without pay in their spare time. Concerning adult education in the country as a whole, Dr. Reeves quotes statistics indicating that the participants in 1934 numbered more than twenty-two million.

Science News a Century Ago

A Balloon Voyage from England to Germany

There were several notable balloon voyages in 1836, but none of them excited greater interest than that by Charles Green in the great Nassau balloon rom the Vauxhall Gardens to Weilburg, in the Duchy of Nassau, on November 7–8, 1836. The balloon had a full equipment of scientific instruments, provisions for a fortnight and an apparatus with which it was hoped to be able to keep the balloon afloat if it was necessary to come down on the surface of the sea.

With two companions, Green ascended at 1.30 p.m. on Monday, November 7, and landed at Weilburg at 7.30 a.m. on Tuesday, November 8. When he passed over Dover, a message for the Mayor was sent down in a parachute. Writing of the episode in the *Athenæum*, "W. P." said: "We look forward with some anxiety to the receipt of a more detailed account of this interesting adventure, the perfect accomplishment of which must have realized the most sanguine expectations of the gentlemen who undertook it. It is no matter of wonder that it should have excited the public attention with such a lively interest, for to say the least of it, it has furnished a fact which is quite new in the history of man—that of his having travelled a distance of from four to five hundred miles in the short space of eighteen hours, or in other words, having travelled, in that period, a distance which is not usually accomplished n six times as many hours".

The Human Brain

In a review in the *Athenæum* of November 12, 1836, of "The Human Brain, its Configuration, etc., illustrated by references to the Nervous System of the Lower Animals", by Samuel Solly, the writer said: "This is a scientific book by a scientific man, and written rather for the profession than the public. We hope, however, that every day will bring physiology more within the range of general education, and that future generations will know something more of themselves, physically as well as morally, than their ancestors did, in the ignorant past. . . . Hitherto as he himself firstly observes, the information conveyed of the anatomy of the brain, by systematic works, has amounted to little more than a vain catalogue of names, applied to parts, without reference to their structure, their functions, or even their analogies in the nervous system of the lower animals. . . . That Mr. Solly should have abandoned this method, and broken through a long night of ancient usage, to proceed in a truly scientific plan . . . is good *primâ facie* evidence in favour of his mental qualifications for the task he has undertaken; and his perpetual reference to comparative anatomy shows an equal contempt for the spirit of routine, which has so long possessed the medical constituted *corps* of London. . . ."

Samuel Solly (1805–71), the author of the book, had been trained under Benjamin Travers (1783–1858), surgeon to St. Thomas's Hospital, London, and was elected a fellow of the Royal Society in 1837.

Identification of the Body of Charles I

In a lecture on this subject delivered at the Aldersgate School of Medicine and reported in the *London Medical Gazette* of November 12, 1836, Dr. William Cummin gave the following account of the identification of the remains of Charles I, when a search conducted by Sir Henry Halford was made for them at St. George's Chapel, Windsor: "The particular vault in which the coffin was deposited had long remained unknown, though it was understood to be the one in which Henry VIII and one of his wives were laid. Accident led to its detection. A scroll with name and date served in some measure to authenticate the outer covering; but the examination of the head left not a doubt of the identity of the royal remains. Upon disengaging the face from the cere-cloth, which had been lined with an unctuous and resinous substance, apparently with a view to exclude the external air, the complexion of the skin was found to be dark and discoloured. The forehead and temples had lost little or nothing of their muscular substance; the cartilage of the nose was gone; but the left eye in the first moment of exposure was open and full, though it vanished almost immediately; and the pointed beard, so characteristic of the period of the reign of King Charles, was perfect. The shape of the face was a long oval; many of the teeth remained; and the left ear in consequence of the interposition of the unctuous matter between it and the cere-cloth was found entire. The countenance, in short, notwithstanding its disfigurement bore a strong resemblance to the coins, the busts and especially to the pictures of Charles the First by Vandyke. Finally the fourth cervical vertebra was found divided transversely—the corresponding surfaces being smooth, betokening that they had been separated by a heavy sharp instrument."

Societies and Academies

Paris

Academy of Sciences, October 12 (*C.R.*, 203, 637–696).

Louis Bouvier : Correction and addition relating to the obituary notice of Jean Charcot (*C.R.*, Sept. 21, 1936).

Lucien Cayeux : The impregnation with hydrocarbons of the North African phosphates and their origin.

Julien Costantin : The production of wheat in Peru in 1932 and 1934. Discussion of the causes of the reduction in wheat production in Peru, with special reference to rust. There would appear to be an optimum altitude for the cultivation of wheat.

Werner Fenchel : Quadratic inequalities between the mixed volumes of convex bodies.

Ervin Feldheim : The orthogonality of the Lagrange fundamental functions of interpolation.

Paul Flamant : Grouping in classes of quasi-analytical functions (*D*).

Paul Montel : Functions defined by series with recurrent coefficients.

Kyrille Popoff : The pendular movement of the projectile.

Michel Duffieux and Léon Grillet : The application to microspectroscopy of the method of the astronomical prism objective.

Marius Aubert : The relations between the Baeyer tension τ and the characteristic Raman frequency in the case of the cyclic hydrocarbons. The characteristic Raman frequency of the nucleus appears to be a definite linear function of the tension τ due to the deviation of the carbon valencies.

B. Rosen and L. Neven : The absorption of sulphur vapour between 3600 A. and 5000 A.

Horia Hulubei : Weak emissions in the *L* spectrum of radium (88). Results in tabular form completing the list of stronger lines given in earlier communications (*C.R.*, 203, 399 and 542).

Mlle. Marie Théodoresco : Study by the Raman effect of a tungstotartaric complex compound in water. The results favour the hypothesis that the complex compound $Na_2(TH_2,WO_3)$ exists in solution in water.

Georges Darzens and André Levy : The synthesis of a new isomer of retene : 1.methyl.9.isopropylphenanthrene.

Henri Longchambon : The characteristic properties of the palygorskites. Study of the rate of dehydration as a function of the temperature.

Jean Chevrier : Relations between the electric field of the atmosphere and some meteorological factors during the year 1934 at the Observatory of Ksara (Liban).

Mario Bossolasco : The nature of magnetic disturbances. Detailed discussion of the records obtained by various magnetic observatories of the magnetic storm of April 30, 1933.

René Souèges : The embryogeny of the Papaveraceæ. The development of the embryo in *Chelidonium majus*.

Raoul Combes : The experimental production in a submerged plant of the structural characters peculiar to aerial organs.

Raymond Chaminade : The passage of potassium in soils to the non-exchangeable state.

Arthur Vernes : Researches on the specific substance of syphilitic fluids.

Robert Paulais : The localization of nickel the organs of lamellibranch molluscs. The nickel distributed in different proportions in different orga of the mollusc. *Cardium edule* contained a mu higher proportion of nickel than the other mollus examined, and this was confirmed by analys additional specimens.

Paul Riou, Gérard Delorme and Hormisda The distribution of manganese and iron in so conifers from the province of Quebec.

Hugues Gounelle and Yves Raoul : T sterilizing action of chloropicrine on the eggs of t bed bug, *Cimex lectularius*. Experiments showi that the sterilizing action of chloropicrin on the e of *Cimex* is certain.

Stig Veibel and Mme. Hanne Lillelund : T fermentative hydrolysis of some β-glucosides tertiary alcohols.

André Boivin : The possible co-existence of t complete *O* somatic antigen and of the correspondi polysaccharidic haptene (residual antigen) in certa bacteria.

Amsterdam

Royal Academy (*Proc.*, 39, No. 7, Sept. 1936).

H. J. Jordan : The properties of smooth ton muscles compared with those of unvulcanize plasticized rubber.

W. A. P. Schuffner and B. Walch-Sorgdrage Immunity to yellow fever among white mice.

L. S. Ornstein : Scattering of neutrons in matt (1). Theory of the statistics of the scattering neutrons by an assemblage of protons.

J. Clay, E. M. Bruins and J. T. Wiersma : temporary excess of ten per cent in cosmic radiatio Two ionization chambers and a counter all show a sudden increase in the cosmic radiation ov several days beginning on May 21.

H. R. Kruyt and G. E. van Gils : Electr phoresis of amino compounds.

E. D. Wiersma : Physical resemblance in co nexion with mental similarity (2).

J. J. van Laar : The position of the λ-point in heliu

O. Posthumus : Some Malayan ferns.

H. Freudenthal : (1) Position operators in co crete Hilbert spaces (1). (2) The Friedrich extensi of semi-restricted Hermitian operators.

M. Ewart : The exact measurement of the speci heats of metals at high temperatures (25). T specific heats and the allotropy of nickel betwe 0° and 1,000° C.

W. Bleeker : Meteorological observations on t three Dutch Karakorum expeditions (2).

L. Algera : Concerning the influence of temper ture treatment on the carbohydrate metabolism, t respiration and the morphological development the tulip (1).

A. van der Meulen and Ida Luyten : Co parison of the young organs of Spanish, English a Dutch irises.

H. Gerth : The occurrence of isolated calicul plates of *Dinocrinus* in the Permocarboniferous Australia and India and its stratigraphical significan

J. Ariëns Kappers : Brain-body weight relati in human ontogenesis.

N. Suzuki : The diencephalic and some oth systems in *Xantharpyia amplexicaudata* (2).

C. H. Waddington and J. Needham : Evocatio individuation and competence in amphibian organiz action.

N. Postma: Shape and slope of rest curves of the stretched foot of the snail (*Helix pomatia* L.) in relation to its water content.

G. P. Frets: The heredity of the size and the form of the seeds of *Phaseolus vulgaris*. The segregation of the F_2 generation.

Brussels

Royal Academy (*Bull. Classe Sci.*, 32, 8–9; 1936).

Th. De Donder and Miss Y. Dupont: New theory of the dynamics of continuous systems.

F. H. Van den Dungen: Application of Bessel functions to the calculation of solid angles.

L. Godeaux: Remark on the surfaces of genus zero and bigenus one.

F. Swarts: Contribution to the study of the action of bromine water on ethylenic compounds. Action on cyclohexene.

J. Géhéniau: Reduction of the second variation.

P. Gillis: Certain classes of partial differential equations.

D. S. Mitrinovich: Asymptotic lines of a class of surfaces.

L. Lison: Histochemical fixation of mineral elements of tissues.

C. Pauc: Introduction of directions in a metrical space. Analysis of the contingent and of the paratingent from the point of view of topology.

Cape Town

Royal Society of South Africa, July 15.

J. S. Griffiths: Women's initiation among the Mpondo. Descriptions from native sources and observation of the ceremonies observed at the initiation from girlhood to womanhood among the Mpondo.

A. J. H. Goodwin: The Mpondo regimental system. An account of the regimental system of the royal houses of the Western Mpondo.

August 19.

J. A. Gilmore: Young's modulus for steel surveying bands. Steel bands hanging in catenary loops between supporting stands are employed in Jaderin's method of measuring base lines. An investigation into the technique of using bands in this way is being carried on in the Surveying and Civil Engineering Departments of the University of Cape Town. An extensometer was used for finding the elastic constants. For steel bands approximately 1/8 in. wide by 1/64 in. thick, the yield point occurred at a stress in the neighbourhood of 53 tons per square inch, while the ultimate stress was approximately 108 tons per square inch. The value of Young's modulus for the same steel was 28,000,000 lb. per square inch.

N. H. Roberts: (1) Some studies of 50 cycle wave-forms in insulation testing. An experimental investigation is described of the factors which influence the wave-form of a particular 30 kilovolt testing transformer. The tests show that, if the capacity of the load is limited, a reasonable amount of resistance regulation combined with the use of an induction regulator will yield reliable results except at the lower readings. A calibration based on a knowledge of the crest factor at all settings is necessary. (2) A device for the superposition and simultaneous delineation of two wave-forms on a single cathode ray oscillograph screen. The paper describes a device in which the two wave-forms are applied alternately, being interchanged 20,000 times per second, and in which the waves may be superposed. Transient phenomena may be studied, and slight differences in wave-form readily shown up.

W. G. Sharples: Rock engravings near Beaufort West.

M. A. Pocock: Studies in South African Algæ: *Hydrodictyon* in South Africa (1).

Sydney

Royal Society of New South Wales, August 5.

G. J. Burrows and A. Lench: (1) Co-ordination compounds of cadmium with tertiary arsines. (2) Derivatives of zinc halides with tertiary arsines.

G. H. Halligan: The causes of ice ages. This is a critical review of the literature on the subject since the year 1864. The question is treated in a new way, the fundamental facts regarding geology, astronomy, oceanography, physics, geography and meteorology, which must be adhered to, being first stated, and the writings judged by the standard thus obtained. The main difficulties encountered are those due to the action and reaction of physical agents brought about by complete changes of atmospheric and oceanic currents, due to cosmical causes. It is believed that no salient fact has been brought forward which vitiates Dr. J. J. Croll's theory advanced in "Climate and Time" in 1890.

A. Bolliger: The reaction of creatinine with 1,3,5-trinitrobenzol, 2,4,6-trinitrotoluol, and 2,4,6-trinitrobenzoic acid. Until recently, picric acid was the only colour reagent available for the determination of creatinine. Then it was found that 3,5-dinitrobenzoic acid also gives a useful colour reaction with creatinine; now it is shown that 1,3,5-trinitrobenzol, 2,4,6-trinitrotoluol and 2,4,6-trinitrobenzoic acid react in a similar way. Trinitrobenzol and trinitrobenzoic acid give a red colour with creatinine in alkaline solutions. These reactions are analytically useful, while trinitrotoluol furnishes a colour reaction which is not sufficiently marked for such purposes. All these colour reactions of creatinine have been explained as the formation of organic molecular compounds.

H. Finnemore, Suzanne K. Reichard and Dorothy K. Large: Cyanogenetic glucosides in Australian plants (5). *Phyllanthus gasstroemii*.

G. J. Burrows and A. Lench: (1) Derivatives of zinc halides with tertiary arsines. Zinc halides were found to react fairly readily with phenyl dimethyl arsine, diphenyl methyl arsine and *o*- and *p*-tolyl dimethyl arsines to give crystalline compounds which were found to be deliquescent like the zinc halides themselves. The iodides were found to be the most stable. With the exception of the compound $Zn(PhMe_2As)Cl_2$, the compounds isolated contained one molecule of zinc halide co-ordinated with two of arsine. (2) Co-ordination compounds of cadmium with tertiary arsines. The authors describe compounds formed by cadmium halides with phenyldimethyl arsine, diphenyl methyl arsine and *o*- and *p*-tolyl dimethyl arsine. The compounds are all crystalline, possessing characteristic melting points which decrease from chloride to iodide. With the exception of $Cd(Ph_2MeAs)_2I_2$, in which two molecules of arsine are co-ordinated with one of cadmium iodide, all of the compounds isolated contained one molecule of arsine to one of cadmium halide.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, November 9

Royal Geographical Society, at 5.—N. E. Odell: "The Glaciers and Morphology of the Franz Josef Fjord".

University of Leeds, at 5.15.—Prof. A. M. Carr-Saunders: "Population Situation in England".*

Tuesday, November 10

Royal College of Physicians, at 5.—Dr. J. D. Rolleston: "The History of Scarlet Fever" (FitzPatrick Lecture).

Imperial College—Royal School of Mines, at 5.15.—Philip Rabone: "Modern Methods of Flotation" (succeeding lectures on November 17 and 24).*

Illuminating Engineering Society, at 7.—(Joint meeting with the Institution of Engineers-in-Charge at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1).—E. W. Murray: "Factory Lighting and Accident Prevention".

Pharmaceutical Society, at 8.30.—Dr. Donald Hunter: "Industrial Toxicology of To-day".

Wednesday, November 11

Institute of Physics, at 8.—L. C. Nickolls: "Physics and the Detection of Crime".

Thursday, November 12

Royal Society, at 11 a.m.—Discussion on: "Chemical and Physical Basis of Pharmacological Action" to be opened by Prof. A. J. Clark, F.R.S.

British Science Guild, at 4.30—(at the Goldsmiths' Hall, Foster Lane, E.C.2).—Lord Rutherford: "Science in Development".*

Royal Aeronautical Society, at 6.30—(at the Royal Society of Arts, 18 John Street, Adelphi, W.C.2).—Dr. F. W. Lanchester, F.R.S.: "The Part played by Skin Friction in Aeronautics".

Friday, November 13

Royal Society of Arts (Indian Section), at 4.30.—Dr. J. H. Hutton: "Head Hunters of the North-east Frontier".

Society of Chemical Industry (London Section), at 6—(at the Institution of Civil Engineers).—Dr. J. W. Mellor, F.R.S., and A. T. Green: "Refractory Materials" (Jubilee Memorial Lecture).

Official Publications Received

Great Britain and Ireland

Imperial Agricultural Bureaux. Herbage Publication Series, Bulletin No. 18: Pastures and Forage Crops in South Africa. Contributions by I. B. Pole Evans, A. R. Saunders, J. W. Rowland and S. R. de Villiers. Pp. 31+4 plates. (Aberystwyth: Imperial Bureau of Plant Genetics.) 3*s*. [1010

Technical Publications of the International Tin Research and Development Council. Series A, No. 44: Micro-Plasticity in Crystals of Tin. By Dr. Bruce Chalmers. Pp. 20. Free. Series A, No. 45: The Retarding Effect of Stannous Salts on the Oxidation of Olein and Oils. By Dr. Ir. S. H. Bertram. Pp. 10. Free. (London: International Tin Research and Development Council.) [2010

Survey of Thunderstorms in the British Islands. British Thunderstorms, containing Summer Thunderstorms. Fourth Annual Report, 1934. By S. Morris Bower and others. Vol. 2, Part 1. Pp. 48+viii+4 plates. (Huddersfield: Thunderstorm Census Organization.) 2*s*. 6*d*. [2110

Society for Preservation of Old Sheffield Tools. A Glossary of Words and Dialect formerly used in the Sheffield Trades. Part 1. Compiled and edited by B. Ronald Dyson. Pp. 56. (Sheffield: Society for Preservation of Old Sheffield Tools.) 1*s*. 3*d*. [2210

Other Countries

Académie des Sciences de l'URSS. Travaux du Congrès Jubilaire Mendeléev. Vol. 1. Pp. v+666+16 plates. (Moscow et Leningrad: Académie des Sciences de l'URSS.) [1910

Obras completas y Correspondencia científica de Florentino Ameghino. Vol. 22: Correspondencia científica. Edición Oficial ordenada por el Gobierno de la Provincia de Buenos Aires. Dirigida por Alfredo J. Torcelli. Pp. 710. (La Plata.) [1910

Annual Report of the Imperial Council of Agricultural Research for 1935–36. Pp. iv+110. (Delhi: Manager of Publications.) 14 annas; 1*s*. 6*d*. [1910

Government of India: Meteorological Department. Magnetic, Meteorological and Seismographic Observations made at the Government Observatories, Bombay and Alibag, in the Year 1934 under the direction of Dr. S. C. Roy. Pp. xiv+136+5 plates. (Delhi: Manager of Publications.) 10.4 rupees; 17*s* [1910

Annual Report of the All-India Institute of Hygiene and Public Health, Calcutta, 1935. Pp. 57+5 plates. (Calcutta: Government of India Press.) [1910

Osiris. Vol. 2, Part 1: Sir Thomas Little Heath. By David Eugene Smith. Pp xxvii+1 plate. Vol. 2, Part 10: Jan Evangelista Purkyně (Purkinje), 1787–1869. By O. V. Hykeš and F. K. Studnička. Pp. 464–483+1 plate. Vol. 2, Part 11: The English Plague Scare of 1820–23. By Charles F. Mullett. Pp. 484–516. Vol. 2, Part 12: Jahrzeiten und Tageslängen in der babylonischen Astronomie. Von O. Neugebauer. Pp. 517–550. (Bruges: The Saint Catherine Press, Ltd.) [1910

Denkschriften der Schweizerischen Naturforschenden Gesellschaft. Band 71, Abh. 1: Les entonnoirs due Glacier de Gorner. Par André Renaud. Pp. iii+28. Band 71, Abh. 2: Die seismischen Eisdickenmessungen am Rhonegletscher 1931; Bericht der Gletscherkommission der Schweizerischen Naturforschenden Gesellschaft. Erstattet von Wilhelm Jost. Pp. 29–42+2 plates. Band 71, Abh. 3: Die paläolithische Station in der Hohle am Schalbergfelsen (Klus bei Aesch, Kanton Baselland). Von E. Vogt; mit einem Vorwort und mit palaontologischen Beiträgen von H. G. Stehlin. Pp. vi+43–70. (Zurich: Gebruder Fretz A.-G.) [1910

Nyasaland Protectorate. Annual Report of the Geological Survey Department for the Year 1935. Pp. 24+7 plates. (Zomba: Government Printer.) 2*s*. 6*d*. [2010

Union of South Africa: Department of Mines. The Mineral Resources of the Union of South Africa: with a Summary of the Mineral Resources of South West Africa. Compiled in the Office of the Geological Survey, Pretoria. Pp. xiv+454. (Pretoria: Government Printer.) 1*s*. [2010

U.S. Department of Agriculture. Circular No. 403: Preventing Injury from Japanese and Asiatic Beetle Larvæ to Turf in Parks and other Large Areas. By Walter E. Fleming. Pp. 12. (Washington, D.C.: Government Printing Office.) 5 cents. [2010

International Institute of Agriculture. Use of Leguminous Plants in Tropical Countries as Green Manure, as Cover and as Shade. Pp. iv+262. (Rome: International Institute of Agriculture.) 10 lire. [2310

Report of the First Scientific Expedition to Manchoukuo, under the Leadership of Shigeyasu Tokunaga. Section 4, Part 3: Myxomycetes of Jehol, by Yoshikadzu Emoto; An Ecological Study of Vegetation in the Province of Jehol, Manchoukuo, by Motoo Takahasi. Pp. 4+1 plate+55+86 plates. Section 4, Part 4: Index Floræ Jeholensis, cum Appendice: Plantæ Novæ vel minus cognitæ ex Manshuria. By Takenoshin Nakai, Masaji Honda, Yoshisuke Satake and Masao Kitagawa. Pp. iv+108+3 plates. Section 5, Division 1, Part 10, Articles 38–52: Insects of Jehol (6) Order Coleoptera (1). By Tadao Kano, Hiromichi Kôno, Kyûkichi Kishida, Kazuo Kamiya, Hiroharu Yuasa and Yûshirô Miwa. Pp. v+140+20 plates. Section 6, Part 2: Palæolithic Artifacts excavated at Ho-Chia-Kou in Ku-Hsiang-Tung, Manchoukuo. By Shigeyasu Tokunaga and Nobuo Naora. Pp. iv+107+26 plates. (Tokyo: Waseda University.) [2610

Tanganyika Territory: Department of Lands and Mines: Geological Division. Short Paper No. 15: The Geology of the Iramba Plateau. By N. W. Eades. Pp. 85+1 map. 2*s*. 6*d*. Annual Report 1935. Pp. 43+1 plate. 1*s*. 6*d*. (Dar es Salaam: Government Printer.) [2610

Department of Agriculture: Straits Settlements and Federated Malay States. Economic Series, No. 7: Malayan Agricultural Statistics, 1935. By D. H. Grist. Pp. xii+90 tables. 50 cents. General Series, No. 24: Reports of the Research, Economic and Agricultural Education Branches for the Year 1935. Pp. iii+89. 50 cents. Scientific Series, No. 18: The Oriental Migratory Locust (*Locusta migratoria manilensis* Meyen) and the Bombay Locust (*Patanga succincta* L.) in Malaya. By G. H. Corbett and N. C. E. Miller. Pp. iii+15+3 plates. 50 cents. (Kuala Lumpur: Department of Agriculture.) [2610

Catalogues

The "Newton" and "Wigmore" British made Epidiascopes. Pp. 28. The Newton Projection Microscope. Pp. 11. The "Newton" Long Range Projection Polariscope. Pp. 2. (London: Newton and Co.)

Catalogue of General Literature, Autograph Letters, Modern Fine Printing, Mountaineering, First Editions, etc. (No. 605.) Pp. 94. (London: Francis Edwards, Ltd.)

Sand's Electrochemical Apparatus: a Modern Redesigned Form, Applicable to Electrolytic, Potentiometric and Conductometric Analysis and to *p*H Measurement. (GT 1123.) Pp. 12. Sulphur Dioxide Determination Apparatus: for the Rapid Determination of SO_2 particularly in Foods. (GT 1160.) Pp. 2. Modern Distillation Methods: New Apparatus for determination of Aqueous and other Liquid Contents by Distillation. (GT 1162.) Pp. 4. Moritz Turbo-Stirrers: Laboratory Models. (Leaflet 65 A.B.) Pp. 2. (London: Griffin and Tatlock, Ltd.)

Of Heffer's Bookshop this will tell. . . . Pp. 8. (Cambridge: W. Heffer and Sons, Ltd.)

Verlagskatalog 1811–1935. Pp. 88. (Leipzig: Wilhelm Engelmann.)

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Outlook of Professional Organizations

PROFOUND changes in manufacturing technique and industrial organization have resulted from the modernization of industry under the influence of power production during the last twenty years. This is generally recognized, but equally important changes in the personnel of industry have largely escaped attention. The recent report of the Industrial Health Research Board, it is true, pointed out that industry is demanding a different type of worker, but apart from Prof. Carr-Saunders' and Mr. P. A. Wilson's study of the professions, the increasing importance of the technical and scientific worker in industry has scarcely received the attention it deserves. Not only have the technical and scientific staffs been immediately responsible for much of the development and reorganization involved in the modernization and rationalization of industry, but they have also assumed an increasing share of the responsibility for the administration of the larger industrial units characteristic of to-day. In fact, large-scale industry mainly depends on their activities, and in turn they find in it the fullest scope for their knowledge and skill.

The rise of virtually a new professional class or type in this way is one of the most significant results of the modern technique in industry and commerce ; and its social consequences have as yet been given little attention. Certain of these questions are considered in a paper by Mr. S. W. Smith on the place and function of the administrative and technical worker in the new forms of economic structure, presented to Section F (Economic Science and Statistics) at the British Association meeting at Blackpool. One of the most important of these changes is the way in which the functional and professional outlook in the direction of industry is replacing the purely speculative or profit-seeking motive.

This growing power of the vocational outlook is of fundamental importance in the adaptation of industry, and indeed of society to meet new conditions. In so far as industry and commerce are directed less by self-interest than by the spirit of trusteeship or stewardship and service, the dangers of exploitation and social friction tend to diminish. Moreover, the type of control required in industry to-day involves leadership rather than domination, without sacrificing authority ; discipline based on intelligent co-operation, and decision reflecting the ideas of trained personnel acting freely and willingly in unity rather than the arbitrary will of a functional head.

That in certain public utility corporations the directors should, contrary to prevailing practice in limited companies, be debarred from any holding of shares, so as to secure that their dominant concern should be with the public interest, is only one example of the way in which a sense of duty and responsibility is replacing purely financial or private interests in the conduct of large undertakings. Moreover, the professional man, whether engaged in administrative work or not, finds his chief interest, when reasonably paid, in his work for its own sake ; and while the professional ideal continues to pervade the control of industry, so we may expect to find the service motive increasing in influence, and professional pride in the proper and efficient conduct of business organizations strongly reinforced.

This in itself should facilitate the wider outlook which to-day is essential in the integration of society to meet the impact of science. Industry can no longer be conducted solely with reference to its own internal efficiency and economy. It has to be considered in relation to society as a whole, and the technical ideal of fitness for a purpose must be applied in even wider spheres. No longer can we be content with a purely financial or even physical concept of the principle of economy. Social and human values are equally concerned, and industrial efficiency to-day involves the consideration not merely of chemical and physical processes but also of industrial health, psychology and the repercussions of a development on the community. What the product and process contribute to the worker and to the community are as important as what the worker contributes to the product.

The entrepreneur spirit alone is entirely inadequate to deal with such a situation and the creative forces involved. On the other hand, those scientific and technical workers whose administrative capacity and technical knowledge have placed them in such positions of trust have not invariably proved equal to the moral responsibilities involved. To this, particular attention was directed in Prof. W. Cramp's forceful address to Section G (Engineering) at the British Association. While the legal liabilities of the engineer and the loss of prestige attaching to faulty design or workmanship are the final safeguard to the community against abuse of privilege, standards of professional conduct are not infrequently honoured in the breach rather than by observance under the stress of commercial conditions.

For this, two factors may be regarded as primarily responsible. In the first place, as the instances cited by Prof. Cramp show, there is the absence of a scale of values firmly accepted by technical and scientific workers and so established by training and tradition that violation almost inevitably involves disqualification from practice. In part, this is a matter of education ; in part, a question of organization. One of the main motives, in fact, in attempts to raise the status of the chemist or the engineer by establishing a legal register and closing the profession has been that of safeguarding the public from the dangers attending a low standard of professional competence or integrity.

In the second place, the disregard of professional standards of rectitude is often due to the absence of a professional organization strong enough to afford its members adequate support in the face of economic or other forms of pressure from any source which tempts them to disregard the accepted ethical code. Nothing is more important to-day than that professional workers, whether within the ranks of science or not, should give their primary loyalty to their professional or vocational associations, and not to commercial or industrial organizations. It is only as they find in vocational organizations their permanent anchorage and shelter that professional workers can hope to make their full contribution to the shaping of organizations into instruments for the service of society and not for its mastery or exploitation.

This is indeed our crucial problem. The same factors that have increased the numbers of technical and professional workers have diminished their economic security and undermined their independence. The incidence of unemployment among their ranks on a scale undreamed of, in a class which was before the War virtually immune, has made efficient and effective professional associations essential if the full independent contribution of the professional worker is to be secured. The last fifteen years or so have witnessed a remarkable increase in the establishment of protective associations among such workers, and already an appreciable number of such organizations have negotiated collective agreements or enjoy the benefit of Whitley councils.

As yet, however, there have been few signs that such professional associations have recognized the wide orbit of their social responsibilities, nor have many of them yet advanced to a stage when they can afford a standard of professional protection commensurate with the pressure which industrial organization to-day could bring to bear if it chose. Nothing is more important than that professional organizations should address themselves to this question and consider their real place both in industry and in society to-day. Only as the professional worker gains his full independence can he make his decisive contribution to the shaping of society. Only, however, as he realizes the magnitude of that contribution is he likely to constrain the multiplicity of professional associations which at present prevents professional unity, for example, among chemists, from acting together in some way adequate to afford the members of the profession the necessary full protection.

The question of the responsibility of scientific workers for the prostitution of scientific effort for purposes of warfare, to which such repeated attention has been given of late, is only a special but rather difficult case. It is the absence of an association of scientific workers with any effective professional code, and the weakness of the professional ties between scientific workers in different countries, which debilitate any action by scientific workers at present. While, however, for the present it is rather as individual citizens than professional men that chemists and scientific workers in general can throw their weight into the scale against the tendencies which are dragging science and civilization down and debasing our heritage of intellectual and spiritual values, the recoil from the present abuse of scientific knowledge should surely inspire some determined effort to organize professional associations.

No thoughtful person can be blind to the dangers which the present abuse of scientific effort offers to science itself as to all that is best in our civilization. It is unthinkable that scientific workers should be so deluded or perverse as to make no attempt to preserve even the integrity of their own vocation. Towards this the first step is adequate professional organization. If that is undertaken in no mean spirit, but in a wide vision of the part which free scientific workers might play in the world of affairs, the petty loyalties and short-sightedness which in the past have prevented professional unity will surely disappear. Instead, we may see different classes of scientific workers, firmly established in their respective professional associations, presenting a united front and using their freedom to serve the community by shaping its organization in accordance with a nobler and wider concept of society. So, too, we shall find the sense of dependence and oppression which multiply so rapidly in the totalitarian State being lifted from the shoulders of men, and a measure of freedom, dignity and responsibility being given to them which once more shall prove the stimulus to creative thought, and add to the spiritual heritage of mankind.

World Population

World Population:
Past Growth and Present Trends. By A. M. Carr-Saunders. (Published under the auspices of the Royal Institute of International Affairs.) Pp. xv+336. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 12*s*. 6*d*. net.

THE public is being very well provided with information on the admittedly important subject of population; its growth and possible decline; its age constitution and the changes of that factor; the probable lengths of our lives; the social causes and effects of changes in the birth- and death-rates; migration and the future of the European races. Quite recently there have appeared several important works in English dealing with these matters, or some of them, such as, "Length of Life, a Study of the Life Table", by Dublin and Lotka; "The Measurement of Population Growth", by R. R. Kuczynski; "The Struggle for Population", by D. V. Glass, and now the important book under review.

Prof. Carr-Saunders is one of our most distinguished authorities on the subject. He was early in the field with his well-known study, "The Population Problem", which was published fourteen years ago and is still a mine of useful information. His new book is presented in a more popular guise and brings the facts up to date. These fourteen years have seen a great increase in the interest of the public in all population questions. One can scarcely take up a newspaper without seeing in it some letter or article on population. It is clear that the public in most Western countries is alive to its importance. There is evidence of this not only in the columns of the Press, but also in the foundation, some nine years ago, of the International Population Union and its constituent body in Great Britain, the British Population Society; in the various congresses that have been held in Geneva, in London, in Berlin; in the announcement of the Population Congress which is to take place in Paris next year; and quite recently, in the appointment, by the Eugenics Society, of a committee to investigate the fall of the birth-rate in Great Britain. All this apparatus, and the books mentioned above, will serve to keep the public provided with reliable information about these vitally important, and, in certain aspects, difficult matters.

In the author's own words, his book "attempts, though very briefly, to reconstruct population history and to describe the present population situation." He naturally begins with some account of the sources of information, and describes the early enumerations for special purposes, the sixteenth century ecclesiastical registrations of baptisms and burials, the first satisfactory French census of 1821, the English census of 1841, and so on. Also he points out that accurate migration statistics, which would require international co-operation, are still sadly to seek.

Two chapters are devoted to a discussion of the growth of world population, and we are given three independent estimates for the present day, the figures varying from 1,988 millions to 2,028 millions, so that the man in the street will be inclined to accept the round figure 2,000 millions, though this may be considerably in error. The chief source of error is in the estimate for China. "Upon any computation Asia holds over half of the world population from 1650 onwards", and "Europeans outside Europe are spread thinly"; there are, in fact, only about 200 millions of them.

After a simple discussion of the natural increase due to the difference between the crude birth- and death-rates, we come to an important chapter on the measurement of the true death-rate. This is arrived at by considering the chance that an individual of specified sex and age will have of surviving for one year. As pointed out by Dr. R. R. Kuczynski, whose valuable work in clearing up this and other population questions deserves all recognition, 'the expectation of life' derived from the 'life table', constructed from the actual data of age constitution and deaths, gives the only satisfactory criterion of mortality. Thus, if, as at present, the expectation of life at birth in New Zealand (mean of both sexes) is 66·46, then the death-rate in a stationary population with this expectation would be the reciprocal of this figure multiplied by 1,000, namely, 15·0. Figures derived in this way are strictly comparable, whereas 'crude' or 'standardized' rates are not.

We pass to the question of birth-rates. Crude birth-rates have no value as guides to the future or as the means of comparing the vital statistics of one country with those of another. In accordance with the method of Dr. Kuczynski, we must find out how many future mothers a thousand mothers will give birth to. It appears from Dr. Kuczynski's calculations that the net reproduction-rate for England and Wales, for 1933, was 0·73; for France, 0·82. The author remarks that "The only saving of life which can affect the trend of population is the saving of the lives of women before the end of the child-bearing period". This does not give much hope of improvement by means of a decrease in the death-rate, and if the net reproduction-rate is to be raised, the size of the family must be increased. This is the principal theme of the book in some of its later chapters. A table is given of the estimated future populations of various countries, on certain assumptions, including the well-known calculations of Dr. Enid Charles. We may take it as reasonably certain that the population of Great Britain will shortly reach a maximum, will diminish by some millions during the next generation, and may decline rapidly thereafter.

In this wise book there will be found statements of many intricate allied questions, judiciously treated. Such questions as the relation between over-population and unemployment; the effect of emigration on population; the desirability, or otherwise, of a reduction of our numbers at home. There are those who think that no harm would be done to Great Britain if the population were to come down by some few millions, provided that the downward acceleration could then be arrested. Some of these are matters upon which a general agreement is scarcely to be expected. But, whatever our opinions, we shall all value the clear presentation of these and many other difficult problems in Prof. Carr-Saunders's admirable work.

C. F. C.

The Phases of Berkeley's Idealism

George Berkeley:
a Study of his Life and Philosophy. By Prof. John Wild. Pp. x+552. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1936.) 25s. net.

IN this imposing volume, which fittingly emanates from Harvard, the author proceeds on the obviously sound principle that Berkeley's own wish should be respected, and his philosophical writings be read in the order in which he had published them. It is now generally recognized that there are two lines of thought running through Berkeley's theological idealism, which scarcely admit of being brought together in coherent fashion. On one hand, Berkeley preserved in his earlier writings, at least, a large portion of the empirical theory of knowledge; and, on the other hand, there gradually emerged in his later writings a conception of mind and of our ways of knowing mind that cannot be so much as stated in terms of the empirical theory.

The earlier phase of Berkeley's philosophizing, which Prof. Wild christens 'spiritism', 'psychologism', or 'subjectivism', leads, he insists, inevitably to 'solipsism'. It is, he conceives, to be traced back to an uncritical acceptance of Locke's causal metaphysics (p. 119). While disposing of the concept of material substance, Berkeley yet inconsistently hypostatized or reified the self into a self-existent substance; while refusing to allow that physical things are efficient causes, he yet inconsistently assumed the self to be an efficient cause, and thought of God as, in like manner, an efficient cause.

There are certainly difficulties enough in Berkeley's position, but I am by no means convinced that they are of the kind just specified. After all, the term 'substance' is excessively ambiguous, and by a 'spiritual substance', it was repeatedly asserted in the "Principles", is meant a thinking, active being, distinguishable from the inert objects of which it is apprehensive. Whether Berkeley's argument to prove that the *esse* of sensible things is *percipi* is successful may well be questioned; but I see no ground for the contention that this argument is inconsistent with his view of individual minds or spirits. Moreover, surely Berkeley is altogether misinterpreted when he is represented as having held that conscious minds can exist in abstract isolation from all objects, that these minds can will without willing anything, and perceive without perceiving anything (for example, p. 38)—a doctrine against which he was, in fact, never weary of protesting.

The later phase of Berkeley's speculation, as Prof. Wild pictures it, culminates in a transcendentalism, according to which the system of consciousness is not to be identified with an individual consciousness, but with a consciousness that includes in one system not only all empirical objects but all empirical selves as well (p. 174). Through this concept of a transcendent 'intelligible world' Berkeley was enabled, so it is maintained, eventually to grasp, to some extent, the nature of the 'world of becoming'; and at last in "Siris" (published in 1744) to construct a system of philosophy in the strict sense of the word. Primarily through Plato he came to appreciate the significance of the 'intelligible world'; and from the Neo-Platonists he learnt not only the meaning of transcendence but also, as a consequence, the meaning of philosophy itself as a revelation of the structure of the whole of being. But, it is argued, in a sense "*Siris* was always present to Berkeley's reflection, from the rude intuitions of the *Commonplace Book* to the strict methodological queries of the *Analyst*" (p. 422, cf. pp. 68–9).

For this statement I can find absolutely no warrant. I agree that it is a mistake to look upon "Siris" as exhibiting an entire break from the position of the early writings, but I fail to see in the latter any indication that Berkeley was then influenced by Neo-Platonic thought. Also, I confess there does not seem to me to be in "Siris" itself the definite metaphysical system which apparently Prof. Wild has discovered imbedded there; at the most, I should say, there are but vague hints as to the form which such a system might presumably take. Admittedly "Siris" is "so full of ancient lore that it is difficult to discern how much is Berkeley and how much is Plato or Plotinus" (p. 500); and I cannot but think that Prof. Wild has been reading into "Sirus" a great deal that is not really there.

A further contention calls for notice. Prof. Wild is assured that in the "Three Dialogues", which appeared in 1713, three years after the publication of the "Principles", Berkeley perceived for the first time "the total indefensibility of the causal subjectivism" (p. 162), on which he had been proceeding; and, particularly in the third *Dialogue*, by introducing a system of eternal 'archetypes' in the Mind of God, and by regarding the finite mind as 'dependent' (p. 183 *sqq.*), he was virtually abandoning his 'spiritism'. But, again, the reasoning does not convince me. For one thing, the notion of 'archetypes' in the Divine Mind meets us already in the "Principles" (for example, § 99), and in the "Principles" also the finite mind is throughout regarded as 'dependent' (for example, § 149). Furthermore, in the third *Dialogue* the 'archetypal' ideas are expressly stated to be ideas of 'things', or 'objects', and are, therefore, quite other than the Platonic 'ideas' or 'forms' referred to in "Siris" (for example, §§ 335–8); the finite mind is still regarded as a "substance" that is "affected from without"; and the Supreme Mind is still conceived as "the powerful cause of my ideas". In "De Motu", published in 1721, there are indications that Berkeley had been diving into Greek philosophy; but it was, I take it, in Rhode Island and in Cloyne that his more detailed researches in that field were made.

I have dwelt chiefly on matters in regard to which I cannot follow Prof. Wild's lead. I will not, however, conclude without expressing appreciation of much of his work. His treatment of Berkeley's critique of the mathematics of his time is, for example, admirable, and makes it clear that the attack on the doctrine of infinitesimals was not without justification. So, too, his account of Berkeley's attitude to natural science in "De Motu" is both judicious and suggestive. Altogether, he has produced a volume for which students of Berkeley will be grateful. G. DAWES HICKS.

Examinations

(1) The Marks of Examiners: being a Comparison of Marks allotted to Examination Scripts by Independent Examiners and Boards of Examiners, together with a Section on a Viva Voce Examination. By Sir Philip Hartog and Dr. E. C. Rhodes. With a Memorandum by Prof. Cyril Burt. (International Institute Examinations Enquiry.) Pp. xix+344. 8s. 6d. net.

(2) Essays on Examinations By Sir Michael Sadler, A. Abbott, Dr. P. B. Ballard, Prof. C. L. Burt, Dr. C. Delisle Burns, Sir Philip Hartog, Prof. C. Spearman and Dr. S. D. Stirk. (International Institute Examinations Enquiry.) Pp. xii+168. 5s. net.

(London: Macmillan and Co., Ltd., 1936.)

THE important part played by examinations in the modern world, not merely in educational, but also in social organization, amply justifies the attention that is at present being directed to the manner in which they function. The International Institute Examinations Inquiry, initiated and financed by the International Institute of Education of Columbia University, has already done exceedingly valuable work in the investigation of some of the more fundamental problems involved; and recent reports published by the French, the Scottish and the English delegations present the results of such investigations. The two books under notice represent part of the labours of the English delegation.

If we assume that examinations are a useful and even necessary part of social and educational machinery, there are two main things we wish to know about the examinations we employ. We wish to know, in the first place, to what extent their results may be taken as valid, and, in the second place, in what measure they are reliable. Validity and reliability are, in fact, the two essential characteristics which examinations must possess in order to perform adequately their social and educational functions. How far do examinations test that which they are designed to test, and how far can the results of an examination be relied on as an accurate measurement of what it measures? The recent report issued by the Scottish delegation—"The Prognostic Value of University Entrance Examinations in Scotland"—is concerned mainly with the answer to the first of these questions; a report of the French delegation, and also "The Marks of Examiners", issued by the English delegation, with the answer to the second.

Validity and reliability are only partly independent of one another. It is clear that an examination may have high reliability and low validity, though it cannot have high validity with low reliability. That is to say, an examination may measure a capacity or acquisition x with great accuracy and reliability, but the measurement of x may be partially or wholly irrelevant to the real purpose of the examination. If, however, the measurement of x is highly unreliable, it does not matter whether this measurement is irrelevant to the purpose of the examination or not; the examination can obviously have no validity. While, therefore, validity is probably the more fundamental characteristic, the investigation of the reliability of an examination would appear to be logically prior to the investigation of its validity.

A detailed account of an investigation by the English delegation into the reliability of the marking of examination papers is given in "The Marks of Examiners". The main findings had already been made public in "An Examination of Examinations", published in 1935, and these findings were then regarded with rather mixed feelings by all who had to do with school or university examinations. The investigation covers all the main types and grades of English examinations, and one and all are shown to be unreliable to an alarming extent, when we consider how much may depend upon them.

In some cases the methods of investigation may be open to rather damaging criticism. For example, in the case of the School Certificate papers in Latin and in history, fifteen scripts to which exactly the same average mark had originally been assigned were submitted to a number of different experienced examiners for remarking. In such a case it is obvious that the whole suggestion of the situation is to distribute the marks—the examiners were all ignorant of the original marks assigned—and consequently chance was bound to play a large part in the distribution. Hence we should expect to find great discrepancies between the marking of the different examiners. Even setting aside, however, all cases where the findings are open to criticism of this kind, the mass of evidence is overwhelming for the conclusions which the investigators draw, and the one question with which we are left is: What are we to do about it?

Another side of the international investigation is represented by "Essays on Examinations". This is a collection of papers by different authors on different aspects of English examinations. The work is more limited in its appeal—it is relevant mainly to English education in the narrow sense—and less important than "The Marks of Examiners". At the same time, it contains a very valuable historical account of the development of the scholarship system in England, from the pen of Sir Michael Sadler. This occupies almost half the book. There are also valuable papers on different aspects of the examination problem by Delisle Burns, Burt, Spearman, Ballard, A. Abbott, and Sir Philip Hartog. An account of the Leaving Examination in Germany, before the War, and under the Nazi regime, is appended. The short paper by Delisle Burns on "Examinations and the Social Needs of the Modern World" breaks new ground in the discussion of our examination system. This is an aspect of examinations demanding the most careful consideration, and it is an aspect which has up to now been largely neglected. The whole book leaves one with the impression—and the same is true of "The Marks of Examiners"—that the problems set to modern society by the role examinations have come to play are many and formidable, and the solution of these problems urgent. J. D.

Astronomy for All

(1) Stars and Telescopes

By James Stokley. Pp. xiv+319+33 plates. (New York: Harper and Brothers; London: Hamish Hamilton, Ltd., 1936.) 10*s*. 6*d*. net.

(2) Through the Telescope:

a Story of the Stars. By Prof. Edward Arthur Fath. Pp. vii+220. (New York and London: McGraw-Hill Publishing Co., Inc., 1936.) 10*s*. 6*d*.

(3) Highlights of Astronomy

By Prof. Walter Bartky. Pp. xiii+280. (Chicago: University of Chicago Press; London: Cambridge University Press, 1935.) 11*s*. 6*d*. net.

(1) THE Zeiss planetarium has done much to stimulate interest in astronomy, and it is much to be regretted that Great Britain does not yet possess one. Mr. Stokley, the director of the Fels Planetarium of the Franklin Institute, Philadelphia, has found that visitors often ask for the name of a book for study. To meet this demand he has written this volume. It contains a historical account of the development of astronomical thought and ideas from the earliest times, with a survey of the present knowledge about the solar system, stars and galaxies. The evolution of the telescope from its invention to the present time is described, and directions are given for assisting the amateur to construct his own telescope.

The book is not written for the busy layman who wishes to become familiar with the general trend of modern astronomical investigation, but it can be thoroughly recommended to the amateur who wishes to make a more detailed study of the subject. There is an excellent series of 33 plates which, instead of being scattered throughout the text, are collected together so that any particular plate is easily found.

(2) In this book, the reader is taken on an imaginary visit to the two large American observatories on Mount Hamilton and Mount Wilson, to see their instrumental equipment and to view different objects in the heavens. This provides the opportunity to describe some of the largest telescopes now being used in solar and stellar research, and to recount some of the main facts and the more interesting theories of the astronomical field of the present day. The role is that of the sightseer rather than that of the student, so that the book is mainly descriptive and the theoretical portions are brief.

The author endeavours to include no more than could be read in one evening by a reasonably rapid reader. Written for the unscientific reader, the book should help to stimulate interest in astronomy. The illustrations are numerous and well chosen; the reproductions of astronomical photographs are excellent.

(3) This book may be described as an elementary text-book that is different from other text-books. It has been written for the astronomical portion of the introductory general course in the physical sciences at the University of Chicago. This course is one of the four introductory courses of the new undergraduate curriculum, designed to give the student a general educational background before he ventures to specialize in any particular field. The ideas are presented in a novel and entertaining way; but to obtain the 'highlight' effect, there is often slipshod and inaccurate statements. Thus, for example, "It is gravity, that invisible force between masses, which causes us to drop and smash crockery and fall downstairs and which compels the earth to move as it does".

The author has used considerable ingenuity in describing the geometrical ideas of spherical astronomy without the use of geometry. The formulæ of spherical trigonometry required for connecting hour angle, declination, latitude, altitude and azimuth are sidetracked by the use of two charts; these enable many problems to be solved with an accuracy of about 2°.

The greater part of the volume is occupied with the geometrical ideas and with a description of the members of the solar system. The stars and the sidereal universe receive fewer than forty pages. In night study of the skies, an instrument called a 'stellarscope' has been designed for use in conjunction with the book. The stars and constellations are viewed on motion picture film so that, by superimposing each individual film upon the appropriate portion of the sky, the exact identification of the stars is made more readily than with a star atlas.

The book is well illustrated with line drawings and photographs; many of the drawings (by Mrs. Chichi Lasley) are arresting, attractive and amusing.

Radio Communication and Short Waves

(1) Principles of Radio Engineering

By Prof. R. S. Glasgow. (Electrical Engineering Texts.) Pp. xii+520. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 24*s*.

(2) Short Wave Wireless Communication

By A. W. Ladner and C. R. Stoner. Third edition, revised and enlarged. Pp. xvi+ 453+11 plates. (London: Chapman and Hall, Ltd., 1936.) 21*s*. net.

(3) Physik und Technik der ultrakurzen Wellen

Von Dr. H. E. Hollmann. Band 1: Erzeugung ultrakurzwelliger Schwingungen. Pp. ix+326. (Berlin: Julius Springer, 1936.) 36 gold marks.

ADVANCES in the science and practice of radio communication lead to a continual supply of new books dealing with various phases of the subject. Some of these are of the nature of monographs describing in detail the technique of a particular application of communications, while others set out in revised form the fundamental principles of the subject and of the various new devices which mark the lines of progress.

(1) Prof. Glasgow's book is based upon a lecture course given for some years at the University of Washington, and the logical development of the subject, with the clear but concise style, bear evidence of the author's experience as a teacher. The more interesting part of the book begins at Chapter vi with the fundamental properties of vacuum tubes and is followed by others in a natural sequence, dealing with amplification at audio and radio frequencies, oscillation, modulation and detection. The last hundred pages of the book are devoted to a brief but adequate study of aerials, including those designed for low-angle radiation, and also to a summary of existing knowledge of radio wave propagation.

The whole work is a really up-to-date exposition of the subject, and numerous references to recent publications are made throughout the book. The bulk of these references, however, are to papers published in the United States, and little mention is made of work in Europe. With this minor criticism, the book can be thoroughly recommended to all serious students of radio engineering.

(2) Most engineers and experimenters in the field of short-wave wireless communication are familiar with Ladner and Stoner's book, and the fact that a third edition has become necessary in about four years from the original publication is evidence of the popularity of the work. In this edition, much of the original text has been revised and some of the chapters expanded to deal with advances in all phases of the subject.

A new chapter on "Commercial Wireless Telephone Circuits" has been added, to deal with the practice in this field, which was insufficiently stabilized to warrant description in previous editions. Separate chapters are devoted to such subjects as modulation and constant frequency oscillators, which are not necessarily confined to short waves, but their inclusion makes for completeness in a book which is likely to continue to be in great demand by all those working in the wide and growing field of short-wave wireless communication.

(3) Dr. Hollmann's monograph is a detailed account of recent research on the various methods of producing electrical oscillations at frequencies corresponding to wave-lengths from a few metres down to a few centimetres. After chapters dealing with the production of such oscillations by spark excitation and by valve retroaction, about 120 pages are devoted to the positive grid type of electronic oscillator, and about half this space to the application of the magnetron valve to the problem. An appendix containing nearly 300 references indicates the vast field of literature covered, and this should help to make the book useful as a work of reference to specialists and research workers in this subject. R. L. S.-R.

Language, Truth and Logic

By Alfred J. Ayer. Pp. 254. (London: Victor Gollancz, Ltd., 1936.) 9*s*. net.

THIS excellent compendium of the views and doctrines of the new positivism derived from the scientific empiricism of the Vienna circle and an extreme interpretation of the aims of logic, will no doubt rejoice the increasing number of thinkers who have discovered lately that there is no philosophy at all. Carrying to its limits the methodological scepticism of Hume, the new positivism holds that sense-data are the primary elements of science, from which things and forces are its highly probable inferences. But as regards metaphysics, it should be put out of the way at all costs. Indeed, the imaginative and constructive functions of philosophy must give way entirely to its analytic function: thus the only real aim of philosophy is to get the propositions of science clarified and self-consistent.

The enthusiasm with which the author develops these points is evidence of the strength gained in Great Britain by these new theories. It should be pointed out, however, that such aims make the business of philosophy appallingly incomplete and uninspiring. For if sense-perceptions are the elementary data of knowledge, there are also intuitions of values and of general principles which are just as real facts as are the sense-perceptions themselves. The greatness and interest of philosophy consist in trying to harmonize such intuitions with sense-perceptions, and thus to give an adequate and systematized picture of experience as a whole. Jokes and jibes may enliven a discussion; but they cannot command an intelligent assent, especially when they are aimed at time-honoured values which are mainly responsible for the existence of philosophy, and also of logic, as such. T. G.

Jouannet:

Grand-père de la Prehistoire. Par Dr. André Cheynier. Pp. 101+3 plates. (Publiés sous les auspices de la Société Historique et Archéologique du Périgord.) (Brive: Chastrusse, Praudel et Cie., 1936.) 15 francs.

FRANÇOIS-RENÉ-BENIT VATAR, SIEUR DE JOUANNET (1765–1845), a native of Rennes, who settled in Périgord in the early years of the Revolution, is here celebrated as a forgotten pioneer in the study of prehistoric archæology, and a precursor of Boucher de Perthes. In 1810, while investigating a Gallo-Roman cemetery near Périgueux, Jouannet discovered a neolithic station, which there is reason to believe is the first ever described. As the author shows by dated references, Jouannet was first in the discovery of palæolithic caves and of a Solutrean site, as well as of the association of worked flints with fossilized animal remains. He was also the first to classify antiquity into stone, bronze and iron ages, and to distinguish two phases of the stone age. In experimenting in working flint and in analysing chemically fossil bones and bronze axes he initiated scientific methods of archæological investigation. His reports, which were submitted to local scientific academies or appeared in the Dordogne Calendar, are here reprinted with an account of his career.

Eclipses of the Sun

By Prof. S. A. Mitchell. Fourth edition, revised and enlarged. Pp. xvii+520+81 plates. (New York: Columbia University Press; London: Oxford University Press, 1935.) 25*s*. net.

PROF. MITCHELL's book on eclipses of the sun is so well known that detailed notice of the new edition is not necessary, the more so because it differs from the third edition only by the addition of a new chapter dealing with the eclipses of 1932 and 1934. A few minor additions have been made, but there has been no general revision. It is odd to read, in a volume bearing the date 1935, a passage such as this: "The author is going to be rash enough to predict that the 1932 corona . . . will show the minimum type of corona". There are a number of other passages which should have been revised. It would perhaps have been better if the results derived from the observations at the recent eclipses had been given as an appendix.

Although the excellent work of Lyot, at the high-altitude station at the Pic du Midi, is for the first time making it possible to study the corona when the sun is not totally eclipsed, it seems probable that astronomers will continue to be dependent upon observations at times of total eclipse for the solution of many solar problems. Prof. Mitchell's treatise remains the best and most complete account of the methods and results of eclipse observations.

Grundzüge der Vererbungslehre

Von Prof. Dr. Friedrich Alverdes. Pp. viii+143. (Leipzig: S. Hirzel, 1935.) 5 gold marks.

THIS is a simply stated introduction to Mendelian inheritance with a biological background. Early chapters deal with cell and nucleus, egg and sperm, fertilization, genotype and phenotype, race and species: "Unter einer Rasse verstehen wir eine Gruppe von Individuen (Pflanzen, Tieren oder Menschen), die in ihren wesentlichen Erbanlagen übereinstimmen". The Mendelian laws are expounded, as well as sex determination, recombinations, linkage, and the basis of these phenomena in the chromosomes. The last two chapters give a short survey of heredity in man. The account is clear but occasionally over-simplified, as in the statement that there are two pairs of factors for eye-colour and three for skin-colour in man.

The Psychology of Human Behavior

By Prof. J. H. Griffiths. Pp. xxi+515. (London: George Allen and Unwin, Ltd., 1936.) 12*s*. 6*d*. net.

THE author of "The Psychology of Human Behavior" is to be congratulated on the production of an extremely readable and well-constructed elementary text-book of psychology. The addition of questions for discussion at the end of each chapter is a most helpful feature and adds enormously to the value of the book from a teaching point of view. The supplementary readings at the end also of each chapter will prove a great help to those who wish to pursue their study of psychology further. This is one of the very best books on the subject.

Fibre Studies

EXCEPT in so far as Section A may regard all other sections of the British Association as subsidiary to the mathematical and physical sciences, the subject of fibre structure is by no means a prerogative of physicists sitting alone, and discussion to be most profitable is best conducted with the co-operation of one or more of the other sciences, such as chemistry and biology. This point was emphasized by W. T. Astbury in opening a brief symposium on fibre studies arranged for Section A at the Blackpool meeting of the Association, but his subsequent remarks, dealing with problems arising out of the long-range elasticity of many protein fibres, were addressed specially to physicists.

Certain natural protein fibres, in particular the hairs of mammals, are endowed with elastic properties of relatively enormous range. The effect is shown by X-ray and related studies to be due to combinations of polypeptide chain-molecules, normally in a regularly-folded configuration, from which they may be pulled out straight by the application of tension, and to which they return when the tension is released. By suitable modification of the state of cross-linkage of these polypeptide chains, both the elastic range and the driving force of elastic recovery may be varied considerably. Animal hairs, for example, may actually be contracted to a length only about half their natural length. Closely analogous, from both the X-ray and physical elastic point of view, to one of the modifications of the hair protein, ***keratin***, is the chief muscle protein, ***myosin***, and there is apparently some fundamental type of molecular fold common to both. The crystalline proteins, which are built from 'globular' molecules, have now also been shown to be based most probably on regularly-folded polypeptide chains. The latter are liberated from their special, and often highly specific, configuration by the change known as 'denaturation', the resulting insoluble mass being often highly elastic like keratin and myosin. X-rays suggest that this elasticity is again to be referred to groups of folded polypeptides which may sometimes be drawn out into straight chains, just as keratin and myosin may be so drawn out. By this means artificial protein fibres may be prepared from originally globular molecules.

The detailed interpretation of the deformation and unfolding of protein chain systems provides one of the most fascinating and difficult problems in molecular mechanics. At the moment, it seems to present two chief aspects: (1) Is the hexagonal fold postulated for keratin and myosin sound? (2) Is the keratin-myosin fold—whatever it may be—a fundamental fold for proteins in general?

Dr. J. B. Speakman, accepting the X-ray picture and intramolecular stress theory of keratin structure as substantially correct, proceeded to show how the many elastic modifications that arise when strained fibres are treated with various reagents can be simply explained in terms of the reactivity of the salt and disulphide cross-linkages of the keratin 'grid'. The reactivity of these linkages depends on their state of stress, which in turn depends on the configuration of the grid. In consequence, the properties of each type of linkage influence those of the remainder: thus the reactivity of the disulphide linkage in stretched hairs is frequently at a maximum under conditions in which the salt linkages are most stable.

The concept was illustrated by the results of numerous experiments in which the stretched fibres were submitted to the action at 50° C. of a series of mixtures of sodium sulphite and bisulphite, so chosen as to vary the *p*H while maintaining the reducing power. The extent of disulphide breakdown was then estimated by measuring the amount of 'permanent set' produced. It is a maximum at *p*H 5·95, where the salt linkages are most stable, and falls off rapidly on either side of this point as their stability decreases. The interpretation put forward by Speakman is that the dissolution of the salt linkages permits a configurational rearrangement which relieves the stress on the disulphide linkages and so reduces their reactivity. In the hands of Speakman, this chemical modification and 'playing off' of one linkage against another has proved exceedingly fruitful, and the properties of hairs so modified present features of unusual interest, whether for chemist or physicist.

The rather more pragmatic side of fibre research was emphasized by the contributions of Dr. M. Mathieu on "The X-Ray Cinematography of a Simple Fibre Reaction", and of Dr. E. Griffiths and J. H. Awbery on "Apparatus for Maintaining Constant Humidity". Mathieu introduced a new example of powerful X-ray tube with rotating anticathode, the latter being shut off from the atmosphere by nothing more elaborate than a ground cone, suitably lubricated with vacuum grease and under the control of an external adjustable spring to prevent 'seizing'. The rate of rotation possible with this system is not high—one or two revolutions per second—but it has sufficed to take one-minute photographs of the nitration of cellulose with gaseous nitrogen pentoxide, and so to follow the process step by step. The regularity of the original cellulose structure first disappears in the direction of the fibre-axis, until a stage is reached where there remain only equatorial reflections and the pseudo-period corresponding to the length of a glucose residue. The molecular chains then move farther apart and slide over one another so as to leave the effective residue thickness unaltered, whereupon the (101) reflection of nitro-cellulose appears. After this, little by little, the chains take up their final stable configuration and the characteristic fibre-period (25·1 A.) of trinitro-cellulose can be observed.

The whole experiment takes only an hour, and illustrates most strikingly the immediate advantages to be derived from the use of powerful X-ray tubes. Indeed, such tubes are rapidly becoming an absolute necessity. The study of unstable systems and of physical and chemical transformations, particularly those associated with life processes, still offers an enormous field to the structure analyst. We need X-ray cinematograph films of all these things. W. T. A.

Food Investigation: a Retrospect and the Future

THE reconstitution of the Food Investigation Board in the autumn of 1934 provided an occasion for a review of the work accomplished by the Board during the seventeen years of its existence and the determination of the lines along which further progress should be sought.* Not only have general solutions been found, in the gas-storage of fruit and chilled meat and in the brine-freezing of fish, for the three main problems with which the Board was faced when originally established, but at the same time great advances have also been made in the science that underlies the storage and handling of foodstuffs.

Although each animal product presents its own problems of handling and storage, yet, in the final analysis, these problems may be stated more generally as those of the properties and behaviour of proteins and fats, of pigments and micro-organisms. Thus, among the main subjects of investigation have been *rigor mortis* and glycogenolysis in muscle; the identity and physical chemistry of animal proteins; the freezing of colloidal systems and tissues; the chemistry of the pigments; the constitution of the animal fats; and the identification and characterization of the micro-organisms found on animal products. The Board now considers that it would be profitable to take up other lines of work as opportunity offers, the most important being the organic chemistry of the proteins. It is now known, for example, that the protein myosin controls the changes taking place in meat and fish during *rigor mortis*, as well as the structural changes that occur during storage: in the egg, the protein mucin is the important factor. Progress has been made in determining the general physico-chemical properties of the proteins, but further advances will depend upon an exact knowledge of the constituent amino acids and of their arrangement within the molecule. The results of such investigations will be of wide interest in chemistry, physiology and nutrition. The Board has therefore arranged for a member of the director's staff to spend a year in Prof. A. C. Chibnall's laboratory at the Imperial College of Science and Technology in order to gain experience of the specialized technique required, before undertaking research on this subject. It is also hoped to commence work on the identification of the autolytic enzymes of meat and eggs and the lipolytic enzymes of bacteria, to the action of which is often due the development of taint in animal foodstuffs. Although attention has hitherto been devoted chiefly to meat, the programme of research has now been widened to include both eggs and poultry, and the problems of their wastage and quality.

The handling and storage of fresh fruit present problems different in character from those of animal produce, since the material is living and not dead, and because the plants concerned belong to different orders and genera, and the parts used as foodstuffs comprise nearly all their chief organs. In spite of the work which has been carried out on the preservation of fruit and vegetables, the qualities after such periods of storage as are customary in commerce are, in general, inferior to those of the material at its best. The extension of control depends upon the advancement of our knowledge of the physico-chemical mechanism upon which the living processes are based. Up to the present, the Board has concentrated upon an intensive study of the respiration and metabolism of carbohydrate in the apple and potato. It is now including a study of the enzymes and the metabolism of nitrogen, and intends to investigate the metabolism of acid, the formation and breakdown of the cell wall and the nature and origin of the substances responsible for the development of colour, flavour and odour.

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* Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1935. Pp. x+232. (London: H.M. Stationery Office, 1936.) 3s. 6d. net.

The Board points out the necessity of a close contact with commercial practice and describes the different steps taken to ensure the application of laboratory results in the trades concerned: thus a small laboratory is being established, in the vicinity of Smithfield Market, London, on the lines of the Covent Garden Laboratory (which is also being extended), to act as a centre for liaison with the trade. Similarly, arrangements have been made with Messrs. Crosse and Blackwell, Ltd., for the trial at Peterhead of a kiln for the smoking of fish, which is designed in accordance with the principles established at the Torry Research Station. The Board also co-operates with similar bodies in the Dominions and is stimulating research in other parts of the Empire, since it is usually essential that the problems of storage should be studied as soon as the produce has been prepared for the market, and this is not possible in Great Britain in the case of such important fruits as the orange and banana.

The report of the Board refers as usual to the changes which have taken place in its composition during the year: Prof. C. H. Lees and Sir Thomas Middleton have been appointed additional members. The Engineering Committee has been reconstituted with the following membership: Prof. C. H. Lees (chairman), Prof. E. H. Lamb, Prof. G. I. Taylor and Prof. H. E. Watson. The bulk of the report is devoted to the report of the Director of Food Investigation, Mr. E. Barnard, and is divided into sections dealing with meat, poultry and eggs, pork bacon and hams, fish, fruit and vegetables, canning and engineering. The researches at present in progress are described by the investigators who are carrying them out. One or two may be referred to here, to indicate some of the problems involved and the results obtained.

Two effects of the treatment of the pig immediately before slaughter on the quality of the carcass have been measured. First, fasting has been shown to increase the thickness of the flank. Secondly, the muscle of pigs overheated before slaughter has a higher electrical resistance than that of rested pigs; low resistance facilitates the penetration of salt during dry salting. Farm-killed pigs were found to have a low resistance as compared with factory-killed, and this difference was traced to the shaking which the carcasses undergo during transport to the factory.

Trials of the refrigerated gas-storage of Conference pears have been made with good results: flavour, texture and appearance are retained after long periods of storage. If soft fruits are given a preliminary heating, there is little loss of the power to set, during storage in the frozen state at − 7° C., a temperature which inhibits the growth of moulds, or during storage with sulphurous acid. Without the preliminary heating, the power to set in jam-making is more or less rapidly lost. Apples and plums, however, do not suffer this loss under the same conditions. It has been shown that the amount of ethylene evolved by ripe apples and bananas is sufficient to initiate the ripening of green, unripe bananas. The passage of air containing one part per million of ethylene over the green fruit also causes it to begin ripening after 24 hours, but with fruit that has just started to ripen the mixture has little effect. These experiments suggest that the efficiency of ripening rooms for bananas heated with coal gas burners may be due to a slight leakage of the gas supply permitting a low concentration of ethylene in the air surrounding the fruit.

The Upper Palæolithic in the Light of Recent Discovery*

By Miss D. A. E. Garrod

THE last twelve years have seen a new impetus given to prehistoric studies by the multiplication of researches outside Europe. Excavations in Africa, the Near East, Asiatic Russia and China have opened up a new field for speculation, and at the same time have revealed the unsuspected complexity of many problems which to De Mortillet and other pioneers seemed relatively simple. Gone for ever is the straightforward succession of Palæolithic cultures from Chellian to Magdalenian as laid down in the Musée Préhistorique. Even so early as 1912, when Breuil produced his classic paper on the subdivisions of the Upper Palæolithic, its foundations were sapped, and the discoveries of the last decade have merely completed its demolition as a system of world-wide application.

In the old system the Palæolithic cultures appeared as a straightforward succession with clear-cut horizontal divisions, as in a diagrammatic geological section. The main outline of a new pattern is, however, already beginning to appear. We can distinguish in the Old Stone Age three cultural elements of primary importance. These are manifested in the so-called hand-axe industries, flake industries and blade industries, and we know that the first two, at any rate, run side by side as far back as we can see, and we are beginning to realize that the origins of the third may have to be sought much farther back than we had suspected. Only a moment of reflection is needed to see that we have here the old divisions of Lower, Middle and Upper Palæolithic, but with a new axis.

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* From the presidential address to Section H (Anthropology) of the British Association, delivered at Blackpool on September 10.

These general considerations are necessary to clear the ground for the subject with which I am going to deal—those cultures the appearance of which in Europe towards the close of the Pleistocene marks the extinction of Neanderthal man and the arrival of *Homo sapiens*. In the main these are essentially blade cultures, though in certain areas industries of Mousterian tradition lingered on into Upper Palæolithic times. Now it is clear that these blade cultures must have passed through the early stages of their development somewhere outside Europe, during Middle or even Lower Palæolithic times, but we have at present only the faintest clues as to how and where that development took place.

The general conclusions which can be drawn from the material at our disposal may be summarized as follows. A point which stands out at once, and very clearly, is the diversity of the strains which have so far been grouped together under the name Aurignacian. So long as we were dealing only with Western Europe this did not matter very much, as everyone knew what was meant by the Lower, Middle and Upper Aurignacian, but when we come to regions in which the sequence is not the same, the use of these terms, with their chronological implications, is definitely misleading. Peyrony proposes to retain the label Aurignacian for the culture so far known as Middle Aurignacian, and to group all the industries characterized by the blunted-back blade under the heading Perigordian. This undoubtedly corresponds with a first, very important distinction, which has been recognized for some time, but it does not go far enough. Perigordian, like the former Aurignacian, is made to cover too much. In spite of fundamental resemblances which certainly suggest relationship, it is doubtful if the passage from the Chatelperron to the Gravette level is the simple evolutionary process supposed by Peyrony. The blade cultures, after all, have an immensely wide distribution, and it is unlikely that the key to their development is to be found in southern France.

If we take more distant regions into account, it becomes clear that the French sequence is the result of successive immigrations, superimposed, perhaps, on a certain amount of local variation and development in place. Since, however, this sequence is so familiar, and has for so long been accepted as a standard, I propose to make it my point of departure, and to examine its various stages in the light of the evidence now available, trying to trace each one back to its original centre. Afterwards it will be possible to shift our point of observation, and taking a wider view of the distribution map thus plotted, to see what general pattern emerges.

The first blade industry to reach Western Europe is that of the Chatelperron stage, Peyrony's Perigordian I, which is the former lower Aurignacian. The distinctive implement of this industry is, of course, the curved blunted-back blade, or Chatelperron point. The Chatelperron level—which, for convenience, I shall provisionally call Chatelperronian—has not so far been found in Central and Eastern Europe, but a similar though not identical industry occurs at the base of the Upper Palæolithic sequence in Palestine. This, however, is less primitive in appearance than that of France, and seems already to be in process of evolution towards something resembling the La Gravette stage. The Lower Capsian, which is characterized by curved points, was formerly regarded as the parent of the Chatelperron industry, but Vaufrey demolished this theory by demonstrating that it is later in time. On the other hand, the Lower Kenya Aurignacian appears to be more or less of Chatelperron type, and may be in part contemporary with this stage in France. We thus have at the beginning of the Upper Palæolithic three areas which may in a wide sense be called Chatelperronian, two of which, Palestine and East Africa, may have been in touch with each other through Arabia and across the Bab-el-Mandeb, while the third remains apparently isolated. The problem of how the Chatelperronian entered Western Europe without leaving any traces on the way is one that awaits solution.

Although the Chatelperronian only appears as a distinct industry at the beginning of the Upper Palæolithic, we can trace its essential features much farther back than this. The Levalloiso-Mousterian of Palestine, which covers a very long period, has yielded throughout a small proportion of well-made curved points, burins and end-scrapers, and in the Tabun cave on Mount Carmel, typical Chatelperron points, end-scrapers, and blades with abrupt retouch were relatively abundant all through a well-determined zone within the Final Acheulean. In Kenya also Leakey has found backed blades associated with the Upper Acheulean, and he suggests that the so-called Lower Aurignacian—the Chatelperronian—may have developed from the contact of the Acheulean and Levalloisian cultures, the makers of the Acheulean hand-axes borrowing from the Levalloisian the idea of making use of long narrow blades. This is not impossible, of course, but it should be noted that in the Upper Acheulean of Palestine, as in Western Europe, the flake industry which is actually associated with the hand-axes is in the Clactonian tradition, and the Chatelperronian tools look markedly out of place and intrusive, while in the Kharga Oasis, where a Levalloisian flake industry actually forms part of the late Acheulean, no Chatelperronian forms have been found.

I should like to put forward the alternative suggestion that the Chatelperronian already had an independent existence at this time, having developed in some centre still unknown, and that it is an intrusive element in the Acheulean. In trying to trace this centre, we must take into account the fact, which seems to me significant, that the two regions in which the presence of backed blades in the late Acheulean is clearly established are precisely those in which a distinct Chatelperronian industry appears at the beginning of the Upper Palæolithic. If—as I am inclined to do—we reject the theory that the Chatelperronian developed within the Acheulean, we cannot accept either Palestine or East Africa as its original home, but must place this somewhere within reach of both. An Asiatic centre seems inevitable, but it is impossible at present to be more precise.

After the early stages of the Upper Palæolithic, the Chatelperronian proper apparently ceases to exist. In Palestine, however, the Chatelperron point reappears unexpectedly in the final stage, which must be roughly contemporary with the Magdalenian, and it is present in the Lower Capsian at approximately the same moment. Now, Vaufrey's theory of the late arrival of the Capsian still leaves us in the dark as to its origin. In its general lines it is unlike either the Sabylian or the blade industries of Palestine. We have seen, however, that the Upper Kenya Aurignacian is a nearly typical Capsian, which seems to have developed in place from the so-called Lower Kenya Aurignacian. I would suggest that East Africa may possibly be the centre of origin of the Capsian, which would thus enter Little Africa already fully developed by way of the Sahara. The Capsian would thus derive many of its features direct from the Chatelperronian, though outside influences may also have played their part, especially in the development of the microlithic element. It is, for example, unlikely that so specialized a type as the micro-burin should have developed independently in the Sabylian and the Capsian.

As for the peculiar industry which closes the Upper Palæolithic sequence in Palestine, it is quite definitely Aurignacian rather than Capsian, in spite of the presence of Chatelperron points, and it may conceivably be a local development, arising on the fringes of our hypothetical Chatelperronian centre and the Aurignacian province of the Near East.

Turning back to the Western European sequence, we now reach the Aurignacian proper, the former Middle Aurignacian. Peyrony claims that this does not represent a real break in the sequence, but that the Perigordian continued to develop in certain sites side by side with the neighbouring Aurignacian. The stratigraphical evidence for this is, however, insufficient. Even if there is a certain overlap, as is probable, all the known facts are in favour of a general separation of the Chatelperron and La Gravette levels by the layers containing the Aurignacian.

This industry can be traced right across Europe, through Lower Austria, Hungary, Rumania, the Crimea, Transcaucasia and Anatolia into Palestine, where it is very abundant and covers a much longer period than in the West. This suggests that the East Mediterranean coast is not very far from the Aurignacian centre of dispersion, and I would suggest tentatively that this should be sought somewhere in the Iranian plateau.

It is an open question and a very difficult one, how far the Aurignacian and Chatelperronian have ultimately a common origin. Certain forms, such as the burin and end-scraper, are found in practically all blade industries, but the Aurignacian, with its use of types derived from cores and consequent development of a fluting technique, has distinctive features which point at least to independent evolution from an early date.

The next stages in the French sequence are those of La Gravette and Font-Robert, formerly grouped together as Upper Aurignacian, which Peyrony has labelled Perigordian IV and V. This industry has clear affinities with the Capsian, and in view of the possibility that the Lower Capsian may be roughly contemporary with it, the question of African influence must be re-examined at this point. For various reasons, however, I think it must be ruled out. Already in the Lower Capsian two very distinctive forms, the micro-burin and the microlithic lunate, are present, and if this industry were the parent of the Gravette-Font-Robert stage of Europe it would seem inevitable that these should occur there also. In fact, however, they enter Western Europe only with the Tardenoisian culture at a much later date. Again, if the Lower Capsian passed into France it must have been through the Iberian Peninsula, and we have seen that in that region Capsian influences appear only at the close of the Upper Palæolithic sequence. Finally, the Gravette-Font-Robert industry has a very wide distribution in central and eastern Europe, and its remarkable development in this region points rather to a Eurasiatic origin. If further evidence were needed, one could cite the complete absence in Little Africa of the very distinctive female statuettes which are constantly associated with this culture in Europe. It does not follow that there is no link between the Capsian and the Gravette-Font-Robert industry; I would suggest that both are derived from the Chatelperronian, but that their common features are due in part to convergent development, certain forms, such as the Gravette point, being evolved almost necessarily from their Chatelperronian prototypes.

I have suggested that an Eastern origin is indicated for the Gravette-Font-Robert industry, and we must now examine this rather more closely. In France the distinction between the Gravette level with its typical blunted-back blades, and the overlying Font-Robert level with tanged and shouldered points is quite clear, but the two are nevertheless very closely related. In Central and Eastern Europe the shouldered point stage predominates and is associated with a distinctive decorative art and apparently a great development of the cult of which female statuettes are the expression. I would suggest for these two very closely related levels the names of Lower Gravettian and Upper Gravettian respectively, the label Grimaldian being reserved for the special development and prolongation of the Upper Gravettian in the Italian Peninsula.

The theory of an eastern centre of dispersion for the Gravettian is based, of course, on this exceptional development in Central and Eastern Europe. I am influenced also by the fact that the female statuettes, the close connexion of which with the Upper Gravettian is incontestable, are very abundant in Russia, but occur only sporadically in Western Europe, where they have an unmistakably alien appearance in comparison with the indigenous naturalistic animal art which had already begun to develop in the Aurignacian.

Assuming an Eastern origin, we cannot regard Central Europe as the centre of dispersion, because we have clear evidence that the Gravettian is there preceded by the Aurignacian proper. In South Russia it is indeed the oldest blade industry so far found, but the geological evidence does not suggest that it is necessarily very early, though it may quite well be contemporary with the Aurignacian of the West. I do not think, however, that the centre of dispersion can lie very much farther to the east, because the lithic industry of Malta, which must be approximately contemporary, is not Gravettian at all, though the presence of statuettes and certain decorative motifs suggests either that Siberia was reached by influences from South Russia or that the particular cult of which female statuettes were the expression came to the Gravettian from the Far East.

We must now consider by what route an industry ancestral to the Gravettian could have passed into North-east Europe from our hypothetical Chatelperronian centre. We have seen that in Palestine the true Gravettian is absent, and that in southern Kurdistan it probably represents a relatively late migration from Russia. In Palestine, however, the Chatelperronian level which lies at the base of the Upper Palæolithic sequence already shows signs of evolution towards the Gravettian type, and it is possible that an industry of this character had already penetrated into the neighbourhood of the South Russian plain before the westward moving Aurignacian invasion had reached the Mediterranean coast.

I need not dwell on the Solutrean episode, which forms the next stage in the French sequence, as this is already well known and understood. The only addition to our knowledge in recent years has been the demonstration that the Solutrean penetrated farther to the east than was originally supposed from its Hungarian centre.

With the Magdalenian we reach a stage when migration on a wide scale gives way to local variations of the cultures already in possession. Apart from the Magdalenian itself, which is undoubtedly the most interesting and the most vital of these variations, we have the Grimaldian in Italy, in South Russia a degenerate industry of Gravettian tradition, in Palestine a kind of hybrid Aurignacian which may extend into the Crimea, in Egypt the Sabylian, in England the Creswellian, while the retreat of the ice sheet in northern Europe made way for the Hamburg culture which is apparently derived from the Upper Gravettian. To round off completely the story of the Palæolithic blade cultures it would be necessary to pursue a number of these branches into the Mesolithic, but the close of the Pleistocene, for general purposes, marks the end of an epoch in human history, and although no catastrophic change is visible, with the dawn of the Mesolithic a new order is already on its way.

If we now take a last general view of this theoretical picture, we see the Chatelperronian, the earliest identifiable phylum of the blade cultures, already emerging in Lower Palæolithic times, in some as yet unidentified Asiatic centre. Ultimately it sends out two branches, one into East Africa, to give rise to the Capsian, the other into North-east Europe, to develop into the Gravettian. Meanwhile another stock, the

Aurignacian, pushes westward, and separates these two great provinces. From the Aurignacian and Gravettian centres migrations pour into Central and Eastern Europe along the southern edge of the ice-sheet, and cultures which in their homelands tend to remain distinct and exclusive succeed and influence each other, until at the extreme limit of their journey we get the characteristic French sequence, which for so long was used as a standard for the rest of the world. Meanwhile, along the fringes of the original provinces interpenetration necessarily takes place, and we find the Upper Gravettian filtering along the valleys of the Zagros Arc into southern Kurdistan, while the Aurignacian penetrates northward into the Crimea. Finally, at the close of the Pleistocene, migration on a large scale comes to an end, and numerous local variations spring up all over the Palæolithic world.

Outside all this, meanwhile, lies the still mysterious Far Eastern province, with its mixed flake and blade culture. In its early stages this may conceivably have played a part in the evolution of the Aurignacian proper, and in this connexion it is perhaps significant that Gordon Childe reports the presence of a slit-base bone point at Malta.

The picture which I have outlined is admittedly largely speculative. I am prepared to be accused of domination by a *mirage orientale*, but to that I would reply that some of my colleagues seem to me at the moment to be unduly influenced by a *mirage africain*. Only further discovery will make it possible to decide between us.

Obituary

Dr. George Forbes, F.R.S.

DR. GEORGE FORBES, who died at Worthing on October 22 at eighty-seven years of age, was a well-known electrical engineer in the early days of electric lighting and electrical transmission of power. He was a man of great versatility, and in addition to electrical engineering work he did much useful physical research and was also greatly interested in astronomy. He was an intimate friend of the late Sir David Gill, formerly H.M. Astronomer at the Cape of Good Hope.

After taking his degree at Cambridge, Forbes was appointed professor of natural philosophy at Anderson's College, Glasgow, and occupied the chair from 1872 until 1880. One of his chief pieces of physical work was an extensive research on the velocity of light, carried out in conjunction with Dr. T. Young, between 1876 and 1880 and described in the *Phil. Trans. Roy. Soc.* of 1882. They used a modified form of Fizeau's method and an arc lamp as a source of light, working over a Scotch loch for a distance of about 3–4 miles. The result they obtained was 301,382 kilometres per second, which is rather in excess of the best results of Michelson and others. The chief novelty of their work was that they found a supposed greater velocity for blue light than red by about 1·8 per cent. Astronomical observations give, however, a denial to such a conclusion and it has not been held to be valid. Forbes also took part in astronomical expeditions, and when only twenty-five years of age he conducted a British party to Hawaii to observe a transit of Venus with the object of determining the solar parallax and distance. He wrote an excellent small book in Benn's Sixpenny Library Series on "The Earth, the Sun, and the Moon".

When electric lighting work began in England in the early 'eighties of last century, after the invention of the carbon filament electric lamp by Edison and Swan, Forbes came to London and was adviser or manager of one of the then formed electric manufacturing companies. He made improvements in an arc lamp and invented an electric meter for alternating electric currents. One of his most permanent improvements was the application of hard graphitic carbon as brushes for electric motors. Before that time it was usual to employ brushes of brass or copper gauze or wire; but these caused unnecessary wear of the commutator. Forbes suggested brushes made of graphitic carbon in the same fashion as arc lamp carbons, and this was a great improvement and is used almost entirely at the present day.

When the great scheme of utilizing the power of Niagara Falls for production of electric current was under consideration, Forbes was one of those (and also the writer of this notice as well) consulted by the projectors as to the system of generation to be employed. In 1891 there was an electrical exhibition at Frankfort-on-Main, and one of the most interesting features was the transmission of power electrically over a distance of 110 miles from Lauffen to Frankfort by means of three-phase alternating electric currents. This transmission comprised the use of 300 h.p. generated at 55 volts and a frequency of 40 cycles. The voltage was raised by transformers to 8,500 volts and reduced again at the receiving end. The success of this performance gave a great impulse to the vaster scheme of utilizing Niagara, and the Cataract Company was formed to carry it out. After taking numerous opinions, it was decided to employ two-phase alternating currents, and generators driven by turbines were constructed of 5,000 h.p. to generate at 5,000 volts for transmission at 11,000 volts to Buffalo and other cities. Forbes went to Niagara to superintend the electrical work. At present, nearly a million horse-power is taken from the Falls.

Forbes travelled extensively, and in 1877 acted as special correspondent of *The Times* during the Russo-Turkish War. He was the recipient of many distinctions for his scientific work. He was elected a fellow of the Royal Society of London in 1887 and received the honorary degree of LL.D. from the University of St. Andrews. He was a Chevalier of the Legion of Honour of France and an honorary member of the Franklin Institute of America.

Forbes invented a range-finder for military work used in the South African War, and a gun-sight for the Navy. He was granted a Civil List Pension in 1931 for his services. Of late years he had not been seen much in scientific society, except for occasional visits to the Athenæum, but in the later years of the nineteenth century he was a well-known member of various British scientific societies and often seen in social and scientific gatherings. He was at one time a vice-president of the Institution of Electrical Engineers. An obituary of him appeared in the *Daily Telegraph* of October 26 last from which by permission some of the above statements are taken and acknowledgement is here made for the courtesy.

J. A. F.

Sir George Hampson, Bt.

SIR GEORGE HAMPSON, who died on October 15, at Thurnham Court, near Maidstone, at the age of seventy-six years, came of an ancient Oxfordshire family, the baronetcy having been created in 1642; he succeeded to the title on the death of his uncle in 1896. He was born on January 14, 1860, the eldest son of the Rev. W. S. Hampson, rector of Stubton, Lincolnshire. He was educated at Charterhouse and at Exeter College, Oxford, where he graduated.

Already in 1883 Hampson was collecting Lepidoptera, as a side-line to planting tea, in the Nilgiri Hills in southern India, and his serious interest in entomology appears to have been born during the five years which he spent in these surroundings. The latter half of the nineteenth century was a kind of golden age in the history of entomological discovery in India, when Marshall and de Nicéville, Moore, Swinhoe, Bingham, Butler and others were constantly extending and gradually reducing to some sort of order our knowledge of the Indian Lepidoptera. But whereas these workers were principally concerned with the butterflies, Hampson, no doubt largely inspired by their activities, after producing a "Catalogue of the Butterflies of the Nilgiris" (which remained in MS.), turned his attention to the moths, in the study of which he was later to achieve a world-wide and unique reputation.

By 1889, Hampson was busily engaged as a voluntary worker in the Insect Room of the British Museum, both upon the general arrangement of the Heterocera and, more particularly, the Indian moths. In 1891 and 1893 the Trustees of the Museum published his first considerable works, namely, his accounts of the Heterocera of the Nilgiris and of Ceylon, which formed Parts 7 and 8 of the "Illustrations of Typical Heterocera in the British Museum". The four volumes, and supplements, of the "Moths of India" appeared between 1892 and 1896, forming part of the Fauna of India series issued by the Government of India; these set the seal upon his reputation and remain still the only comprehensive work on the subject.

Meanwhile Hampson had been offered an appointment as assistant under Dr. Günther in the Department of Zoology in the British Museum. He accepted this post, and took up his duties in January 1895. This placed him in charge of the whole of the collection of moths, and immediately he concentrated his attention almost exclusively upon the production of his truly monumental "Catalogue of the Lepidoptera Phalænæ in the British Museum". Between 1898 and 1923 fifteen volumes were published. This was, in fact, an attempt at a fully documented and illustrated descriptive catalogue of the moths of the world, and manifestly too great a task for any one man to perform. Yet it is amazing how much Hampson achieved, and how much more he had achieved than was ever published, for on his retirement in 1920 he left a great quantity of manuscript, of which the bare bones were issued in 1926 as a single volume entitled "New Genera and Species of Noctuidæ in the British Museum". The catalogue included the Syntomidæ, Arctiidæ, and the major part of the Noctuidæ, that is to say, perhaps one third of the moths which are usually called Macrolepidoptera. Yet during the progress of this work, Hampson found time to publish many valuable and extensive papers dealing with the large and important family of Pyralidæ, notable among which is his account of the Phycitinæ and Galleriinæ (in continuation of Ragonot's work) which formed vol. 8 of the Romanoff "Memoirs".

Times have changed greatly in entomological circles since Hampson took up his task. His working equipment consisted of a hand lens, benzene (for temporarily clearing the wings) and a pair of dividers. It is scarcely a matter of surprise that more recent investigations have brought to light many facts which escaped him. He was always more inclined, too, to concede a far greater range of variation in species than was customary at the time his early volumes appeared, possibly as a reaction to the obviously unjustified hair-splitting of such workers as Butler, Moore and Swinhoe, and in consequence, especially in the "Moths of India", some of his "species" have been shown to be compact of many. There can be few systematists, however, against whom such a charge cannot be levelled.

The present writer remembers well, as a very young man, his first introduction to Hampson. He had some foreign moths to name, and on asking for help, was firmly but courteously told that "he would find them over there—" a wave of Hampson's arm indicating the entire collection of Heterocera in the Museum. This was very characteristic; but it had some advantages. It enabled the speaker to proceed uninterrupted with his work, and it forced the inquirer to learn something about the moths in such a way that he would remember it. Hampson's methodical industry was amazing, and his "Catalogue" is not only a worthy testimony to it, but also a mine of information that will not be exhausted for many years.

N. D. R.

Sir George Buchanan, C.B.

THE death, on October 11, of Sir George Buchanan, a devoted public servant in public health, will be regretted by a wide circle of friends. George Seaton Buchanan was born on February 19, 1869. He was the eldest son of the late Sir George Buchanan, F.R.S., who was principal medical officer to the Local Government Board from 1880 until 1892. The younger Buchanan graduated at the University of London with the degrees M.B. (gold medallist), 1891; M.D., 1892; M.D. (State medicine), 1893; and B.Sc.; and became later a fellow of the Royal College of Physicians. In 1895, at the age of twenty-six years, he was appointed to a post of medical inspector in his father's old Department, then under the leadership of Sir Richard Thorne-Thorne. After serving for nearly forty years in this Department and the Ministry of Health, which was created from it, he retired at the age limit of sixty-five years in 1934, but continued to hold the office of president of the Permanent Committee of the Office International d'Hygiène publique in Paris (which carries with it the vice-presidency of the Health Committee of the League of Nations in Geneva) to which he had been elected in 1932. His soul was devoted almost exclusively to the public service, and he thus, after leaving the British Government service, was able to continue public health work of international importance.

When first appointed to the Local Government Board and for many subsequent years, Sir George was occupied in making epidemiological inquiries into outbreaks of infectious disease in England and Wales. He became president of the Epidemiological Section of the Royal Society of Medicine in 1918 and 1919. His first published report in 1897 on an inquiry into enteric fever in some districts of East Anglia provided an early proof of the disease being due to polluted oysters. A few years later, his epidemiological inquiry into the manner in which smallpox spread during an epidemic in Essex supported the view (first brought to notice by Power in 1881 and again in 1884) that smallpox can be spread, from hospitals receiving acute cases of this disease, by distal atmospheric convection, apart from personal contact.

From 1901 until 1903, Sir George Buchanan acted as secretary to Lord Kelvin's Royal Commission on food contaminations, which led in 1905 to the organization by the Local Government Board of a new section with Buchanan at its head with the title of 'Chief Inspector of Foods'. In 1912 he became first assistant medical officer under Sir Arthur Newsholme, then chief medical officer of the Board. Two years later, by his appointment as official delegate for Great Britain on the Permanent Committee of the Office International d'Hygiène publique in Paris, he entered the field of international public health affairs, which thereafter formed his chief public health work. During the Great War, he served on special commissions which visited Gallipoli, Egypt, Salonica and Mesopotamia, and the honour C.B. (Military) was conferred upon him for these services. When peace came, his services on the Army Sanitary Committee and the Inter-Allied Sanitary Commission in Paris were retained, and he continued to take an active part in international arrangements for preventing the spread of typhus, dysentery and other diseases which affected troops and refugees returning from the war areas.

His valuable services in solving various international health problems cannot be enumerated here, but special mention must be made of the large share Sir George took in designing and drafting the International Sanitary Maritime Convention which was agreed upon and signed at the International Sanitary Conference held in Paris in 1926. Later he took similar action in drawing up international rules for the prevention of transmission of yellow fever and other infectious diseases by aircraft. These rules were embodied in the "International Sanitary Convention for Aerial Navigation" which is now in force. The activities of the international health organizations in Paris and Geneva are given in full in the Milroy Lectures on "International Co-operation in Public Health, its Achievements and Prospects" delivered by Buchanan before the Royal College of Physicians of London on February 27 and March 1, 1934.

The honour of knighthood was conferred on Buchanan in 1922. He was appointed master of the Society of Apothecaries of London for 1934–35, and in the same year was awarded the Mary Kingsley Medal by the Liverpool School of Tropical Medicine and the Jenner Medal by the Royal Society of Medicine in London for his work in the control and prevention of epidemic diseases.

DR. JAN BAŠTA, a distinguished Czechoslovak engineer and member of the Masaryk Academy of Work, died in Prague on October 13 aged seventy-six years. He was the first student to graduate from the Prague Technological University in 1902. Later he had a distinguished career as a railway engineer, but never lost his keen interest in pure science. His last publication, dealing with the relationship of force with matter, was referred to in NATURE of July 11 last p. (83).

WE regret to announce the following deaths:

Prof. H. R. Briton-Jones, professor of mycology in the Imperial College of Tropical Agriculture, on November 3.

Dr. Kurt W. Franke, chemist at the South Dakota Agricultural Experiment Station, known for his work on enzyme action and nutrition, on September 15, aged forty-six years.

Mr. C. E. Haselfoot, fellow (formerly dean) of Hertford College, Oxford, lecturer in mathematics in Wadham College, from 1888 until 1913, on October 28, aged seventy-two years.

Prof. Henry Landes, professor of geology and dean of the College of Science, University of Washington, an authority on the mineralogy of Washington, on August 23, aged sixty-eight years.

Mr. A. E. Hodge, founder and editor of the *Aquarist and Pond-Keeper*, aged fifty-eight years.

News and Views

Medal Awards of the Royal Society

HIS MAJESTY THE KING has approved of the following awards this year by the president and council of the Royal Society in respect of the two Royal Medals: to Prof. R. H. Fowler, for his work on statistical mechanics and allied departments of modern mathematical physics; and to Prof. E. S. Goodrich, for his work on the morphology of the excretory organs of the invertebrata and for his work on the comparative anatomy and embryology of the vertebrata. The following awards of medals have also been made by the president and council: Copley Medal to Sir Arthur Evans, in recognition of his pioneer work in Crete, particularly his contributions to the history and civilization of its Minoan Age; Rumford Medal to Prof. E. G. Coker, for his researches on the use of polarized light for investigating directly the stresses in transparent models of engineering structures; Davy Medal to Prof. W. A. Bone, for his pioneer work on contact catalysis and his researches on the mechanism of combustion of hydrocarbons and on the nature of flames and on gaseous explosions; Darwin Medal to Dr. E. J. Allen, in recognition of his long-continued work for the advancement of marine biology, not only by his own researches but also by the great influence he has exerted on very numerous investigations at Plymouth; Hughes Medal to Dr. W. Schottky, for his discovery of the Schrot effect in thermionic emission and his invention of the screen-grid tetrode and a superheterodyne method of receiving wireless signals.

New Officers of the Royal Society

THE following is a list of those recommended by the president and council for election to the council of the Royal Society at the anniversary meeting on November 30: *President*, Sir William Bragg; *Treasurer*, Sir Henry Lyons; *Secretaries*, Sir Frank Smith and Prof. A. V. Hill; *Foreign Secretary*, Sir Albert Seward; *Other members of Council*, Prof. A. J. Allmand, Dr. G. T. Bennett, Prof. J. Chadwick, Prof. A. S. Eve, Prof. W. G. Fearnsides, Prof. L. N. G. Filon, Dr. J. Gray, Sir Daniel Hall, Prof. C. R. Harington, Prof. D. Keilin, Prof. J. Graham Kerr, Dr. R. H. Pickard, Mr. H. R. Ricardo, Prof. W. Stiles, Prof. W. W. C. Topley, Mr. W. Trotter.

Frederick Wollaston Hutton, F.R.S. (1836–1905)

ON November 16, the centenary occurs of the birth of the distinguished geologist Frederick Wollaston Hutton, who together with Ferdinand von Hochstetter (1829–84), Sir John F. J. von Haast (1824–87) and Sir James Hector (1834–1907), laid the foundations of our knowledge of the geology of New Zealand. Hutton was born at Gate Burton, Lincolnshire, being the second son of the Rev. H. F. Hutton. Educated at Southwell Grammar School and the Naval Academy, Gosport, he spent three years as a midshipman in the India Mercantile Marine and then entered the Army. He served in the Crimean War and the Indian Mutiny, and afterwards at Sandhurst gained a liking for geology from Prof. Thomas Rupert Jones (1819–1911). Leaving the Army in 1866, he went to New Zealand. In 1871 he became an assistant on the New Zealand Geological Survey, and two years later was made Government geologist of Otago. In 1877 he was appointed professor of natural science at the University of Otago and in 1880 settled in Christchurch as a professor in the University of New Zealand. Besides a large number of scientific papers, he published "Darwinism and Lamarckism" (in 1899), "The Lesson of Evolution" (in 1902) and "Animals of New Zealand" (in 1904). After an absence of nearly forty years, he revisited England, and was on his way back to New Zealand in the S.S. *Rimutaka* when he died at the Cape on October 27, 1905. After his death, a subscription was raised for the endowment of a bronze medal in his honour, and for the furtherance of research.

The Background to Harvey

IN his Harveian Oration delivered before the Royal College of Physicians on October 19 and published in the *British Medical Journal* of October 24, Sir Walter Langdon-Brown, emeritus professor of physic in the University of Cambridge, described the background to Harvey as represented by contemporary thought, of which Francis Bacon, Robert Burton, the author of "The Anatomy of Melancholy", John Donne, the Dean of St. Paul's, Sir Thomas Browne, Thomas Hobbes, the author of "Leviathan", and the Cambridge Platonists were the chief exponents. Like Sir William Hale-White in his Harveian Oration of 1927, Sir Walter maintained that the "Novum Organum", in which the new spirit of England found its clearest expression, had a deep influence on the mind of Harvey who, as his medical adviser, came in close contact with Bacon. A striking contrast was offered by John Donne, who represented a transition from the sixteenth to the seventeenth century, being in certain aspects the most medieval and in others the most modern writer of his time. In conclusion, Sir Walter showed how the turmoil of thought in Harvey's time is being repeated to-day. In both instances a phase of great and rapid expansion both in thought and wealth was followed by disillusionment on the intellectual side and greater stringency on the financial; old standards were destroyed before new ones could take their place and a new form of art and literature appeared.

The Chemical Exploration of the Stratosphere

For his Friday evening discourse at the Royal Institution on November 6, Prof. F. A. Paneth took as his subject "The Chemical Exploration of the Stratosphere". Prof. Paneth pointed out that while the temperature and the electrical state of the stratosphere have been the object of many investigations, its chemical composition has seldom been studied. If winds are absent, or at least rare in the stratosphere, we should expect a partial separation of the atmospheric gases under the gravitational field of the earth. In order to decide this question of the stillness of the stratosphere, samples of air have to be collected. For this purpose, the sending up of automatic devices in unmanned balloons is the most efficient method. In collaboration with the Meteorological Office of the Air Ministry, Prof. Paneth and Dr. E. Glückauf, working at the Imperial College of Science and Technology, have developed methods for the automatic collection and subsequent analysis of air samples from the stratosphere. From the first results, published a year ago, it was concluded that up to 18 km. no definite change in the chemical composition of the stratosphere occurred, but that at a height of 21 km. the relative amount of the light gas helium has already distinctly increased. During the last few months, this has been confirmed by further successful flights reaching more than 23 km.

Similar investigations have lately been started by Prof. E. Regener, in Stuttgart, using larger balloons; in one of his samples, from a height of more than 28 km., he found an oxygen deficit, in good agreement with the helium surplus detected in the London flights. The only two air samples obtained by manned stratosphere balloons confirm these findings: Prokofiev's sample collected over Russia in 1933 at a height of 19 km. showed no variation in its composition; but the air brought back by Capt. Stevens and Capt. Anderson from 22 km. over the United States already revealed a slight oxygen deficit. All this supports the conclusion that from about 20 km. onwards the stratosphere is quiet enough to permit a partial separation of its constituents by gravity. Neither the London nor the Stuttgart samples show a gradual change in the composition of the atmosphere in proportion to altitude. This is of special interest as it proves that in spite of their relative quietude, the air masses even of higher layers of the stratosphere are liable to disturbances, probably corresponding to weather conditions.

The Royal Society of Arts

For his inaugural address delivered on November 4 to the Royal Society of Arts, Sir Henry McMahon, chairman of the Society, took as his subject "One Hundred and Eighty Years of Pioneer Work by the Royal Society of Arts". The Society was founded in 1754 "for the Encouragement of Arts, Manufactures and Commerce" at a time when there were no departments of Government, societies or institutions to deal with such matters as Colonies, agriculture, forestry, fine arts, health, trade or industry. In the early days, the field of work was divided into six sections, each being left to the charge of a separate committee. Money prizes, or premiums as they were called, and in some cases gold and silver medals, were then offered for specific objects, and in this way a very great stimulus was provided for improvements in all directions. The agricultural industry in particular derived much benefit from such a policy. At the time of the foundation of the Society, agricultural methods were largely based on medieval practice. In the second half of the eighteenth century, the Society took an important share in developing a more scientific outlook. The prizes offered by the Committee on agriculture covered a very wide range, including the improvement in the quality and yield of established crops, such as wheat, barley, oats and rye, the introduction of new grasses and roots for cattle feeding, better methods of cultivation, the invention of new types of agricultural machinery and the improvement of existing models, the use of manures, soil analysis, the management of sheep and cattle, and indeed almost every aspect of what is now understood by the term 'scientific agriculture'.

The offer of rewards did not always produce results. For example, a handsome reward was offered and renewed for no less than forty-six years (1774–1820) for an effective corn-reaping machine, without success. One of the most useful pieces of work for which the Society can claim credit was the introduction of the swede and mangel-wurzel into Great Britain. Remarkable results were also achieved by the Society in connexion with afforestation carried out in the period 1758–1835, anticipating in fact the work of the present Forestry Commission, which was not founded until 1919. Much attention has also been paid by the Society to the polite arts, the importance of encouraging the art of drawing in many employments, trades and manufactures being recognized from the start. The introduction of industrial exhibitions was a feature of the pioneer work in this direction, and the success of the Exhibition of British Art in Industry in 1935 was an indication of the desire on the part of both designers and manufacturers of the present time to increase this spirit of co-operation.

Prevention of War

There can be no doubt of the general and passionate determination of the great majority of the thinking youth of the world to prevent another world war. This desire is strongly expressed by the New History Society, of 132 East 65th Street, New York, and illustrated by its offer of prizes amounting in the whole to five thousand dollars for the best papers submitted on the subject of "How Can the People of the World achieve Universal Disarmament?" The essays are to be of not more than two thousand words in length, and the prizes are variously graded from one thousand dollars downwards, so that there seems abundant opportunity for any helpful contribution sent in from any part of the world to receive some recognition. We recommend all sympathizers to obtain the necessary further particulars from the address above. The last date for the posting of the essays is May 1, 1937, so that ample time is allowed for all inquiries and for the writing of so short a composition. It will not be the length, however, but the pregnancy of what is said that will arouse attention, and one hopes most sincerely that something may be said which will bring light and hope to this most perplexing and dangerous question. Everyone knows, and most people admit, for example, that Great Britain in this matter of rearmament is acting most unwillingly and feels herself compelled to her present action by what is being done by others. If this is to go on, the vicious circle is complete. How to break it? That is the question to which the essayists will have to address themselves.

IT is not for us here to sketch an essay for the competition, but it does seem possible that after our darkest moment light may appear. The appalling business which now absorbs our attention in Spain may prove the turning point for an upward movement of peace. It is clearly seen that this conflict is a reflection, in a distorted form, of the greatest underlying conflict which is threatening the peace all over the world, that between what is called 'fascism' or an authoritarian and comprehensive nationality, and 'communism' or the organized power of the manual workers. Men see now the hideous excesses and dangers of extinction which threaten civilization, if such a conflict is pushed to extremes. They must see also that, as in England, there is no essential reason why the conflict should not be avoided by rational compromise and goodwill. There is an honest and widespread movement on foot to avoid extreme courses in the case of Spain. Clearly something must be done there, to save that country from extinction. This may be the lesson which the world so badly needs. It is at least plainly written in the events of the last three months. The friends of science will also reflect that the crisis has occurred in the one land in Western Europe where science had taken least root, the one place where there was no renascence of science in the seventeenth century. That was the proper scene for the play of the forces of unreason. No other Western land has been torn by such an internecine strife; no other was so unfortunately free from the pacifying influences of scientific education.

Spawning of the Common Toad

IT is only during recent years that biologists have realized that they are far from a complete understanding of the influence of external factors on the spawning of even the commoner amphibians. The common toad (*Bufo bufo bufo*) is an 'explosive breeder', that is to say, all the sexually mature individuals in a district migrate from their diverse hibernation quarters to their breeding sites within a few days of one another, and within even large areas there is singularly little deviation from the normal of the year. There have been occasional records of isolated pairs found spawning long after the normal time, but some observations made by Mr. G. Shrubsole, who writes from the Victoria Court Hotel, Eastbourne, made during the last two years, seem to indicate the existence in Sussex of an area which is exceptional. A series of small ponds on Beachy Head were visited at intervals for conchological work, and on July 30 and August 1, 1935, unhatched toad spawn was found in at least three of them. One pond was kept under observation and unmetamorphosed tadpoles were still found at the beginning of December. In 1936 tadpoles were first found in the same, and one other pond, at the beginning of May, but never throughout the year were they ever observed in any of the others. The development of the tadpoles was apparently very slow, for even in September the majority still had mere rudiments of hind-limbs. But whether these very late tadpoles were of the same brood as those found early in May is uncertain (the normal larval period is only 12–14 weeks), for although no fresh spawn was found, adult toads were discovered in the water in July. Their presence at a time so long after tadpoles had been observed is unusual, for the whole of the breeding operations are normally concluded within a week or so, and the adults then leave the water for the rest of the year. Their presence certainly suggests the possibility that there may have been a July spawning in 1936, as there was in 1935, and, if this proves to be a regular occurrence, a detailed investigation of the physical conditions of the district should be of importance.

Native Labour from Nyasaland

THE announcement by the Colonial Office that the Governments of Southern Rhodesia, Northern Rhodesia and Nyasaland have entered into a provisional agreement regulating the employment of emigrant labour from the last-named has come shortly after Mr. Ormsby-Gore's recent insistence on the importance of the labour problem in its effect on the well-being of the native community (see NATURE, Oct. 31, p. 735). It is an assurance that the conditions to which the report of the Committee on emigrant labour from Nyasaland has directed attention will not be allowed to continue without a serious endeavour to eliminate those factors which have been shown to be the cause of hardship and suffering, as well as a danger to the future prosperity of the Protectorate. The agreement is to remain in force for four years as from August 21 last, and thereafter is terminable at twelve months notice. Under its terms, identification certificates are to be issued to all male natives seeking employment, and those leaving their own territories for that purpose will bear evidence to that effect, as well as a notification of physical fitness. In future, so far as native and industrial conditions permit, only such certificated labour will be admitted by the employing Governments. Not only will the flow of labour be controlled, if necessary, but also—a matter of much greater importance—labourers are to be returned to their own territory after an economic period of employment, which is not to exceed two years. This provision, even if it does not entirely remove the evil of a permanent loss in population, will at least lessen the numbers of those who do not return to their homes after a period of extra-territorial employment. A further important provision sets up a standing committee of representatives of the three Governments to secure co-ordination and to consider problems in connexion with the supply of labour as they arise.

Population Investigation Committee

IT is announced in *The Times* of November 5 that a committee has been formed to investigate the fall in the birth-rate in Great Britain and its probable consequences. The committee, which has been appointed by the council of the Eugenics Society, is presided over by Prof. A. M. Carr-Saunders, and has among its members, Lord Horder, Mrs. Hubback, Dr. Julian Huxley, Prof. L. Hogben, Dr. R. R. Kuczynski, Lady (Rhys) Williams, Prof. J. Young, and other authorities on various aspects of the subject. Dr. C. P. Blacker, the general secretary of the Eugenics Society, is honorary secretary of the Committee, and Mr. D. V. Glass is research secretary. Mr. Glass has recently published a useful book on this subject, entitled "The Struggle for Population". The committee has already held two meetings, and its investigations are gradually taking shape. The main object is, in the first place, to ascertain the facts of the case and the causes of the decline in the number of births per family; and for this purpose it invites the co-operation of institutions and individuals engaged upon relevant lines of research. Inquiries may be addressed to the Secretary, Population Investigation Committee, 69 Eccleston Square, London, S.W.1.

New Discharge Bulb Lamps

THE new discharge bulb lamps are already in use on the Continent, and judging from the fact that they were shown at a meeting of the Illuminating Engineering Society on October 13, they will probably be soon on sale in Great Britain. In appearance, they are like the ordinary 'pearl' lamp but they have no filament. They contain a small quartz mercury vapour discharge lamp "about the size of half a cigarette" and they are corrected for colour. Internally the bulb is coated with a fluorescent powder, in the same way as the lower area of the inside of the cathode ray tube, where the picture is shown in television reception. According to the *Electrical Contractor* of November, the lamps are available in two sizes, 80 watts and 125 watts. The light output of these lamps is about 40 lumens per watt. This compares with the 12 lumens per watt of the ordinary coiled-coil incandescent lamp. The life is stated to be about 1,500 hours. The 'colour correction' of these lamps is effected by the fluorescent powder used. The human complexion when illuminated by the lamps shown at the meeting was very little altered, the change being scarcely noticeable. Owing to the fact that the internal film transforms the invisible ultra-violet light emitted by the mercury vapour lamp into light of visible wave-length, the loss of light by the absorption of the bulb is compensated for by this fluorescence. No details are yet available as to the price of the lamp, but we seem to be on the eve of a new development in house lighting.

Recent Acquisitions at the Science Museum

THE Oxford heliometer of 1848 has been placed on exhibition in the Astronomy Collection (Gallery LXIV). This instrument was made for the Radcliffe Observatory, Oxford, by Messrs. A. and G. Repsold of Hamburg on the advice of the famous German astronomer F. W. Bessel, who had in 1838 with a similar instrument obtained the first satisfactory measure of the parallax of a fixed star. The distance of the star, 61 Cygni, was found to be some 400,000 times the sun's distance of 93,000,000 miles. The Oxford heliometer was for many years one of the most powerful and accurate instruments of its kind in the world. It is notable among other things for the first application of electrical illumination to an astronomical instrument. It was dismounted and taken to pieces in 1906, and so remained until its removal in 1935 to the Science Museum, where it has been renovated and set up as it was originally, a striking testimony to the nineteenth century instrument maker's art. In the Chemistry Collection (Gallery LXVI), an original tube of the metal rhodium prepared by its discoverer, Dr. William Hyde Wollaston, about 1825 has been placed on exhibition. Rhodium has recently become of interest as a non-tarnishing substitute for silver in electroplating.

Zoological Survey of India

THE report of the Zoological Survey of India, recently issued, covers the years 1932–35, coinciding with a period of retrenchment in civil expenditure and consequent restriction of activities. It records the retirement of Lieut.-Colonel R. B. Seymour Sewell in 1933, and his subsequent extensive biological investigations as leader of the Murray Oceanographical Expedition to the Indian Ocean, and is written by his successor, Dr. Baini Prashad. The investigations of the Survey include detailed work upon the *Trochus* shell fisheries of the Andaman Islands; identification of animals of economic importance from the medical or sanitary point of view, carried out for various institutions and public bodies; identification of human and animal remains excavated at various chalcolithic sites in Sind; and anthropological work connected with the census. Unfortunately, the abolition of the post of zoological collector and the necessity of restricting expenditure has greatly reduced the field-collecting and observations which used to be so desirable and characteristic an activity of the Survey.

Bibliography of Seismology

THE last two quarterly numbers of the "Bibliography of Seismology" prepared by Mr. E. A. Hodgson and printed in the Publications of the Dominion Observatory, Ottawa (12, 159, 181;

1936), complete the record for the year 1935 and begin that for the present year. The general impression that one receives in reading over the titles is that references are gathered from more varied sources and that the bibliography is increasing much in usefulness. The last number for 1935 contains an index classified according to the subjects of the various memoirs catalogued during the year. A useful feature of both numbers is the list of references to notes or short articles that have appeared in various journals, such as NATURE, *Science*, etc. The first number for 1936 shows that Great Britain is represented among the collaborators by Dr. E. Tillotson, 23 Roseville Road, Leeds, 8, who will be glad to receive notices of papers on any seismological subjects published in Great Britain.

Veterinary Education

THE following Committee has been appointed by the Secretary of State for Scotland and the Minister of Agriculture and Fisheries "to review the facilities available for veterinary education in Great Britain in relation to the probable future demand for qualified veterinary surgeons and to report thereon, and in particular to make recommendations as to the provision which should be made from public funds in the five years 1937–42 in aid of the maintenance expenses of institutions providing veterinary education": The Right Hon. Sir Thomas Molony (chairman), Sir James Currie, Dr. Thomas Loveday, Sir John Robertson, Mr. John Smith. Mr. V. E. Wilkins, of the Ministry of Agriculture and Fisheries, and Mr. W. N. McWilliam, of the Department of Agriculture for Scotland, have been appointed joint secretaries of the Committee.

Poultry Mortality Committee: New Chairman

ARISING out of a recommendation of the Eggs and Poultry Reorganisation Commission for England and Wales, a Committee was set up some months ago by the Secretary of State for Scotland and the Minister of Agriculture and Fisheries "to consider the present methods of supply and distribution of hatching eggs, day old chicks, and breeding stock, both generally and with particular reference to the reduction of poultry mortality; and to make recommendations for the improvement of those methods". The Committee's proceedings were however suspended by the illness, recently followed by death, of its chairman, the late Mr. F. N. Blundell. Sir Duncan Watson has now been appointed chairman of the Committee. The secretary of the Committee is Mr. V. E. Wilkins, of the Ministry of Agriculture and Fisheries.

Rat Control Film

THE Ministry of Agriculture and Fisheries has recently produced a new cinematograph film dealing with the loss and damage caused by rats and mice and the measures which may be taken for their destruction. The film, which is entitled "Your Enemy—The Rat", is available in two versions—a short sound film for display in public cinemas, and a longer silent version designed for display at exhibitions, conferences, etc. Copies of the film will be loaned free of charge. Applications for bookings should be addressed to the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1.

Royal Prowess in Ancient Egypt

No little interest and some amusement has been aroused by the inscribed stela of Amenhotep II discovered at Giza, on which the monarch transcends the customary royal assumption of credit for achievement by an intimate personal touch in his description of his prowess as an oarsman and athlete. The stela, which was found in the course of Prof. Selim Hassan's excavations in the neighbourhood of the Sphinx at Giza (*The Times*, Nov. 7), records that Amenhotep, when visiting Giza as a young man to pay homage to his ancestors Khufu and Khephren, had rowed a boat for three miles against the stream with an oar twenty ells long without fatigue, while his boatmen were tired after rowing for half a mile. As a horseman and archer he was no less remarkable. He had trained his horses to draw his chariot at a gallop without sweating, and shooting from his chariot he had pierced with an arrow copper targets which were as thick as his hand. The stela upon which is the inscription also bears above a representation of the king making offerings to a figure which is said to be identifiable as the god Ra. It was set up in the second year of Amenhotep's reign (1447 B.C.). The expedition of which Prof. Selim Hassan is in charge is engaged in clearing the whole area adjacent to the Sphinx, and with this purpose in view additional land, at present encumbered with refreshment booths, has been purchased to obviate interference with the work of excavation.

Institute of Physics: London and Home Counties Branch

THE inaugural meeting of the London and Home Counties Branch of the Institute of Physics was held on November 4 under the chairmanship of Mr. E. R. Davies, director of the Kodak Research Laboratory. This, the third branch of the Institute to be formed in Great Britain, has been created in response to the desire expressed by some three hundred members resident in London and the surrounding districts. The formation of these branches serves to demonstrate the growing number of physicists in industry who wish to have opportunities for social intercourse and discussion of problems of mutual interest. At the meeting numerous suggestions were made for activities that the branch might usefully undertake; these included visits to works and industrial research laboratories, discussions on professional matters, and short groups of lectures on recent advances in physics. It was emphasized that it is not intended to hold meetings for the reading of original papers, as this is the function of the Institute's participating societies, namely the British Institute of Radiology, the Faraday Society, the Physical Society, and the Royal Meteorological Society. Full particulars of the new branch may be obtained from Dr. H. Lowery, honorary secretary of the branch, North-Western Polytechnic, Prince of Wales Road, N.W.5.

Science and War

THE Association of Scientific Workers is organizing a public meeting and discussion on "Defence and the Responsibilities of the Scientist", to be held in the mathematics lecture theatre, Huxley Building, Royal College of Science, Exhibition Road, South Kensington, on Thursday, November 19, at 8 p.m. The chair will be taken by Prof. J. B. S. Haldane, and the speakers will include Prof. S. Chapman and Air Commodore L. E. O. Charlton. It is the purpose of the meeting to provide a forum for the full discussion of problems arising out of the increasing application of science to war. Measures that might be adopted by scientific workers as an organized body to further the cause of peace will also be considered.

Announcements

IT is announced in *The Times* of November 6 that Dr. Edward Bohane, director of the Royal Dublin Society, is retiring from this post on a pension of £1,900 a year and a gratuity of 7,500.

MR. M. A. C. HINTON, deputy keeper of zoology in the British Museum (Natural History), has been elected zoological secretary of the Linnean Society for the remainder of the present session, in succession to Dr. Stanley Kemp, who has resigned.

PROF. L. A. ORBELI, of Leningrad, has been appointed a member of the Permanent International Committee of the Physiological Congresses in succession to Prof. I. P. Pavlov, who died last February. The Committee therefore is now constituted as follows: Profs. F. Bottazzi (Italy), W. B. Cannon (U.S.A.), O. Frank (Germany), A. V. Hill (Britain), secretary, B. A. Houssay (Argentine), Y. Kuno (Japan), L. Lapicque (France), G. Liljestrand (Sweden), and L. A. Orbeli (U.S.S.R.).

THE following have been elected as officers of the Cambridge Philosophical Society for the year 1936–37: *President*, Dr. F. W. Aston; *Secretaries*, Dr. J. D. Cockcroft, Mr. A. H. Wilson, Dr. O. M. B. Bulman; *New Members of Council*, Prof. E. V. Appleton, Mr. G. E. Briggs, Dr. A. N. Drury, Mr. A. E. Ingham, Dr. D. Stockdale.

THE centenary of the foundation of the Army Medical Library of the United States, generally known as the Library of the Surgeon-General's Office, will be celebrated at Washington, D.C., on November 16, when Sir Humphry Rolleston will deliver an oration on its history with special reference to Billings, Fletcher and Garrison.

PROF. A. BUTENANDT, director of the Institute of Organic Chemistry of the Technical University at Leipzig, has been appointed director of the Kaiser Wilhelm Institute of Biochemistry at Berlin-Dahlem, and has been awarded the Rinecker Gold Medal by the University of Würzburg.

THE recent decline in the birth-rate in Japan is shown by the following figures: 1932, 100,688 births; 1933, 927,209 births; and 1934, 809,224 births.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

An agricultural organizer for Gloucestershire—The Clerk of the County Council, Shire Hall, Gloucester (November 16).

Two district officers in the Forestry Commission—The Secretary, Forestry Commission, 9 Savile Row, London, W.1 (November 17).

A research bursar in physiology in the National Institute for Research in Dairying, Shinfield, near Reading—The Secretary (November 20).

A divisional engineer to the London County Council—The Clerk of the Council, County Hall, Westminster Bridge, London, S.E.1 (November 20).

A principal scientific officer, a senior scientific officer, a scientific officer (quote C.E. 6634/36) and a junior scientific officer (quote C.E. 6873/36), with qualifications in chemistry, physics, mathematics or engineering in the Admiralty Scientific Pool—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (November 21).

An assistant lecturer in engineering in the Brighton Technical College—The Education Officer, 54 Old Steine, Brighton (November 23).

A principal of the Luton Technical Institution—The Director of Education, Shire Hall, Bedford (November 24).

Two assistants (Grade II) (physics or chemistry) and one assistant (Grade III) (physics or chemistry) in the Explosives Directorate; and two scientific officers (mathematics), one scientific officer (engineering or mechanical sciences), one scientific officer (physics or electrical engineering), one assistant (Grade I) (physics or electrical engineering), one assistant (Grade II) (mathematics) and two assistants (Grade III) (physics or electrical engineering) in the Ballistic Directorate of the Research Department, Royal Arsenal, Woolwich, S.E.18—The Chief Superintendent (November 24).

A demonstrator in physics in the London (Royal Free Hospital) School of Medicine for Women—The Warden, 8 Hunter Street, Brunswick Square, W.C.1 (November 25).

A Stokes student for research in mathematical or experimental physics in Pembroke College, Cambridge—The Master (December 1).

A Tweedie exploration fellow in archæology and anthropology in the University of Edinburgh—The Secretary (May 12).

Mechanical and electrical engineers in the Royal Army Ordnance Corps—The Under-Secretary of State (A.C. 9), The War Office, London, S.W.1.

An economic geologist in the Mineral Resources Department (Intelligence Section) of the Imperial Institute, South Kensington, London, S.W.7—The Establishment Officer.

Veterinary officers in the Colonial veterinary service (vacancies in Malaya, East Africa and West Africa)—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, S.W.1.

Assistant civil engineers in the drawing office of the Civil Engineer-in-Chief's Department, Admiralty, London, S.W.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 846.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Rates of Cleavage of Sea Urchin Eggs in Different Latitudes

THE oxygen consumption of various kinds of poikilothermal marine animals in English waters is higher, at the temperatures at which they live, than that of northern and arctic species of the same genera at their lower sea temperatures, although the arctic animals seem to move about just as fast in their cold habitat as do the English forms in our own waters[1]. The same relation holds for ciliary movement on the gills of scallops: the cilia beat more rapidly in the English species. On the other hand, the respiratory movements of English Crustacea are no more rapid at, say, 15° than those of arctic species at 5°. The same rule applies also to the rates of heart-beat of most of the species studied. I have now measured the rate of cleavage of eggs, and find that this behaves like the respiratory movements and hearts, not like oxygen consumption and cilia.

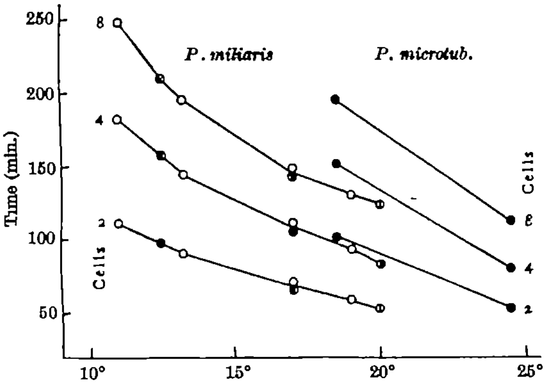

FIG. 1. Time for cleavage of sea urchin eggs. ○, Plymouth; ⊖, Millport; ⦶, Roscoff; ●, Tamaris.

I have compared the rates of cleavage of the eggs of two species of sea urchins, *Psammechinus miliaris* from Roscoff in Brittany[2], Plymouth, and Millport in Scotland, and *P. microtuberculatus* at Tamaris in the south of France. The results are shown in Fig. 1. The points giving the times after fertilization, for the first three cleavages at different temperatures in *P. miliaris* from the various localities fall, on smooth curves, but the eggs of the Mediterranean species at a given temperature, say 20°, cleave much more slowly than those of the northern species. The rate for the southern species at 20° is no faster than that for the northern species at 12°–13°.

From data in the literature, it is evident that the same phenomenon occurs within a single species of sea urchins, namely *Paracentrotus lividus*. At Roscoff the 2-, 4- and 8-cell stages are reached in 66, 100 and 147 minutes at 20°[2]. At Rovigno, in the Adriatic, the respective times are 105, 135 and 182 minutes at the same temperature[3]. Indeed the cleavage rates of *P. lividus* at Naples differ at different times of the year. At 13°, 71 and 91 minutes elapse between one cell division and the next in winter and in summer respectively, while at 26°, 31 minutes are taken in winter and 25 minutes in summer[4].

The results described above will be published in full in the *Proceedings of the Zoological Society*.

H. MUNRO FOX.

Institut de Biologie, Tamaris,
and Birmingham University.
Oct. 19.

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[1] H. Munro Fox, NATURE, 137, 903 (May 30, 1936).
[2] B. Ephrussi, *C. R. Soc. Biol. Paris*, 89, 928 (1923).
[3] O. Koehler, *Arch. Zellforsch.*, 8, 272 (1912).
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Physical Nature of Certain of the Vibrating Elements of the Internal Ear

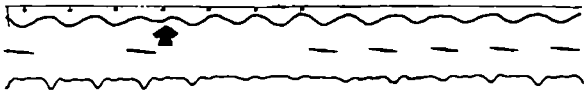
THE sensation resulting in the human subject from a change of phase of π (180°) occurring in the course of a continuous musical tone has been the subject of a number of earlier publications[1]. Under certain conditions, the sensation has been found to resemble the beat produced by two pure tones slightly out of unison, and has been described as a "phase-change beat"[2]. As stated by Hartridge[1], it is demanded by the Helmholtz resonance theory that the physiological event which corresponds to such a phase-change beat must be a transient arrest of the resonant elements of the internal ear brought about by the opposition of the impressed forces following the change of phase to the after-swings enforced by resonance.

An experiment is described below in which direct evidence is adduced that an event of this kind does in fact take place.

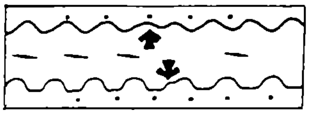
For the purpose of acoustic stimulation, the phase-reversing photo-electric siren to which reference is made elsewhere[3] has been employed. By means of this device, tone frequencies of 256 ∼ and 1,024 ∼ and of 40–80 phons intensity were generated and led by means of thick-walled rubber tubes to the ear of an animal preparation (decerebrate cat).

Employing suitably disposed electrodes and an amplifying system of conventional resistance-capacity type to feed a cathode ray oscillograph, the electrical response of the cochlea (Wever and Bray phenomenon), and also the auditory action-potentials of the mid-brain, were recorded photographically upon fast-moving cine-bromide. In addition, arrangements were made for the simultaneous recording of the sound stimulus by means of a piezo-microphone feeding a separate amplifier and oscillograph.

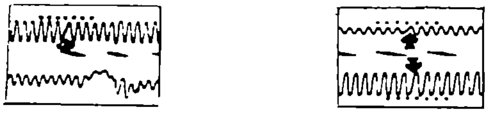
The records depicted in Fig. 1 show that in the case of the auditory tract potentials, the response is of the resonant type, in that it exhibits a well-marked 'silent period' in correspondence to the change of phase occurring in the stimulating tone. This finding is considered to provide clear evidence of the occurrence under the conditions described of a transient arrest of the vibrating elements responsible for the initiation of the auditory action potentials. As stated by Hartridge, this phenomenon is explicable only upon the hypothesis of Helmholtz that these elements are resonant structures. The widely held view that the elements in question are the fibres of the basilar membrane is accepted.



256 ~ Microphone and auditory tract response.



256 ~ Microphone and cochlear response.



1024 ~ Microphone and auditory tract response.

1024 ~ Microphone and cochlear response.

FIG. 1. Oscillograph records of auditory tract and cochlear responses to 180° phase changes. In all the records, the upper tracing represents the microphone response; arrows indicate the position of the phase-changes. Time marker, 1/200 sec.

In the case of the cochlear response, the records displayed in Fig. 1 show that no such silent period occurs, and that further, the change of phase in the stimulating tone is reproduced with considerable fidelity. This finding provides evidence which enforces the view that the cochlear response differs fundamentally in its mode of origin from that of the auditory action-potentials recorded, as in the present experiment, from the tracts of the mid-brain. The fidelity of reproduction of the impressed phase change must be taken as indicating the light, but heavily damped, character of the moving parts responsible for the generation of the cochlear response, and is in clear accordance with the membrane hypothesis of its origin put forward in a previous publication[4]. This hypothesis regards the potential changes in question as originating in movements occurring in a polarized membrane. Reissner's was considered to be such a membrane, and a possible mechanism of polarization was suggested, based upon the known differences of origin of the endolymph and perilymph.

The more widely accepted hypothesis of Davis and his collaborators[5], that the cochlear phenomenon originates in the manner of a piezo-electric effect from the hair-cells of Corti's organ, must in the light of the present findings be regarded as untenable, in view, first, of the direct attachment of these cells to the basilar fibres, and secondly, of the failure of the phenomenon to exhibit any silent period in response to a phase-reversal such as is now shown to be imposed by the resonant character of these fibres upon other anatomically associated elements, namely, the terminal fibrils of the cochlear nerve.

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[3] C. S Hallpike, H. Hartridge and A. F. Rawdon-Smith, *Proc. Physiol. Soc*, Feb 15, 1936. *J. Physiol.*, 88.

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The Theory of Phase Transitions

THE only phase transitions which up to the present time have been thoroughly investigated are transitions between the liquid and gaseous states. As regards transitions between liquids and crystals or between different crystalline modifications, their treatment has not always been quite satisfactory. For example, one sometimes hears not only of transition points (with jumps of energy) and Curie points (with jumps of specific heat), but also of transition points of the *n*th order, as if there were reason to assume that such generalized transitions can really exist. Some transitions have been attributed to the rotation of molecules, although I cannot see how rotation by itself can lead to discrete transitions. The idea seems to exist that there can be an absolutely continuous transition between the liquid and crystalline state (analogous to the transition liquid-gas), which would require the existence of a miraculous state which is neither isotropic nor anisotropic.

A mathematical treatment of the problem can be developed by introducing a density function $\rho(x,y,z)$, which determines the probability density for an atom or an electron to be found at a given point x,y,z. The symmetry of this function determines the symmetry group of the crystal. For liquids, $\rho(x,y,z)$ is a constant. For the investigation of continuous or nearly continuous transitions, we can write $\rho(x,y,z) = \rho_0(x,y,z) + \delta\rho(x,y,z)$, expand the thermodynamic potential in powers of $\delta\rho$ and investigate the minimum properties of this expression.

Such an investigation in the most general form, the details of which will appear elsewhere, leads to the following results. There exist only two kinds of transition points (more exactly lines in the p-T diagram), namely, phase transition points and Curie points. Curie points are only possible when the symmetries of both modifications are different and the symmetry group of one modification is a certain sub-group of the symmetry group of the other. Thus, for example, the symmetry of the ammonium chloride molecule changes at the Curie point from O_h to T_d, which is a sub-group of O_h. In alloys the change of symmetry consists generally in a doubling of the lattice constant.

If the relation between the more symmetrical group and the sub-group does not satisfy certain conditions, no Curie point line in the p-T plane is possible. But there is still a possibility of a continuous transition (without a jump in the energy) at a single point in the *p-T* plane. The *p-T* diagram near this point has in the simplest case the form shown in Fig. 1. Here I denotes the region of the more symmetrical phase. II*a* and II*b* are two different phases with the same symmetry, which is that of a subgroup of I. At the point *O* all the three phases become identical.

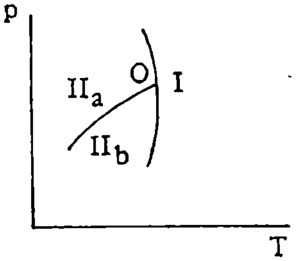

FIG. 1.

It can be shown that the transition crystal-liquid belongs to this class. No Curie point line can therefore exist for melting, and the only possible type of continuous transition crystal-liquid is that shown in Fig. 1, where in this case I refers to the liquid and II to the crystalline state.

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Emission of Beta-Rays from Substances bombarded with Neutrons

IT is well known that a Geiger-Müller counter placed near a target containing heavy hydrogen gives a large number of responses when the target is bombarded with deuterons of considerable energy. Oliphant[1], and later Alexopoulos[2], stated that these radiations are unable to induce simultaneous discharges in two thin-walled Geiger-Müller counters placed side by side, and concluded that no gamma-ray of energy higher than 1×10^6 ev. accompanies the D–D reaction. Results contrary to these authors have been obtained repeatedly by us[3] using Geiger-Muller counters the walls of which were made of aluminium 0·1 mm. in thickness. But as the energy of the electrons was nearly equal to that of secondary electrons of gamma-rays excited by fast neutrons in several elements, we consider that they might have been due to the gamma-rays excited in several parts of the apparatus by the action of neutrons emitted not only from the target but also possibly from different parts of the accelerating tube bombarded by stray deuteron beams.

We have now performed the experiments with a different arrangement in which the secondary effects are minimized, and confirmed that the radiation in question cannot be ascribed to any secondary origins. From the ratio of the number of coincident discharges to the number of responses of the single counter, it is estimated that the greater part of the discharges taking place in the single counter is due to the electrons, which are also responsible for the simultaneous discharges. The absorption curve of the beta-rays indicates that most of the electrons had energy lower than 1·0 mv., while a small portion of them had somewhat higher energy extending up to 1·5 mv. (In the single counter experiments, the counter was in most cases covered with a sheet of lead 0·5 mm. in thickness to protect it from the electrons, which might be emitted from the walls of the boron box in which the counter was placed. In the case of double counter experiments, semi-cylindrical lead covers 1·0 mm. thick were attached to the outer sides of the counters.)

Now, we can consider two possibilities: (1) the gamma-rays are emitted in the D–D reaction; or (2) the beta-rays are emitted under the action of fast neutrons from the substances of which the counter, including lead covers, is constructed. To decide between these alternatives, lead and aluminium absorbers 2 cm. in thickness were inserted between the target and the counter. The effect of the gamma-rays excited in the absorbers was allowed for. The decrease in the rate of discharge of the counter was conclusively in favour of the second alternative.

We further investigated the change in the number of responses when the lead cover 0·5 mm. in thickness was replaced by the sheets of carbon, aluminium, iron, nickel, copper, zinc, silver, cadmium and platinum of about 0·5 gm./cm.^{2} thickness, which was sufficient to stop the beta-rays of energy lower than 1·3 mv. A similar effect was observed in each case, and the effect seems to increase rather smoothly with the atomic number, while the energy of the electrons remains constant within the experimental error.

In explaining this phenomenon, the effect of ordinary induced radioactivity is excluded, for we could observe no activity remaining after the bombardment. It was easily proved impossible to explain the observed large effect by the gamma-rays excited in the walls of the counter and its cover, which were comparatively small. The only possible explanation in terms of the reaction hitherto known is the excitation of the nucleus by the fast neutrons, and subsequent emission of the extra-nuclear electrons through internal conversion. If this be true, the coefficient of the internal conversion must be very large, that is, nearly equal to unity for all the elements investigated, including light elements such as carbon and aluminium. Further, the smooth dependence of the effect on the atomic number seems to indicate also the inappropriateness of the assumption.

We must then assume some new types of interaction of the neutron with atoms, such as the direct interaction of neutrons with the bound electron, or the disintegration of a neutron into an electron and a proton in the nuclear field. The cross-section of the process was estimated to be of the order of 10^{-25} cm.^{2} for the light elements and 10^{-24} cm.^{2} for the heavy elements. These values are very much higher than those expected from existing theories. The observed energy of the electrons is what might be expected from the disintegration of neutrons. If this assumption be correct, we should have to find trident tracks, consisting of an electron, a proton and a recoil atom, in a Wilson chamber traversed by neutrons in amount well above the error of observation.

A detailed account of the experiments will be published in the *Proc. Phys.-Math. Soc. Japan* soon.

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An X-Ray Study of Sulphuric and Orthophosphoric Acids

THE study of X-ray diffraction patterns of liquids is one of the least indirect means of obtaining information concerning their structure, but the amount of information is restricted by the limitations of the theory. The straightforward application of the original Debye theory[1] leads to an expression for the intensity of scattering

$$I = I_0 \frac{e^4}{m^2c^4} \cdot \frac{P}{R^2} F^2 \left[1 + \int_0^\infty 4\pi r^2 [g(r) - \rho] \frac{\sin sr}{sr} \, dr \right] . \quad . \; (1)$$

where I_0 is the intensity of the incident beam, P is the polarization factor, R the distance from specimen to point of observation; $4\pi r^2 g(r)dr$ represents the number of atoms or molecules lying within radii r and $r + dr$; ρ is the mean density in atoms or molecules per c.c., e, m and c have their usual significance, and $s = 4\pi \sin \theta/\lambda$, where θ is half the scattering angle.

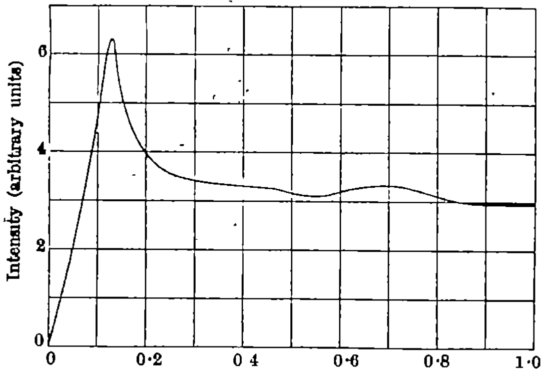

FIG. 1. Scattering of molybdenum $K\alpha$ radiation by orthophosphoric acid.

In the simple case of an atomic liquid, such as sodium, F^2 is identical with f^2, the square of the atomic scattering power. By the use of Fourier inversion, it can be shown that:

$$4\pi r^2 g(r) = 4\pi r^2 \rho + \frac{2r}{\pi} \int_0^\infty s\varphi(s) \sin rs \, ds \quad . \quad . \quad . \quad (2)$$

where

$$\varphi(s) = \frac{(I/kP - f^2)}{f^2} \text{ and } k = \frac{I_0 e^4}{m^2c^4} \cdot \frac{1}{R^2}.$$

$\varphi(s)$ can be derived from a knowledge of f^2 and the experimental scattering curves, and it is therefore possible to obtain a Fourier analysis of the distribution of matter in the liquid[2,3].

For a molecular liquid

$$F^2 = \Sigma_p \, \Sigma_q \, f_p \, f_q \frac{\sin sr_{pq}}{sr_{rq}},$$

and a knowledge of the internal structure of the single molecule is necessary before (2) can be applied. $g(r)$ then gives the distance apart of *molecular* centres.

In the case of sulphuric and orthophosphoric acids, the rigid tetrahedral nature of the SO_4 and PO_4 groups is beyond question, and it was thought to be of interest to determine the arrangement of molecules in the liquids. (When f^2 becomes F^2, $g(r)$ refers to molecules and not to atoms.) Strictly speaking, orthophosphoric acid is a sticky solid, but a trace of water, about 1 per cent, is sufficient to turn it into a liquid.

The Fourier analysis is not yet complete, but it is clear that the scattering curves for the two liquids are almost identical, each having one main sharp diffraction band at an equivalent spacing of 3·85 A. There are, however, minor differences between the curves at larger values of sin θ/λ. Fig. 1 shows the scattering curve for orthophosphoric acid, taken with molybdenum radiation, and corrected for lack of polarization in the incident beam.

Further studies of other acids and molecules of roughly spherical shape should be of interest. The theory takes no account of molecular rotation; in spherical molecules this effect should be of minor importance, and the Fourier analysis can be relied on to give a fairly accurate picture of the average distance apart of molecules in the liquid.

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[1] Debye, *Ann. Phys.*, 46, 809 (1915).

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Specific Heat of a Liquid at Different Temperatures

IT is possible to measure the specific heat of a liquid at a number of different temperatures by determining the power required to hold the temperature of a calorimeter and its contents stationary at different temperatures above that of the surroundings. The power is supplied electrically to a coil immersed in the liquid, and we have

$$-(Ms + W) \, d\theta/dt = E^2/RJ.$$

If a cooling curve is now taken, it can be shown that within the limits of experimental error,

$$-d\theta/dt = K\theta^n,$$

where n is nearly, but not exactly, equal to 5/4, K and n being determined by the use of a least-square or some equivalent method. We thus have

$$(Ms + W) K\theta^n = E^2/RJ,$$

giving the specific heat s in terms of the 20° calorie, if an experiment be performed with water at 20° C.

The method has proved to be surprisingly sensitive, and gives results which are reproducible with a very high degree of consistency. We have used the method to determine the specific heat of water over the range 15° – 45° C., and, by the very great kindness of Imperial Chemical Industries Ltd., we were able to conduct an experiment with heavy water of 99·2 per cent purity over the same range. The sample of heavy water lent to us was 375 gm. in mass, and, although this is relatively a large quantity of a rare liquid, it is small compared with the quantity demanded by a continuous-flow experiment. The accompanying table gives results in terms of the 20° calorie:

Temp.	Water	Heavy water
15° C.	1 0010	$1·009_0$
20° C.	1·0000	$1·007_0$
25° C.	0 9991	$1·005_4$
30° C.	0·9986	$1·004_3$
35° C	0·9984	$1·003_8$
40° C.	0·9984	$1·003_9$
45° C.	0 9986	$1·003_7$

It will be seen that the results for deuterium oxide are consistently higher than the values for water, and that a minimum value is shown at about 41° C.

These values, which were announced at the Blackpool meeting of the British Association, are preliminary in character, and may be subject to small corrections.

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Effect of Large Centrifugal Forces on *Paramecium*

THE effect of subjecting *Paramecium* to large centrifugal forces has been investigated and has given some encouraging results.

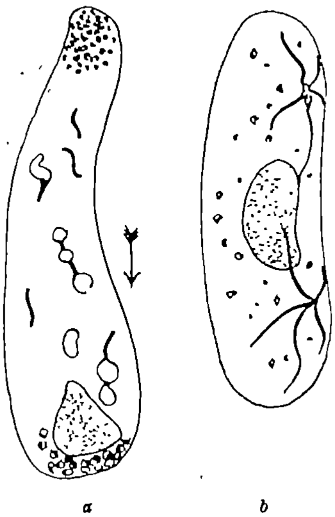

FIG. 1. (*a*) Centrifuged, (*b*) control *Paramecium*. The arrow indicates the direction of the force.

Fig. 1 illustrates the effects produced. The animal becomes elongated. The nucleus and crystals are moved to the centrifugal side, the excretory mechanism is fragmented, the canals being torn away from the pore and enlarging to form vacuoles. In addition, there is a collection of small granules visible after the Golgi methods, both osmic acid and silver. These granules are moved towards the centripetal pole, and it is thought that they may be Golgi bodies of a rudimentary type.

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Diffraction of Light by Ultra-sonic Waves

WE have recently given a theory of the diffraction of light by ultra-sonic waves, which is quite general and leads to numerical results for the diffracted intensities[1]. In this paper, we considered normal incidence only ; we have now calculated some diffraction patterns at oblique incidence. We found these in good agreement with the experimental results of Parthasarathy[2].

Parthasarathy apparently explains the observed asymmetry of the diffraction pattern by the "characteristic reflection" of light on the ultra-sonic wave, although we know from the theory of diffraction of X-rays in crystals that this reflection is simply a consequence of the equations of propagation. In fact, even for X-rays, as Ewald has shown[3], Bragg's angle of reflection is not sharp, but spreads out over a region which covers a few seconds of arc, and our theory shows that for ultra-sonic and light waves this region is much larger and may cover as much as a few degrees.

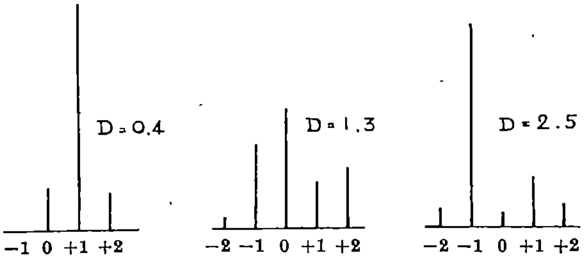

FIG. 1. Intensity of the diffracted light in the various orders for three different values of the thickness d of the ultra-sonic beam. The light is incident obliquely in the direction of the + 1 order, the 0 order being on the normal to the direction of the ultra-sonic wave. d is connected to the pure number D which appears in the figures through the relation $D = \frac{\pi \lambda}{\Lambda^2} d$, λ and Λ being the wave-lengths of the light and of the sound waves respectively.

The three diagrams reproduced (Fig. 1) show the calculated intensities in the different orders of diffraction for different thicknesses of the beam of ultra-sonic waves. The angle of incidence and the intensity of the ultra-sonic waves have been kept constant. One sees clearly that the repartition of intensity among the different orders is a function of the thickness of the ultra-sonic beam. The reason for this is that the intensity of a wave diffracted in Laue fashion is a quasi-periodic function of the thickness of the diffracting medium (corresponding to the *Pendellösung* of Ewald for X-rays).

Our diagrams exhibit the asymmetry which is the main feature of Parthasarathy's photographs. It is, of course, impossible to obtain more than qualitative agreement, without precise information about the intensity and breadth of the ultra-sonic beam.

The geometrical representation of Ewald allows an interpretation of the equivalent Brillouin theory, which clarifies greatly the apparent mathematical complexity of the latter. In fact, one can reason out very simply the exact solution of the problem of diffraction, and this seems much easier than trying to solve it approximately, as N. S. Nagendra Nath has done in a recent paper[4].

The complete report of our investigation will appear shortly in the *Helvetica Physica Acta*.

I wish to thank Prof. Weigle for his valuable advice in this work.

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Sodium and Water Metabolism in Relation to Disturbances of Carbohydrate Metabolism after Adrenalectomy

We have found that in the absence of the adrenal cortex, flavin is not transformed to flavin phosphoric acid, but that adrenalectomized animals can be kept alive with large quantities of the latter substance (vitamin B_2)[1]. We have also shown that lack of adrenal cortex causes serious disturbances in intermediate metabolism of carbohydrates and fats, particularly in the absorption of these substances[2-5]. In the following experiments, we have tried to show how these facts are related to the well-known disturbances of water and sodium metabolism which may cause death in adrenalectomized animals.

The selective absorption of glucose is inhibited after adrenalectomy, and this is due to the absence of the cortex, since it can be restored by administering cortical hormone[1]. We have now demonstrated this by injecting a mixture of glucose and xylose (each in half blood-isotonic solution) into a ligatured loop of a rat's intestine. From such a solution, glucose disappears four times as quickly as xylose, in normal animals, and in adrenalectomized animals the ratio is almost 1 : 1, that is, both sugars are absorbed at the same rate.

Table 1. Absorption of a mixture of 3 c.c. of 5·4 per cent glucose and 3 c.c. of 4·5 per cent xylose from a 60 cm. loop of intestine in a rat during one hour.

	Injected (gm.)		Absorbed (gm.)		Ratio of Absorption
	Glucose	Xylose	Glucose	Xylose	
Normal rats	0·162	0·135	0·146	0·034	4·3 : 1
Adrenalectomized rats	0 162	0·135	0·049	0·028	1·7 : 1

If the selectively rapid absorption of glucose from an intestinal loop is inhibited by poisoning the animal with iodoacetic acid, then sodium salts diffuse into the interior of the intestine more rapidly than glucose leaves it; hypertony results, and a large quantity of water enters the intestine by osmosis[6]. Exactly the same happens when the selective absorption of glucose is inhibited by adrenalectomy. The intestine is found to be full of fluid one hour after glucose administration. The example given in Table 2 is typical of many such experiments.

Table 2. Absorption of 5·4 per cent glucose solution from a 30 cm. intestinal loop of a rat during one hour.

	Glucose (gm.)		Fluid movement (c.c.)	
	Injected	Absorbed	Injected	Found
Normal rat	0·162	0·147	3	0 6
Adrenalectomized rat	0·162	0·042	3	3·5

Thus in adrenalectomized rats, ingestion of glucose causes great losses (into the intestine) of sodium by diffusion and of water by osmosis. Therefore the adrenalectomized animals, in contrast to normal rats, develop intensive diarrhœa after glucose administration. This is also seen in normal animals after the administration of xylose, which is slowly absorbed, or after glucose with iodoacetic acid poisoning, when the glucose is also slowly absorbed.

Thus the inhibition of the selective absorption of glucose in adrenalectomized animals leads *secondarily* to losses of sodium salts and water. Similar disturbances are possible in the intermediate metabolism of carbohydrates and fats[2-5].

These secondary disturbances of loss of sodium and water may be the cause of death of adrenalectomized animals which can be prevented by giving sodium salts. In several cases, rats adrenalectomized 8–15 days before, died in 3–5 hours when 5 c.c. of 50 per cent glucose solution was fed by stomach tube. A second group of such rats survived when sodium chloride and carbonate were given simultaneously. This supports the above explanation.

A detailed report will be published in *Pflügers Archiv.*

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Biosynthesis of Ascorbic Acid

Some time ago[1], we observed that incubation of some tissues of the rat with mannose in a mixture of Ringer-Locke solution and phosphate buffer at *p*H 7·4 resulted in an increase of the ascorbic acid value, as determined by the usual titrimetic technique with 2 : 6-dichlorophenol indophenol[2]. The experiments *in vitro* were supported by experiments *in vivo*, in which it was shown that the injection of mannose into the rat also caused an increase in the ascorbic acid content of some of its tissues[3]. Cell-free extracts were also obtained from germinating *Phaseolus mungo*, which were likewise capable of converting mannose into ascorbic acid[4].

Euler, Gartz and Malmberg[5] have, however, not been able to detect the above conversion with the tissues of the rat. Their experiments indicate that they worked in an atmosphere of nitrogen, and that they compared the ascorbic acid values of the fresh tissues with the values obtained after incubation with mannose. We repeated the following experiments in order to clear up the discrepancy. 0·5 gm. of the finely minced tissue was used in each case, suspended in a mixture of 3 c.c. Ringer-Locke solution and 2 c.c. phosphate buffer of *p*H 7·4, to which 1 c.c. of a freshly prepared aqueous solution, containing 20 mgm. mannose, was added. This was shaken up and incubated for 3 hours at 37° in a 25 c.c. conical flask closed with a rubber cork. The flask was not shaken any more. The control vessel contained 1 c.c. water instead of the mannose solution. Two other vessels contained the same two mixtures in an atmosphere of nitrogen. The results are shown in the accompanying table:

Ascorbic acid (mgm.) per 0·5 gm. liver tissue.

Expt.	In nitrogen		In air		
	With mannose	Without mannose	With mannose	Without mannose	Percentage of increase in air
1	0·29	0·29	0·27	0·20	35
2	—	—	0·21	0·19	10
3	0·32	0·32	0·25	0·21	18
4	0·32	0·32	0·21	0·18	16
5	0·22	0·22	0·18	0·18	23
6	—	—	0·097	0·080	21

These figures show that in an atmosphere of nitrogen the amount of ascorbic acid remains constant, whether mannose is added or not. But in a closed volume of air, if the experiments are carried out precisely under the conditions mentioned, there is an increase in the amount of ascorbic acid on incubation with mannose. The ascorbic acid value thus obtained after incubation with mannose in air is, however, invariably lower than the value obtained with the fresh tissue, and cannot naturally be compared with it. The figures obtained after incubation with and without mannose are alone comparable. It appears from these results that molecular oxygen is necessary for the conversion with which we are dealing.

Similar results have been obtained with the aqueous extracts of germinated *Phaseolus mungo*, which can also convert mannose into ascorbic acid at *p*H 5·8 in a closed volume of air but not in nitrogen. Numerous experiments have been carried out in this connexion, and they will be reported later.

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Oct. 12.

Guha and Ghosh, NATURE, 134, 739 (1934)

[2] Ghosh and Guha, *J. Indian Chem. Soc.*, 12, 30 (1935).

[3] Guha and Ghosh, NATURE, 135, 234 (1935).

[4] Guha and Ghosh, NATURE, 135, 871 (1935).

[5] Euler, Gartz and Malmberg, *Biochem. Z*, 282, 402 (1935).

Expansion Pressures of Metallic Hydrogen and Deuterium

FROM a recent calculation[1], it follows that the striking difference in properties between hydrogen and lithium is due to the great stability of the covalent H–H link. Metallic hydrogen (the analogue of metallic lithium) would be formed from hydrogen atoms with an evolution of about 10 kcal. per gm. atom, but is only stable with respect to diatomic hydrogen molecules at pressures not less than $2 \cdot 5 \times 10^6$ atmospheres.

Although these pressures have not been experimentally realized, it is possible to investigate the properties of metallic hydrogen (Graham's hydrogenium) in some of its alloys. There is evidence that in the 'hydrides' of transitional elements such as tantalum, palladium and nickel, as well as in solutions of hydrogen in other metals at high temperatures, the hydrogen is in the metallic state, that is, is dissolved as atoms, and is partly dissociated into protons and electrons[2].

One of the most readily investigated properties is the expansion pressure. Although on purely geometrical grounds the hydrogen atoms and protons could fit into the interstices of the metal lattice with which the hydrogen is alloyed, metallic hydrogen exerts a considerable expansion pressure. For palladium, with a compressibility of approximately $0 \cdot 4 \times 10^{-6}$ per atmosphere, an expansion pressure of $2 \cdot 5 \times 10^5$ atmospheres would lead to an expansion of 10 per cent in volume, whereas the observed value, when approximately 0·5 gm. atom H is added per gm. atom Pd, is 11 per cent.

In a recent communication[3], a method is described for investigating special problems in the structures of solids, by making use of the differences in zero point energy when deuterium is substituted for hydrogen. The changes are usually quite large enough for X-ray investigation, and provide an additional parameter which can be varied in studying the equilibrium of the lattice. In the case of the metallic linkage, for example, it is possible to obtain an estimate of the differences in expansion pressures of metallic hydrogen and deuterium, by measuring the expansion of the palladium lattice when alloyed with each of these isotopes.

As is discussed in a forthcoming publication, the expansion of the palladium lattice leads to an increased heat of solution of hydrogen, with the result that below about 300° C. two phases with atomic ratio H/Pd about 0·02 and 0·5 are formed, with the same lattice structure and the same dissociation pressure of hydrogen. By investigating these two phases in equilibrium, when either hydrogen or deuterium is dissolved in palladium, it is found that the average expansion in the lattice parameter on forming the β-phase is 0·1430 ± 0·0004 A. for hydrogen, 0·1325 ± 0·0004 A. for deuterium. The concentration of deuterium in the β-phase is slightly greater than in the case of hydrogen, and the expansion pressures of these two isotopic metals differ by about 7 per cent.

The lattice energy of transitional metals appears to be particularly sensitive to volume changes, and information about the energy changes involved may be obtained by alloying with each of the two isotopes.

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[1] Wigner and Huntingdon, *J. Chem. Phys.*, 3, 764 (1935).

[2] cf. Ubbelohde, *Trans. Far. Soc.*, 28, 275 (1932).

[3] Ubbelohde, *Trans. Far. Soc.*, 32, 525 (1936).

Viscosity of Binary Mixtures

SEVERAL attempts have been made to represent the viscosity, η, of a mixture, as a function of the concentrations, c_1 and c_2, and the viscosities, η_1 and η_2, of the components. So far as we are aware, all investigators (with the exception of Dolezalek) have used the general form:

$$f(\eta)=c_1.f(\eta_1)+c_2.f(\eta_2)$$

with various expressions for f, such as $f=\log \eta$ (Arrhenius), $f=1/\eta$ (Bingham), $f=\eta^{1/3}$ (Kendall and Monroe). The latter demonstrated very clearly that, with any of these functions, deviations up to 20 per cent and more appear, when used for mixtures of two liquids with very different physical constants. As a matter of fact, there is no reason to suppose that any expression of this general form can give satisfaction.

Let N_1 and N_2 be the mole fractions of the two components; let us denote by z_1 the interaction of one particular molecule of kind 1 in the layer A with a molecule of the same kind in layer B, and by z_{12} the interaction with a molecule of kind 2. The relative amounts of these interactions of the molecule in the layer A will be proportional to their probabilities, and thus, in the simplest case, also proportional to the number of the molecules of kind 1, respectively kind 2 in the layer B, that is, to N_1 and N_2. The relative amount of the interaction between the two layers A and B generated by the total number of molecules of kind 1 is then again proportional to N_1, and thus amounts to $(N_1z_1+N_2z_{12}).N_1$. Similarly, that of the molecules of kind 2 amounts to $(N_2z_2+N_1z_{12}).N_2$. If z denotes the total interaction, we may thus write:

$$z=N_1^2z_1+2\,N_1N_2z_{12}+N_2^2z_2\,;$$

and as we may put $N_1+N_2=1$,

$$z=N_1^2(z_1+z_2-2z_{12})+2N_1(z_{12}-z_2)+z_2 \qquad (1)$$

The dissipation of energy occurring when the two layers A and B are sliding over each other (as in laminar flow) results from their interaction. In other words, the internal friction must be some function of z. Dolezalek[1] assumed $z=\eta$, but his assumption does not give results in agreement with the experimental data. For reasons which will be stated elsewhere, we have to put $z=\log \eta$, and thus, from (1)

$$\log \eta = N_1^2 . \log \frac{\eta_1 \eta_2}{\eta_{12}^2} + 2N_1 . \log \frac{\eta_{12}}{\eta_2} + \log \eta_2 \qquad (2)$$

On the other hand, Guzman has pointed out, and Sheppard[2] recently emphasized, that log η represents a work-function, and thus (2) represents an energy relationship.

This relationship contains only one constant, namely η_{12}: the coefficient of internal friction for molecules of two different kinds. This coefficient should be used in the calculation of diffusion.

Equation 2 fits the data, determined by Kendall and Monroe[3], with fair accuracy; especially the system benzylbenzoate–toluene, in which case the interpolation formulæ hitherto employed gave very unsatisfactory results (see accompanying table). The same holds for the system hexane–carbontetrachloride.

We obtained by equation 2, again from the data of Kendall and Monroe, for the viscosity of naphthalene dissolved in benzene or in toluene, at 25° C. 2·19 and 2·24 centipoises respectively. The values calculated by Kendall and Monroe differed by more than 20 per cent in the two solvents, as in the case of diphenyl, while we obtain, from the same data, 3,740 centipoises in each case.

N_1	η observed (K. and M.)	η calcul. (K. and M.)	η calcul. (equat. 2)	Difference (K. and M.)	Difference (equat. 2)
				Per cent	Per cent
0 000	0·552	—	0·552	—	0
0·2367	1·183	1·362	1·15	+ 15 1	− 2·6
0·4261	2·015	2·399	2·01	+ 19·1	− 0·4
0·6502	3·614	4·182	3·64	+ 15·7	+ 0·7
0·7890	5·080	5·645	5·15	+ 11·1	+ 1·5
0·9002	6·660	7·024	6·67	+ 5·5	+ 0·6
1·000	8·450	—	8·45	—	0
η_{12} = 2·75 centipoises					

N_1 = mole fraction of benzylbenzoate, in toluene.

The same line of reasoning is being applied to a number of related problems. It seemed, however, worth while to publish these first results.

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[1] Dolezalek, *Z. phys. Chem.*, **83**, 73 (1913).
[2] Sheppard, NATURE, **125**, 489 (1930).
[3] Kendall and Monroe, *J. Amer. Chem. Soc.*, **39**, 1785 (1917).

Points from Foregoing Letters

PROF. H. MUNRO FOX shows that the rates of cleavage of sea urchin eggs are adapted to the temperature of the seas in which they live. For a given rate of cleavage, a higher temperature is necessary in a certain Mediterranean species than in an English species of the same genus; and the same phenomenon occurs within another single species in different latitudes.

Support for Helmholtz's theory that the elements responsible for the initiation of electrical ('action') potentials in the inner ear are 'resonant structures', is adduced by C. S. Hallpike, Prof. H. Hartridge and Dr. A. F. Rawdon-Smith. They find by means of oscillograph records that a 180° phase change in a stimulating tone produces a 'silent period' in the auditory tract potential. No such silent period is observed in the cochlear response, though the phase change is recorded.

Mathematical considerations of the problem of phase transitions between liquids and crystals lead Dr. L. Landau to the view that a Curie point line (with jumps of specific heat, on melting) is not possible, but that there is a possibility of a continuous transition, without a jump in the energy, at a single point in the pressure-temperature plane.

The emission of beta-rays (electrons) from metals during bombardment with fast deuterons is reported by S. Kikuchi, H. Aoki and K. Husimi. There is no residual activity after the bombardment, and the authors consider that the observed effect is due to new types of interaction of the neutron with atoms.

A curve showing the scattering of X-rays ($K\alpha$ rays of molybdenum) by orthophosphoric acid (containing 1 per cent of water) is submitted by J. T. Randall. The author states that this is almost identical with that for sulphuric acid and, in view of the known rigid tetrahedral nature of the SO_4 and PO_4 groups, he intends, by means of a Fourier analysis of the curves, to deduce the distribution of matter in those liquids.

The specific heats of water and of heavy water at various temperatures between 15° and 45° C. have been calculated by Prof. A. Ferguson and A. H. Cockett by determining the electrical power needed to hold the temperature of a calorimeter and its contents stationary at different temperatures above the surrounding medium.

If glucose is administered to rats from which the adrenal glands have been removed, sodium and water diffuse into the intestine producing diarrhœa. The effect may be lethal, but it can be inhibited by giving simultaneously sodium salts. Prof. F. Verzár and L. Laszt, reporting these results, state that they may be related to the previously observed effect of vitamin B_2 on adrenalectomized rats.

Further experiments by Prof. B. C. Guha and B. Ghosh confirm their previous findings, that rat tissue incubated with mannose, in the presence of a limited amount of air, leads to an increase in the amount of ascorbic acid. This increase, however, does not take place when nitrogen is substituted for air, which explains the negative results obtained by Euler, Gartz and Malmberg.

A. R. Ubbelohde reports that X-ray measurements show the expansion pressures of hydrogen and deuterium dissolved in palladium to differ by about 7 per cent. He concludes that in certain hydrides the hydrogen is probably present in the metallic state, and exerts a considerable expansion pressure on the metal with which it is alloyed.

Research Items

Marriage among Serbian Gypsies

IN a final study of the Serbian gypsies, Dr. Alexander Petrović deals with certain conditions affecting the married state (*J. Gypsy Lore Soc.*, iii, 15, 4). Although monogamy is the rule, polygamy is not unknown, depending upon ability to bear the expense of additional marriages. The orthodox gypsies, however, are forbidden plural marriages by law. Among the gypsies of Rogatika, although they are Moslem, polygamy is rare on account of their poverty. The wealthy nomad tin-smiths as a rule have a plurality of wives. One gypsy aged forty years has three wives; and for these it is the custom that one should remain on duty in the tent for a period of eight days, while the other two go out begging. Only rich Christian gypsies solemnize marriage as soon as the bride is brought home. Usually the bride is kept for a while on trial, especially when she is too young for the priest to marry the couple legally. Others do not marry in order to escape payment, or to facilitate getting rid of an undesired wife. Permanence of marriage depends upon economic conditions. In this there is great difference between towns and villages, and different occupations, as for example, between musicians and factory hands. Begging and high earnings in factories have an appreciable effect on the fidelity of the women; and this is the cause of constant quarrels. Of the men in the villages, only one quarter had been married once only, while the remainder had been married repeatedly. In both sexes more than fifty per cent of the marriages had lasted from one to four months only. As a rule, the last marriage lasts the longest—six years and upwards. While the men in the towns tend to marry at a slightly later age than in the villages, the girls marry quite as early.

Cultural Contacts between India and China

IN *Current Science* (August 1936) an interesting paper appears entitled "The Himalayan Uplift since the Advent of Man: Its Culthistorical Significance" by Prof. B. Sahni. The main idea of Prof. Sahni's paper is to show that cultural contacts between India and China have probably existed since the dawn of human existence; that intercourse between the two countries by direct route across the Himalaya was possible before man conquered the ocean. On the evidence amassed by explorers and observers, it is held that round about Middle Pleistocene time, when the main valley of Kashmir was still occupied by the great 'Karewa Lake', interglacial man of about the same stage of cultural development as Neanderthal or Mousterian man in Europe and as Peking man in the Far East, flourished (*a*) in the plains of the northern Punjab, (*b*) on the shores of the Karewa Lake in the heart of Kashmir, and (*c*) just across the great Himalayan Range. The close cultural contacts between India and China during the historic period are fairly easily explained, as both countries possessed considerable seafaring power in ancient times, whilst the physical endurance of the Buddhist pilgrim mountaineers has become legendary. Palæolithic man had little incentive to travel beyond the necessary distances to provide him with his daily food. Even if he had wandered between the Punjab and Kashmir, it would be difficult to explain his crossing even the lowest pass in the Himalayas. Thus, the importance of the uplift of the Himalayas during the human epoch is evident.

Two-Factor Inheritance in Man

IN the Laurence-Moon syndrome, first described in 1866, mental retardation is accompanied by obesity, hypogenitalism, retinal degeneration with pigmentation, and polydactyly, the last condition alone being visible at birth. Dr. E. A. Cockayne has recently shown that although normal parents may produce affected children, their frequency is too great to be due to a single recessive factor. Dr. Madge T. Macklin (*J. Heredity*, 27, No. 3) has collected from the literature 53 families having a total of 283 children, 112 (or 39·6 per cent) of whom were affected. There is also an excess of affected males. An analysis of the various families leads to the conclusion that the condition is due to the presence of two genes, one an autosomal dominant and the other a sex-linked recessive. The large range of characters affected would also support the hypothesis that more than one gene was probably concerned. Cousin marriages are also found to be more frequent in these pedigrees than in the ordinary population.

Diseases of Birds

THE Biological Institute of São Paulo, Brazil, has published a valuable treatise upon the diseases of birds, compiled by J. Reis, P. Nobrega and A. S. Reis ("Doenças das Aves, Tratado de Ornithopathologia", pp. 469). The thoroughness with which the compilation has been made may be judged by the extent of a few of the sections of the work: virus diseases, 91 pages; various forms of mycetosis, 142 pages; protozoan diseases, 78 pages; diseases of nutrition, 21 pages. The book is well illustrated by photographs and diagrams.

American Flies of the Genus *Psychoda*

THE family Psychodidæ has been the subject of great attention, particularly with reference to the blood-sucking genus *Phlebotomus*, while the non-hæmophagous forms of the genus *Psychoda* have attracted much less notice. Both in Europe and North America the species *Psychoda alternata* and *P. phalænoides* breed in vast numbers in sprinkling filter beds. At times they issue in such swarms that it is impossible to work in the vicinity without the creatures entering the mouth and nose. No adequate evidence, however, has been presented with regard to their functioning as disseminators of disease germs. In the *Philippine Journal of Science* (59, No. 1, 85; 1936), Mr. F. del Rosario contributes a detailed revisional study of the genus, dealing with the American species. Since Haseman's work, published in 1907, little attempt has been made at a taxonomic study of the group in so far as North America is concerned.

Crustacea from the *Godthaab* Expedition

DR. K. STEPHENSEN has extended our knowledge of the distribution of many species of Crustacea from the waters between Greenland and Arctic America north of the east corner of Labrador in his two papers "Crustacea Decapoda" and "Crustacea Varia" (The *Godthaab* Expedition 1928. Leader: Eigil Riis-Carstensen. Meddelelser om Grønland, Bd. 80. No. 1, 1935 and No. 2, 1936). The decapods are here divided into bottom and pelagic forms, the bottom forms into Arctic, Boreal and Atlantic, the pelagic forms into Arctic and Atlantic. The Arctic forms are again sub-divided, the whole arrangement being based mainly on the summary by Holsten (1916), and maps of the distribution of the species are given. Specially interesting is the distribution of *Bythocaris leucopis* and *B. payeri*, the former belonging to much deeper water than the latter, *Ephyrina benedicti* new to northern waters, *Hymenodora glacialis* and *H. gracilis*. The finding of the two *Bythocaris* species and *Hymenodora glacialis* proves the identity of the Arctic deep-sea faunas north of the ridge east and west of Greenland. Most useful in the decapod paper are descriptions of larval forms, many of which were hitherto unknown. The larvæ of *Chionoecetes opilio* and of *Hymenodora glacialis* are described for the first time, and a beautiful new *Eryoneicus* (*E. groenlandicus*) which is certainly a larval form. There are also numerous suggestive notes on other larvæ not definitely fitted into their respective places, but the probable adults in most cases being given. In "Crustacea Varia" are included the groups not recorded in the other *Godthaab* Expedition papers.

Anther Smut of Carnations

DR. H. L. WHITE has directed attention (*Gard. Chron.*, Oct. 3) to the prevalence of the rather unique disease caused by the fungus *Ustilago violacea*. This organism can attack a large number of Caryophyllaceous hosts; but its effects are not usually noticeable until dark-coloured smutty spores are produced upon the anthers. The disease has probably occurred frequently where carnations have been grown in glasshouses; but it has recently attained rather more serious proportions. Numerous side shoots appear on an infected plant, before spores are produced. This feature favours control, for such shoots can be removed before they become a source of further infection, and they should also be rejected in the selection of shoots for purposes of propagation.

The Plant Chloroplast

PROBABLY no more important physiological unit can be chosen for study than the green chloroplast which is usually regarded as the seat of the photosynthetic process, yet an interesting paper by Kogane Kiyohara (*J. Fac. Sci., Tokyo*, Sec. 3, Botany, 4, Pt. 5) makes it clear how little definite information we have as to its structure and life-history. From a study of 262 species of flowering plants, he finds that the plastid is always a round object, spherical or a more or less flattened disk, with a diameter of about 5μ. Treatment with silver nitrate or osmic acid reveals a blackened ring in this disk; the starch formation is associated with the non-blackening central region of the plastid. In *Hydrilla verticillata*, in the growing cells of the leaf-base, clear cases are figured of the elongation and subsequent division of such disk-like chloroplasts, an observation which confirms the views of Schimper and Meyer. But a more controversial point is raised by the author's observation that whilst certain fixatives, particularly Kolatchev's and Carnoy's, show round typical chloroplasts in meristematic cells, the normal chondriosome fixatives distort these structures—which appear to be fluid in these meristematic cells—into typical thread-like chondriosome structures, so that the author concludes that the genetic connexion of chondriosomes with chloroplasts and indeed the presence of chondriosomes in plant cells is not as yet established.

Direct Oxidation of Soil Humus

DECOMPOSITION of organic matter in the soil leads, amongst other things, to the production of nitrates, which may be used directly by growing crops. Mr. C. B. Greening has suggested (*J. Roy. Hort. Soc.*, 61, Pt. 9; Sept. 1936) that this change might be brought about directly by oxidation of the organic matter with potassium permanganate. Lawns and several garden crops have benefited by the application of a dilute solution of this substance. Experiments quoted in the paper are on a very small scale, but larger trials are in progress at Wisley. The production of large quantities of nitrate in the soil is not to be desired for most crops, and any quick process of oxidation would deplete the soil of its reserves of organic matter, but the new process may well find application in some particular technique of horticulture, and in any case it would provide a new item of intellectual equipment for the scientific gardener.

Continental Motions

IN the October issue of the *Journal of the Franklin Institute*, Dr. Ross Gunn, of the United States Naval Research Laboratory, calculates by an approximate method the gravitational force on the North American continent due to the probability that the density of the earth's outer shell under the Pacific Ocean is about two per cent greater than under the continents. He finds it is equivalent to a slope downwards towards the Pacific of 1 part in 15,000. He is not prepared to say whether under these conditions the continent is at present at rest, but he considers that the presence of mountain ranges bordering the Pacific shows that in the past these forces have produced crushing and folding of the crust. For the North Atlantic he calculates these forces as being about half those of the Pacific. He considers these unsymmetrical distributions of density throughout the earth's crust support the theory that satellites were produced by fission due to tidal forces in the parent planet when in the liquid state.

Diamagnetism and Particle Size

INVESTIGATIONS on the susceptibility of substances in the form of small particles, produced by colloidalization or cold working, have revealed, in many cases, an apparent dependence of diamagnetism on particle size. There has been considerable controversy as to whether this is a true surface effect or, as has been maintained by Bhatnagar, simply an impurity effect, due to the larger surface of finely divided material facilitating such processes as oxidation and hydration. A critical survey of the subject has recently been made by Prof. H. Lessheim (*Current Science*, 5; 1936). He shows that the theoretical arguments which have been advanced in favour of a surface effect are certainly inadequate to account for the magnitude of the changes observed, and gives a detailed discussion of the experimental work on different substances. In many cases, as with bismuth, antimony and lead, the change in diamagnetism is due to the formation of surface layers of oxides; when the oxide is chemically removed, or when sufficient care is taken to exclude the possibility of oxidation during the preparation, the finely divided material has the same susceptibility as the material in bulk. Carbonization and the adsorption of gases may produce similar effects. Changes in diamagnetism are often associated with changes in crystal structure, and in some cases such changes may be brought about by the processes by which the fine particle material is produced. Where such changes can be excluded, Lessheim concludes that there is no definite evidence of an appreciable change in diamagnetism due simply to change in particle size.

A New Oxide of Phosphorus

THE discovery of a peroxide of phosphorus, with the formula PO_3 (or possibly P_2O_6) is reported by P. W. Schenk and H. Platz (*Naturwiss.*, 24, 651; 1936). When a mixture of phosphorus pentoxide vapour and oxygen is admitted to a discharge tube under a pressure of about 1 mm., and the discharge is passed, a bluish-violet product collects behind the discharge zone. The substance may be kept for about a day at ordinary temperature and in the absence of moisture. In aqueous solution it liberates iodine from potassium iodide. Using this reaction as a method of estimation, it is found that the bluish violet substance contains about two per cent of the new peroxide.

Theory of Photographic Development

EXPERIMENTS in favour of their adsorption theory of photographic development have recently been carried out by A. J. Rabinovitsch and S. S. Peissachovitsch (*Acta Physicochim. U.R.S.S.*, 4, 705; 1936). The conditions obtaining in the exposed photographic plate may be imitated by mixing a colloidal solution of silver bromide to represent the nuclei of silver bromide, and a silver sol, to represent the nuclei of silver present in the exposed plate. Addition of alkaline hydroquinone, metol, adurol, and other photographic developers causes a rapid blackening of the mixture. The colloidal silver may be replaced by platinum, gold, or copper sols, and the same development is obtained. If, however, Bredig's silver sol, or sols of palladium, bismuth, the hydroxides of aluminium, and iron, titanium oxide, or activated charcoal are substituted for silver, development does not occur. It has been shown that the sols which may replace silver and give similar results are those which will adsorb hydroquinone and other developers, whilst those which inhibit development are sols which do not adsorb the developer. By a study of cataphoresis and other experiments it is shown that the particles of the added silver sol are intimately linked with the silver bromide particles. If gelatin is added to the silver bromide sol before the addition of the silver sol, no development of the mixture occurs. Many other phenomena of importance in the theory of photographic development can be examined by means of the above system, including the effect of size of silver particles, hydrogen ion concentration, and addition of various chemicals, such as sodium sulphite and potassium bromide, on the rate of development.

Numerical Methods in Late Babylonian Astronomy

PROF. OTTO NEUGEBAUER, of Copenhagen, has published in *Osiris* (2, part 12, 517) what is intended to be the first of a series of studies of Naburimannu's and Kidinnu's systems of the solar and lunar motions, to be continued elsewhere. The texts used are the same as those used by Kugler in his epoch-making work, "Die Babylonische Mondrechnung" (1900) in one of which Prof. Neugebauer has introduced a number of corrections from a British Museum photograph. His interest is in the arithmetical methods used in these texts, especially in the length of the day and the anomalistic motion of the sun. His exposition is remarkably clear, and he finds, as Kugler found before him, that in the system now known as Naburimannu's, the sun is given two uniform velocities each lasting half the year, and the length of the day is made to increase at a uniform rate from one solstice to the other and to diminish at the same uniform rate in the opposite half of the year, while in Kidinnu's system, instead of uniform motions changing suddenly in amount or direction, we have a uniform change between two extremes in the rate of change. In other words, with Naburimannu, first differences are constant between limits, while with Kidinnu second differences are constant between limits. These methods, as Prof. Neugebauer has illustrated elsewhere, are very characteristic of Babylonian mathematics.

Multi-Cylinder Steam Turbines

THE English Electric Co. so early as 1923 constructed multi-cylinder turbines, but the development of this engine in recent years is due to the great increase in steam pressures and temperatures, and in the outputs of turbines. In the *English Electric Journal* of September, Mr. J. T. Moore describes the large multi-cylinder turbines now made by the E.E.C. The multi-cylinder turbine has the great advantage that the high pressures and temperatures are confined to a comparatively small section of the turbine. The high pressure cylinder which the steam first enters can be made of symmetrical and very simple design. The casting is therefore free from residual stresses, and high temperatures cause little distortion. It is admirably suited for work in large power stations where sudden changes in the electrical load cause fluctuations in temperature. Recent engines are of the three-cylinder type, the steam after passing through the high-pressure cylinder passing into the much larger intermediate cylinder and finally into the still larger low-pressure cylinder which works at much lower temperatures. Mr. Moore points out that with very high initial steam pressures and temperatures, the casing of the high-pressure cylinder, which is subjected to the highest temperatures, could be made of molybdenum cast steel. The intermediate-pressure cylinder, which is subjected to more average temperatures, could be made of normal cast steel and the low-pressure cylinder of close-grained cast iron. Multi-cylinder turbines have proved their worth in service. For example, a 25,000 kw. set in Sheffield was in operation for 93 per cent of the greatest possible time for a year at an average load of 86 per cent of the total. A 30,000 kw. set at the West Ham power station has generated over five consecutive years 75 per cent of the total output of the station.

Recent Advances in Horticultural Research

EAST MALLING RESEARCH STATION

THE annual report of the East Malling Research Station, Kent, for 1935, was published a short time ago (4*s*., including postage, from the Station). Administrative details are set forth in a supplementary report, leaving the main volume for the presentation of research findings.

The third section is the largest in the volume, and portrays the results of research work in progress. J. Amos, T. N. Hoblyn, R. J. Garner and A. W. Witt describe their studies in incompatibility between stock and scion, and Misses A. B. Breakbane and M. E. Renwick have also contributed to a solution of this problem by issuing a preliminary report upon the internal structure of root wood of stock and scion varieties. H. M. Tydeman reports further investigations in the root systems of apple trees, W. S. Rogers has considered the effects of soil moisture upon plant growth, using an ingenious vacuum moisture meter, and M. C. Vyvyan has a note on the moisture content of the stems of different rootstocks. Spring frosts at East Malling, from 1915 until 1935, are described by T. N. Hoblyn, whilst H. C. Chapelow and H. M. Tydeman deal with more general weather conditions.

Injection as a method of supplying deficiency of particular nutrients has been studied by W. A. Roach, who describes leaf injection, and by J. Hearman, B. F. Goodman Levy and W. A. Roach, who write on stem injection. Dr. H. Wormald has papers upon silver-leaf disease, *Verticillium*-wilt of hops, and a slime fungus on strawberry leaves, in addition to a general report on plant diseases. F. H. Beard, Dr. H. Wormald and W. A. Roach have investigated the bacterial canker of plum trees in relation to nutrition. Entomological investigations are concerned with the mites of hops and fruit trees, and the transmission of strawberry 'yellow-edge' virus, by Dr. A. M. Massee, and "Studies of Impregnation of Tree-banding Materials, by Dr. A. M. Massee and R. M. Greenslade. W. Steer has some "Observations on the Codlin Moth", whilst M. H. Moore, H. B. S. Montgomery and Dr. H. Shaw report upon field trials of several new fungicides and combined washes.

Section 4 of the Report is devoted to bulletins of interest to fruit growers. Here the progressive grower is advised upon "The Rapid Conversion of Unprofitable Fruit Trees by Grafting" (R. J. Garner), "Some Observations on the Roots of Fruit Trees" (W. S. Rogers), and "Some Notes on One Year's Experience with a Gas Store", by A. C. Painter. There are also articles on frost damage by W. A. Bane, the use of derris-root insecticide (W. Steer), upon walnut culture, by Miss J. B. Hamond, and on growing healthy raspberries, by R. V. Harris.

LONG ASHTON RESEARCH STATION

The staff of the Agricultural and Horticultural Research Station at Long Ashton, Bristol, is to be congratulated upon the extensive results of research work portrayed in the Station's Annual Report for 1935. A rather severe financial loss was sustained when the incipient crop of fruit was ruined by frost in May of last year, but this does not seem to have curtailed the volume of investigation. G. T. Spinks and Dr. T. Swarbrick have made a virtue of necessity, and have described the frost and its effects in great detail. Dr. Swarbrick has also a progress report of investigations into the varieties of rootstocks for plum propagation.

Reports of work on plant pathology occupy the greater part of the volume. Descriptions of new or specific diseases and pests including a malady of strawberry resembling the American 'crimp' (L. Ogilvie and C. R. Thompson), new virus diseases of the tomato, and *Sclerotinia*-wilt of the hop, by L. Ogilvie, and *Melasoma Populi*, a chrysomelid pest of the basket willow, by Dr. H. G. H. Kearns. The incidence of reversion in seedling black currants and in clones derived from them is described by E. Umpleby and T. Swarbrick. New work has been done upon control of the woolly aphid (H. G. H. Kears and E. Umpleby), of flea beetles (Dr. C. L. Walton), and upon the effects of calcium cyanamide on pea and potato sickness by C. L. Walton, L. Ogilvie and P. W. Brian. Drs. H. G. H. Kearns and H. Martin have investigated the action of lauryl rhodanate as an egg-killing wash, and they have had the co-operation of R. W. Marsh in an investigation of combined washes, designed to eradicate a number of pests or diseases.

A number of papers on cider and fruit products include "Low-temperature Keeving of Cider", by V. L. S. Charley, "Experiments on the Improvement of the Juice from Culinary and Dessert Apples by Maceration with Pressed Bittersweet Pomace", by P. T. P. Pickford, and "Investigations on Fruit Products" by V. L. S. Charley. The last-mentioned paper includes several useful descriptions of modern methods of making fruit syrups, squashes and wines.

The investigations on willow culture are represented by a paper by H. P. Hutchinson, discussing the planting of the cricket bat willow on sewage farms, and a very gratifying report from the Berkeley Square Advisory Centre is also included in the volume. This organization has answered more than 6,500 inquiries, as against 4,813 in 1934, and this in spite of an increased amount of advisory work handled directly by the Long Ashton Research Station.

CHESHUNT RESEARCH STATION

The twenty-first Annual Report, for 1935, of the Cheshunt Experimental and Research Station, Turner's Hill, Cheshunt, Herts, sets forth the results of a very considerable volume of original investigation. The director, Dr. W. F. Bewley, reviews the whole work of the organization, and also discusses the practical value of experiment and trial work in progress under his ægis. This includes such useful features as the use of straw to provide a more efficient distribution of heat in soil sterilization, the employment of peat as a surface rooting medium for tomatoes, and the provision of soil heat. Mr. P. H. Williams has a very interesting paper on the overwintering of a perennial *Phragmidium* rust of the rose. Dr. H. L. White describes the 'damping-off' disease of lettuce, the crown-rot of rhubarb, the stem-rots and *Verticillium* wilt of the carnation. A disease of cultivated heaths has been studied by Miss E. Oyler and Dr. Bewley, who find that it is caused by the fungus *Phytophthora Cinnamomi*. New work on virus diseases by Dr. G. C. Ainsworth includes the description of 'bushy-stunt' of tomato, a disease of the 'fern-leaf' type upon the same host, fig mosaic, and a virus disease of water-cress. Mr. E. R. Speyer has turned the entomological investigations to a study of various injuries caused by thrips, particularly on carnations and roses. The uses of the new spray fluids, copper oxychloride, copper salicylanilide, and cuprous cyanide, are discussed by Mr. W. H. Read, whilst Dr. O. Owen has investigated the use of chlorate weed killers, and other problems. In the realm of physiology, Messrs. B. D. Bolas and I. W. Selman have studied the movement of assimilate in seedling tomato plants, and Mr. D. W. Goodall considers some of the causes of variation in growth-rate of the tomato. Finally, a modest report from the Station's Extension Officer, Mr. O. B. Orchard, shows that the important work of translating research findings into practical technique receives the energetic attention it deserves.

The work of the Station is made possible by the Nursery and Market Garden Industries' Development Society, Ltd., and it is encouraging to note that an endowment fund has now been opened. The Society's late president, H. O. Larsen, has performed his last act of generosity to the Station by a bequest of £2,000.

British Thunderstorms

IT is a fortunate circumstance for British climatology that there has never been a lack of scientifically-minded laymen ready and willing to co-operate in large-scale observational work. The late G. J. Symons and his successor, Dr. H. R. Mill, found it possible to enrol more than five thousand voluntary observers of rainfall. Quite recently, as we learn from the annual report of the Director of the Meteorological Office, more than eight hundred observers responded to an invitation to co-operate in a special investigation of mist and fog.

Mr. S. Morris Bower began his work on summer thunderstorms in 1931, when he invited co-operation in a project to record storms occurring between the months of April and September. Prior to that date, he had been engaged on a census of winter thunderstorms, following earlier work on similar lines by Capt. C. J. P. Cave. Nearly a thousand observers assisted Mr. Morris Bower in 1931; in 1934 the number of observers had risen to 1,254[*]. That is a very large number of persons to take part in a purely private enterprise, and it affords remarkable evidence of the extent to which scientific zeal is disseminated among the general population. We may conclude that the enthusiastic private investigator is assured of public support in a piece of work that seems worth doing, notwithstanding the official meteorological service, to the maintenance of which the observers themselves have to contribute as tax-payers.

That leads us to reflect upon the relationship which should exist between the official service—represented by the Meteorological Office—and a private organization such as that maintained by Mr. Morris Bower. So far as climatology is concerned, the function of the Meteorological Office is to collect and preserve for public use an adequate number of weather records from all parts of the British Isles. In pursuance of that aim, it maintains about fifty official stations; the records from these are supplemented by about three hundred co-operating 'climatological' stations, most of which are maintained by local authorities. The principle of voluntary co-operation has, indeed, been a fundamental feature of British climatological work since the earliest days of the Meteorological Office. The 350 official and voluntary stations suffice for the general purposes of climatology; but they do not suffice for an intensive study of the geographical distribution of a particular element such as rainfall, fog or thunderstorms. Thus we have to recognize the need for a closer network of stations when problems of this character arise, and the need is best met by an *ad hoc* organization. The role of the special organization is to amplify and extend the work of the official climatological organization, just as the three hundred co-operating climatological stations amplify and extend the work of the fifty official stations. There is clear evidence that Mr. Morris Bower and his collaborators have fully appreciated this aspect of their work. It is of interest to note that all the observers who participated in the special investigation of fog referred to above, and a large proportion of Mr. Morris Bower's thunderstorm observers, are drawn from the ranks of the five thousand or so rainfall observers of the British Rainfall Organization, which thus forms as it were a 'reservist' body of meteorological workers who may confidently be relied upon to furnish volunteers for any special piece of work.

To return to the report under notice—it is a well-produced account of the summer thunderstorms of 1933 and 1934, illustrated with numerous charts (many in two colours), photographs and diagrams. In addition to the charts and statistics relating purely to the incidence of thunderstorms, there are sections on damage to house property, trees struck by lightning (by Mr. S. T. E. Dark) and on damage to wireless installations (by Mr. Ralph A. Price). The present writer feels that the report is rather lacking in details of individual storms. In "British Rainfall" one finds a good deal of information about the rainfall occurring in noteworthy thunderstorms, and one would like to be able to turn to Mr. Morris Bower's report in order to find the corresponding information about the incidence of thunder and lightning. Such information exists in the form of manuscript records, and it is to be hoped that it will find its way into the report as funds allow. Meanwhile, Mr. Morris Bower and his collaborators are, nevertheless, to be congratulated on the results of their ambitious undertaking.

E. G. BILHAM.

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[*] Survey of Thunderstorms in the British Islands. British Thunderstorms, continuing Summer Thunderstorms. Fourth Annual Report 1934. By S. Morris Bower and Others. Vol. 2, Part 1. Pp. 48+viii+4 plates. (Huddersfield: Thunderstorm Census Organisation, 1936.) 2*s*. 6*d*.

Applications of Mechanical Science

TWO pamphlets recently issued by the Association of Engineering and Shipbuilding Draughtsmen (London: The Draughtsman Publishing Co., Ltd.) may be cited as indicating the continued process of translating the work of investigation and research into the most practical terms. One of these is Part 2 of "The Application of Influence Lines to the Stress Analysis of Beams and Lattice Girders" by R. McCrae (2*s*.), of which Part 1 dealing with beams was noticed in NATURE of May 23, p. 861. The part now published treats of lattice girders and deals with various types of loading.

While a lattice girder is, as a whole, subjected to bending and shear, these actions produce in its individual members conditions of tension and compression which vary according to the loading. It follows, then, that the treatment differs from that of beams, where the influence line diagrams represent the bending moments and shear forces due to a unit load at any point in the span. Despite this difference, however, the variation in the treatment here expounded is more a matter of detail than of principle, and for those who have much work of this kind to do the method offers useful advantages over the more formal modes of analysis.

The second pamphlet referred to is "Mechanical Tests for Engineering Materials" by A. M. Roberts (4*s*.), a subject of wider appeal. The development of mechanical testing has been very rapid in recent years, and an elaborate and comprehensive technique has been devised to deal with different materials and to meet widely varying requirements. For the draughtsman it is advisable that he should be able to indicate or specify suitable acceptance tests for the materials he has incorporated in his designs, and it follows that he must be in a position to decide which methods of testing are most appropriate to each machine or structural detail, so that he can ensure its satisfactory performance in service.

It is to meet this particular requirement that the pamphlet has been prepared, and it explains, in suitably condensed form, the methods and purposes associated with the more usual forms of tests. Tensile, bend, hardness and impact tests are described and elaborated in detail, and the relation of the part under consideration and its service conditions to the appropriate test procedure is discussed; while, in some cases, suggestions are included as to the method of approach in designing for service under static, dynamic or other special conditions. It will thus be apparent that the point of view of the author is different from that of the usual writer on material testing, and his information will supply a real need in the case of many who as designers, buyers or in other capacities are not directly brought into contact with the technical processes of testing, yet require to possess such knowledge as is set out here.

Sir Charles Parsons Memorial

ACTING in conjunction with various engineering institutions, the Royal Society has made arrangements for honouring the memory of Sir Charles Parsons, whose name is best known in connexion with his invention of the compound steam turbine. These include a memorial in Westminster Abbey, a memorial library in London House, and an annual lecture which, each fourth year, will be delivered on the north-east coast—the scene of Parsons' major activities—and in the intervening years is to be given in London.

This year's lecture, the first of the series, was given before the North-East Coast Institution of Engineers and Shipbuilders at Newcastle-on-Tyne on Friday, November 6, and took the form of a personal appreciation by Sir Frank Smith, who is one of the secretaries of the Royal Society and also secretary of the Department of Scientific and Industrial Research. On the same day, the Institution inaugurated a special exhibition to illustrate the work of Parsons, the wide range of his scientific interests and the fertility of his inventive powers.

In introducing his subject, Sir Frank Smith referred to the influences which heredity and the scientific environment of his youth, as a son of that distinguished man of science, the third Earl of Rosse, exercised upon the course of Parsons' life and work. Those who saw the workshops at Birr Castle have testified to the profound impression made on them by the installations of machinery and furnaces in the towers of the old building and by the matchless self-possession and unfailing resources of the master mind and guiding hand. The son, who had received his early training there, retained throughout life a keen interest in optics and astronomy, and in his later years was attracted by the same astronomical problem as had earlier engrossed his father, namely, that of producing reflecting mirrors of great size. Their construction in glass did not appeal to him as an engineer and, holding the view that, in the future, larger sizes than 200 inches would be required, he planned that they should be made of steel and had arranged to build a small mirror in sections to test his ideas in practice.

When Parsons went down from Cambridge in 1877, the prevailing feeling about the steam engine was that the limit of useful improvement had been reached. Newcomen's engine required 25 lb. of coal per horse-power hour; Watt had reduced this figure to 5·5; and the amount had in the succeeding years been brought down to about 2 lb. Undaunted by those views, Parsons pressed forward with his invention, and in 1884 took out his first patent, the claims of which show to-day how clearly he realized the future of his engine. The novelty he introduced lay in the method by which he utilized the expansive force of steam. His first turbine, which was of the double-flow type, was made in the same year, and is now to be seen in the Science Museum. It is suggested that, in this invention, Parsons was inspired by three main influences: the first, his love of attempting what others thought impossible; the second, his exceptional knowledge, at that time, of thermodynamics and the properties of steam; and the third, the advent of the electric dynamo for power generation.

The earliest turbines were designed for driving electric dynamos, and from 1888 the installation of turbo-generators steadily increased, the coal consumption being brought down to 0·7 lb. per horsepower hour. In 1894, Parsons planned the *Turbinia*, an experimental vessel to demonstrate the capabilities of the turbine for ship propulsion, and, in 1897, the Admiralty adopted the method. Trials made a few years later established the efficiency, economy and higher speed possibilities of this new motor for naval purposes. In the merchant service, the Clyde steamer *King Edward* led the way, and by 1904 such important vessels as the *Lusitania* and *Mauretania* were fitted with turbine engines—a remarkably rapid success.

The Parsons Exhibition, which is being held at the Municipal Museum of Science and Industry, Newcastle-on-Tyne, and was opened by the Right Hon. Lord Rayleigh, is well described in the "Catalogue of Parsons Exhibition, November 1936–January 1937" (London: E. and F. N. Spon, Ltd. 6*d*.). In it are to be seen numerous models of the turbine at the different stages of its development—Hero's, Branca's, Wilson's and several machines made by Parsons. There are many details of blading, bearings, governors and other parts, and some of the instruments and apparatus used by Parsons in his experiments. A series of coloured sectional drawings and photographs illustrates the development of the turbine from 1894 down to 1936. The other inventions of Sir Charles Parsons are also represented, and there are examples of silvered glass reflectors, optical instruments and experimental disks made under his supervision, to round off this notable appreciation of the range of practical inventiveness of one man who, in the province which he made his own, exercised a profound influence upon his time.

Educational Topics and Events

CAMBRIDGE.—J. F. Brock, Trinity Hall, has been appointed assistant director of research in medicine. J. S. Baxter has been appointed University demonstrator in the Department of Anatomy.

At Gonville and Caius College, Dr. V. J. Chapman, formerly scholar of Pembroke College, has been elected to an unofficial Drosier fellowship.

In accordance with its usual practice, Trinity College announces the offer of a research studentship open to graduates of other universities who propose to go to Cambridge in October 1937 as candidates for the degree of Ph.D. The value of the studentship may be as much as £300 a year. Candidates must not have reached the age of twenty-six years before May 1, 1937. The College also offers Dominion and Colonial exhibitions to students of Dominion and Colonial universities who wish to go to Cambridge next October as candidates for the degree of B.A., M.Litt., M.Sc. or Ph.D. These exhibitions are of the titular value of £40. A candidate for a studentship or exhibition should apply through the principal authority of his university, and his application should reach the Senior Tutor (from whom further particulars may be obtained) by May 1, 1937.

OXFORD.—The Rolleston Memorial Prize for 1936 has been divided between J. A. Moy-Thomas, lecturer of Christ Church, and B. G. Maegraith, fellow of Exeter College.

The Theodore Williams scholarship in physiology for 1936 has been awarded to R. T. Campbell of Magdalen College.

Lord Halifax, chancellor of the University, will preside at a meeting of Congregation on November 24 at which a decree will be promulgated thanking Lord Nuffield for his benefaction to the medical school and describing how it is proposed to make use of it.

ST. ANDREWS.—Under the will of Miss Edith Mary Valentine Scott Lang, the University is offered a bequest of £20,000 provided that it will undertake to supply an astronomical observatory and the necessary instruments. Miss Lang was a daughter of the late Sir Peter Redford Scott Lang, regius professor of mathematics in the University for forty-two years, who was desirous that a lectureship in astronomy should be founded in the University. She directs that the lectureship should be called the Napier lectureship in astronomy, in memory of Baron Napier of Murchiston. From the reading of the will it would appear that in the event of the acceptance of the £20,000, the university is committed to the building of an observatory and the provision of instruments from funds outside the bequest. The will gives no indication of the destination of this £20,000 if the University does not accept it.

THE next election to Beit fellowships for scientific research will take place on or about July 9, 1937. The annual value of a fellowship is £240, and it is tenable for two years. Fellows will be attached to a department of the Imperial College of Science and Technology. Further information can be obtained from the Rector, Imperial College, South Kensington, London, S.W.7.

THE thirty-seventh annual meeting of the Science Masters' Association will be held in the Physics Department of the University of Manchester on January 5–8, 1937, under the presidency of Dr. J. S. B. Stopford, vice-chancellor of the University. On January 5, Dr. Stopford will deliver his presidential address entitled "Aims of Biology in Education". There will be the usual exhibitions of members' apparatus, etc., and a number of visits to works, collieries, etc., has been arranged. Further information can be obtained from the Annual Meeting Secretary, 15 Norham Gardens, Oxford.

WHEN invitations were issued to universities and scientific and learned institutions to take part in the celebrations in June last at the University of Heidelberg, considerable discussion was aroused in the Press in Great Britain, and as a result the invitations to English bodies were withdrawn. It seems there was little controversy on the subject in the United States, and the Viking Press, Inc., New York, has now published a booklet of 61 pages entitled "Heidelberg and the Universities of America", reprinting the "Heidelberg" correspondence and articles from *The Times* and NATURE; a brief explanatory introduction, signed by Charles C. Burlingham, James Byrne, Samuel Seabury and Henry L. Stimson, states that the publication has been issued so that "Americans may know the grounds of the English refusal" to take part in the celebrations.

Science News a Century Ago

British Surveying in South American Seas

SEVERAL communications were read at a meeting of the Royal Geographical Society on November 14, 1836, some of them relating to expeditions in Kashmir, Australia, South and Central Africa and in British Guiana. The first paper was by Captain R. FitzRoy and was entitled "A Sketch of the Surveying Voyages of H.M.S.S. *Adventure* and *Beagle*, from 1825 to 1836". From the time Captain FitzRoy resumed the surveys in 1831, every mile of the coast from the Rio de la Plata to Cape Horn was closely surveyed and laid down on a large scale, every harbour and anchorage was planned, thirty miles of the Rio Negro and two hundred miles of the Santa Cruz were examined; a chart was made of the Falkland Islands and the whole coasts of Chile and Peru were surveyed. "Traced copies," said Captain FitzRoy, "of the charts of coasts adjacent to Buenos Ayres, of the whole coast of Chili and of the greater part of the shores of Peru were given to the respective governments of those countries before our vessels left their territories, and long before the original documents could reach England." Commenting on this, the *Athenæum* said, "this is, we believe, an instance of liberality without parallel in the whole annals of maritime survey or discovery".

Geology of the Clyde Estuary

IN a paper entitled "On Indications of Change in the relative level of land and water in the Estuary of the Clyde" read to the Geological Society on November 16, 1836, James Smith (1782–1867) said that in the west of Scotland there are two superficial deposits. The lowest, locally called 'till', consists of unstratified clay, mixed with boulders and rarely containing organic remains, while the upper deposit is composed of finely laminated clay overlaid by sand and gravel. In the latter, marine remains of existing species occur in every part of it, but most abundantly in the clay. This stratum he had traced on both sides of the Clyde from Glasgow to Roseneath and Greenock, at points varying from thirty to forty feet above the level of the sea. The lower deposit, the 'till', in his opinion was accumulated by a violent, though transitory, action of a body of water; but the upper was deposited, he thought, at the bottom of the sea, and that there had been a gradual change of level similar to that taking place on the coast of Sweden as described by Mr. Lyell.

Local Botany in Great Britain

ON November 17, 1836, at a meeting of the Botanical Society, Alexander Irvine (1793–1873) directed the attention of members to the importance of local botany. In the course of his paper, he said that 1,500 species of flowering plants occurred wild in Great Britain, of which about two-thirds were to be found within a circle of twenty-five miles around London. He had himself discovered 670 different species within two miles of Hampstead, while within two miles of Croydon he had found no fewer than 900 different species. The species of vascular plants found in Great Britain comprised nearly all those of Lapland and Sweden, three fourths of those of Germany and about three fifths of those of France. (*Athenæum*.)

Fox Talbot on the Integral Calculus

AT a meeting of the Royal Society held on November 17, 1836, Henry Fox Talbot (1800–77) read part 2 of his paper "Researches in the Integral Calculus". The report on the paper said: "Having explained, in the first part of his paper, a general method of finding the sums of integrals, the author proposes in the second place, to apply this method to discover the properties of different transcendents, beginning with those of the simplest nature. With this view, he first shows its application to the arcs of circles and the conic sections; and demonstrates the possibility of finding three arcs, such that neglecting their signs, the sum of two of them shall be equal to the third, though not superposable in any part: an equality which has been hitherto deemed impossible in the ellipse and hyperbola, without the addition of some algebraic quantity".

Study of Physiology

IN a lecture delivered at the Collège de France and published in the *Lancet* of November 19, 1836, M. Magendie criticized as follows the way in which physiology was being taught in almost all the universities of Europe, Paris included: "What is the student taught, what does he hear during a course of physiology, such as we find it at the present day? A collection of theories, one more visionary, if not more absurd than another; a mass of words, and nothing else, collected from antiquated works and thrown before him without the support of a single fact; to be believed on the words of his professor, without a shadow of that material evidence which constitutes the force of every exact science. It is truly extraordinary to observe how even the most elevated minds are led away by the influence of prejudice, and refuse to acknowledge truths so evident as that contained in the following proposition: 'We can only study phenomenally the experimental method; the laws of physiology are revealed in the manifestation of phenomena; ergo, we should submit the phenomena of physiology to the experimental method'."

Medico-Botanical Society

THE *Lancet* of November 19, 1836, gives the following account of the first meeting of this society, which was held on November 9, 1836, under the presidency of Earl Stanhope: "The meeting was a good one. Dr. Sigmond read a very interesting and learned paper on the Early English Botanists and the Progress of the Science of Medical Botany in England. The study of the science may be dated from the reign of Henry VIII, when Dr. Turner published his 'Medical Botany'. After this various works at different periods appeared, though but little order was observed in any of them, and none of them gave the results of the author's experience with the various plants described, but merely stated their virtues on the authority of Pliny or Dioscorides. The first Pharmacopœia was published by the London College of Physicians in May 1618, but it contained so many blunders that a new edition was published in December in the same year. Pharmacopœias were first thought of by Valerius Cordus, a student of Nuremberg. In 1745 Sir Hans Sloane improved the Pharmacopœia greatly by giving to it a description of the various plants used in medicine. It was still further improved in 1788, and in 1809 the names adopted by the French chemists were first introduced."

Societies and Academies

London

Royal Society, November 5.

O. A. Saunders: The effect of pressure upon natural convection in air. Dimensional considerations suggest that natural convection in air should depend upon the dimensionless number $ag\theta l^3 s\rho^2/\mu k$, the effect of which can be found experimentally by varying either the representative linear dimension l, the representative temperature difference 0, or the pressure of the air. Measurements with vertical plane surfaces of four different heights in air at pressures from 0·001 to 65 atmospheres give results which can be expressed satisfactorily in terms of the dimensionless number. Natural convection at higher pressures, up to 1,000 atmospheres, is also discussed. The values of some of the constants are uncertain at the higher pressures, but $as\rho^2/\mu k$ is not appreciably increased by raising the pressure above about 200 atmospheres, and $\mu s/k$ is nearly independent of pressure up to 1,000 atmospheres.

R. A. Bagnold: The movement of desert sand. The motion of sand grains and their reaction on the air stream when wind blew over a thick layer of dry uniform sand on the floor of a wind tunnel was investigated experimentally. The paths of the individual grains were photographed. The wind velocity distribution and the pressure drop were measured during the sand movement and when movement was prevented. At the same time the total flow of sand past various sections of the tunnel was measured directly. The grain motion was found to consist of a series of bounds: the grains rose steeply into the air stream and fell slowly, gathering forward velocity and striking the sand surface with sufficient impact to splash up more grains into the air stream. Irregularities in the grain paths due to internal air movements were undetected. The drag due to the sand movement is measurable, and is a maximum at the height above the surface at which maximum acceleration of the grains takes place. The length of the characteristic path from impact to impact was found in all experiments to be the same as the measured wave-lengths of the ripples formed on the surface.

J. Smiles and H. Wrighton: The micrography of metals in ultra-violet light. Increased resolution of the microstructure of metals has been achieved by the use of ultra-violet radiation. A method of critical illumination used in micrometallurgy and developed for use in high-power visual light systems, so as to reduce glare set up in the optical system to a minimum, has been used. A dispersing system has been incorporated and adjusted to introduce ultra-violet radiation ($\lambda = 2750$ A.) co-axially with the visual light system. Most metals and alloys can be successfully photographed in ultra-violet radiation with increased resolution conforming to the higher equivalent aperture available.

Paris

Academy of Sciences, October 19 (*C.R.*, 203, 697–752).

Paul Lévy: General determination of the limit laws [probability].

Bertrand Gambier: Surfaces of which the asymptotics of one or the other system belong to linear complexes.

David Wolkowitsch: Homofocal quadrics.

Ole Peder Arvesen: Laguerre's solution of the problem of Apollonius.

Jean Chazy: The advance of the node of a planet under the action of a circular ring.

Alexandre Proca: Photons and particles free from charge.

André Fortier: The determination of the viscosity of a gas and Sutherland's constant. Discussion of the effects of the experimental error in the viscosity determinations of the Sutherland constant.

Edmond Rouelle: Some new experiments on the reduction of frequency in an oscillating circuit the coil in which has an iron core.

Pierre Barchewitz and Aurel Naherniac: An automatic recording spectrograph for the near infra-red (6000–9500 A.). The amplifying system allows photo-electric currents of the order of 10^{-15} amp. to be detected: the accuracy of determination of the position of well-defined bands is ± 3 A.

Antoine Goldet: The thermal variation of the electric double refraction of a liquid mixture presenting a critical point of miscibility.

Jacques Rabinovitch: Magnetic rotatory polarization and magnetic double refraction of α-nitronaphthalene in acetone and nitrobenzene solutions.

Mme. Marie Freymann: The absorption spectra of secondary amines in the near infra-red.

Jean Chedin and Mme. Jeanne Cieutat Pradier: The Raman effect and molecular structure of nitric anhydride. The experiments described lead to the conclusion that N_2O_5 exists in two molecular forms. In the gaseous form or in solution in chloroform, carbon tetrachloride or phosphoryl chloride, it is monomolecular. The other form is polymerized, and this is found in the crystals and in the nitric acid and sulphuric acid solutions.

Marcel Ballay: The constitution and structural hardening of austenites with beryllium carbides.

A. E. Favorsky and P. A. Fikhomolow: The synthesis of an asymmetrical allenic molecule of the fatty series by means of an acetylene-allene transposition.

André Barbot: A method of extracting aldehydes and ketones from their bisulphite compounds. In certain cases, the usual methods (acid or sodium carbonate) give rise to inconvenience and reduction of yield. The use of formaldehyde is suggested and shown to possess advantages.

Henry Gault and André Chablay: The action of organic acids on esters. Studies of the reaction velocities of the reversible system acetic acid, methyl palmitate, with and without a catalyst.

Marcel Frèrejacque: The polymorphism of octacetylsaccharose. This acetate is trimorphous.

Georges Dupont and Victor Desreux: Contribution to the study of β-myrcene. Its catalytic hydrogenation. The hydrogenation of myrcene with platinum black as catalyst gives results entirely different from those obtained when palladium black or Raney nickel is used as the catalyst: the mechanism of hydrogenation is not the same in the two cases.

Albert Demolon and Etienne Bastisse: The genesis of clay colloids in the spontaneous alteration of a granite in a rain percolation chamber.

Jacques Fromaget: The stratigraphy of the recent formations of the northern Annamitic chain and on the existence of man in the lower Quaternary of this part of Indo-China.

André Savornin and André Ranarivelo: Observations on a magnetic storm at Ambatoabo (Madagascar).

Emile Thellier : The determination of the direction of permanent magnetization of rocks. An improved method for marking the direction of the piece of rock before removing from the soil for examination in the laboratory.

Pierre Berthault : The specific origin of the potato.

Julien Costantin : Remarks on the preceding communication.

Ad. Davy de Virville : The flora of some Anglo-Norman reefs.

Emile Brumpt : The receptivity of various domestic and wild birds to the parasite *Plasmodium gallinaceum* of the domestic fowl. The transmission of this hæmatozoa by the mosquito *Stegomyia fasciata*.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, November 16

University College, London, at 5.—Mrs. P. Tookey Kerridge: "The Physiology of Hearing and Speech" (succeeding lectures on November 23, 30 and December 7).*

University of London Institute of Education, at 5.30.—Prof. José Castillejo: "Education and Revolution in Modern Spain" (succeeding lectures on November 18 and 25).*

London School of Hygiene and Tropical Medicine, at 5.30.—Prof. W. Bullock, F.R.S.: "The Development of Bacteriology with an Account of some of the Pioneers who made it a Science" (Heath Clark Lectures. Succeeding lectures on November 18, 23, 25 and 27).*

Royal Society of Arts, at 8.—Prof. E. V. Appleton, F.R.S.: "Some Problems of Atmospheric Physics" (Cobb Lectures. Succeeding lectures on November 23 and 30).

Geographical Society, at 8.30.—Sir Eric Teichman: "The Motor Route from Peking to Kashgar".

Tuesday, November 17

Eugenics Society, at 5.15.—(at the Linnean Society, Burlington House, Piccadilly, W.1).—W. T. J Gun: "The Heredity of the Royal Caste".*

Wednesday, November 18

Royal Microscopical Society, at 5.30.—J. E. Barnard, F.R.S., and F. V. Welch: "Microscopy with Ultra-Violet Light".

Thursday, November 19

University College, London, at 5.30.—E. Ford: "The Nation's Fish Supply" (Buckland Lectures. Succeeding lectures on November 26 and December 3).*

Chemical Society, at 8.—Discussion on "Mesomerism in Organic Chemistry" to be opened by Prof. C. K. Ingold, F.R.S.

Association of Scientific Workers, at 8.—(in the Mathematics Lecture Theatre, Huxley Building, Royal College of Science, South Kensington, S.W.7).—Public meeting and discussion on: "Defence and the Responsibilities of the Scientist", speakers to include Prof. S. Chapman, F.R.S., and Air Commodore L. E. O. Charlton.

Friday, November 20

Institute of Chemistry, at 8.—Prof. John Read, F.R.S.: "A Chapter in the Chemistry of Essential Oils" (Streatfeild Memorial Lecture).

Royal Institution, at 9.—H. G. Wells: "World Encyclopædia".

Official Publications Received

Great Britain and Ireland

The North Staffordshire Field Club. Transactions and Annual Report, 1935–36. Vol. 70. Pp. 98+A183–A212+3 plates. (Stoke-on-Trent: North Staffordshire Field Club.) 7*s*. 6*d*. [2210

The Journal of the Institute of Metals. Vol. 58. Edited by G. Shaw Scott. Pp. 325+80 plates. 31*s*. 6*d*. Metallurgical Abstracts (General and Non-Ferrous.) Vol. 2 (New Series). Edited by G. Shaw Scott. Pp. vii+889. £4, including 2 "Proceedings" vols. (London: Institute of Metals.) [2310

University of London: University College. Calendar, Session 1936–1937 Pp. lxxx+582+26. (London: Taylor and Francis.) [2310

Seventeenth Annual Report of the Ministry of Health, 1935–36. (Cmd. 5287.) Pp. vi+318. (London: H M. Stationery Office.) 5*s*. net. [2310

Philosophical Transactions of the Royal Society of London. Series B, No. 536: Genetical and Taxonomic Investigations in the Genus Œnothera. By Prof. R. Ruggles Gates. Pp. 239–355. (London: Harrison and Sons, Ltd.) [2310

The Journal of the Society for the Bibliography of Natural History. Vol. 1, Part 1: A Catalogue of Papers concerning the Dates of Publication of Natural History Books. By Francis J. Griffin, C. Davies Sherborn and H. S. Marshall. Pp. 30. (London: Society for the Bibliography of Natural History.) 7*s*. 6*d*. [2410

Annals of the Solar Physics Observatory, Cambridge. Vol. 4, Part 2: On some Spectrograms of Nova Persei, 1901, by Prof. F. J. M. Stratton; Vol. 4, Part 3: Nova Aquilæ 1918, a Discussion of the Development of the Band Structure, by Dr. E. S. Pearson; Vol. 4, Part 4. The Absorption Spectrum of Nova Herculis 1934, the First Phase, by Prof. F. J. M. Stratton. Pp. vii+75–161+10 plates. (Cambridge. At the University Press) 15*s* net. [2610

Speech Institute Pamphlet No. 1: Speech Tunes, Emphasis in Speech, Sounds of Connected Speech. Three Articles by Barbara Storey. Pp. 21. (London. Speech Fellowship and Institute, Ltd) 7*d*. [2710

Department of Scientific and Industrial Research. Report of the Forest Products Research Board for the Year 1935. Pp. vi+78+6 plates. (London: H.M. Stationery Office.) 2*s*. net. [2910

Other Countries

Memoirs of the India Meteorological Department. Vol. 26, Part 6: Typhoons and Indian Weather. By V. Doraiswamy Iyer. Pp. ii+93–130+10 plates. (Delhi: Manager of Publications.) 1.10 rupees; 2*s*. 9*d*. [2610

Canada: Department of Mines: National Museum of Canada. Bulletin No 80 (Geological Series, No 53): Revision of the Genus *Calapœcia* Billings. By Ian Cox. Pp. ii+49 (4 plates). (Ottawa: King's Printer.) 25 cents. [2610

Canada: Department of Mines: Bureau of Economic Geology, Geological Survey. Memoir 189: Carmacks District, Yukon. By H. S. Bostock. (No. 2413.) Pp. ii+67+5 plates. 25 cents. Memoir 190: Geology and Mineral Deposits at the Mine of B.C. Nickel Mines, Limited, Yale District, B.C. By H. C. Horwood. (No. 2414.) Pp. ii+15+1 plate. 10 cents. Memoir 192: Gold Occurrences of Ontario East of Lake Superior. By E D. Kindle. (No. 2416.) Pp. vi+167+1 plate. 50 cents. Memoir 193: Mining Industry of Yukon, 1935. By H. S. Bostock. (No. 2417.) Pp. iii+12. 10 cents. Memoir 195: Mineral Deposits in Renfrew County and Vicinity. By B. C. Freeman. (No. 2419.) Pp. ii+34+1 plate. 25 cents. (Ottawa: King's Printer) [2610

Annual Report for the Year 1935 of the South African Institute for Medical Research, Johannesburg. Pp. 91+2 plates. (Johannesburg: South African Institute for Medical Research.) [2610

The Rockefeller Foundation: International Health Division. Annual Report 1935. Pp. iv+286. (New York: Rockefeller Foundation) [2810

Annual Report of the Board of Regents of the Smithsonian Institution showing the Operations, Expenditures and Condition of the Institution for the Year ending June 30, 1935. (Publication 3348.) Pp. xiv+580+95 plates. (Washington, D C.: Government Printing Office) 1 dollar. [2810

Indian Science Abstracts (Being an Annotated Bibliography of Science in India), 1935. Part 1. Pp. 174. (Calcutta: National Institute of Sciences in India) 7.8 rupees. [2810

Bibliography of Doctorate Theses in Science and Arts accepted by Indian Universities from January 1930. Issued by the Inter-University Board, India Pp. 22. (Bangalore: Bangalore Press.) [2810

Coconut Research Scheme. Annual Report for 1935. Pp. 52. (Lunuwila: Coconut Research Scheme.) [2910

Advisory Department of the Imperial College of Tropical Agriculture. Report on the Department of Agriculture, St. Lucia, 1935. Pp. v+54. (St. Lucia: Government Printing Office.) 6*d*. [2910

Report of the Haffkine Institute for the Years 1932–35. By Lieut.-Col. S. S. Sokhey. Pp. ii+209. (Bombay: Government Printing and Stationery Office; London: High Commissioner for India.) 12 annas; 1*s*. 3*d*. [2910

Statens Meteorologisk-Hydrografiska Anstalt. Meddelanden, Serien Uppsatser. No. 2: Axel Wallén. Av Gustaf Slettenmark. Pp. 208–217. No. 4: Sunshine and Radiation, Mount Nordenskiold, Spitsbergen. By Hilding Olsson. Pp. 93–118. No. 5: Jordtemperaturen i Bestånd av Olika Täthet. Av Anders Ångstrom. (Soil Temperature in Stands of Different Densities.) Pp. 187–218. No. 6: Vindhastighetens dagliga Gång vid Några Svenska Stationer. Av Walter Persson. Pp. 12. No. 7: On the Turbidity of Polar Air. By Olof Tryselius. Pp 10. No. 8: Effective Radiation during the Second International Polar Year. Pp. 22. (Stockholm: Statens Meteorologisk-Hydrografiska Anstalt.) [3110

Bulletin of the Madras Government Museum. New Series, General Section, Vol. 3, Part 2: An Outline of Indian Temple Architecture. By Dr. F. H. Gravely. Pp. ii+22+1 plate. (Madras: Government Press.) 12 annas. [211

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Physique, Nutrition and National Health

THE incursions of the Lords and Commons into regions where the voice of science should be, and is occasionally, heard, are always of interest to the scientific worker. A notable debate of this kind was held on November 10 in the House of Lords on the Government's declared intention to raise the general standard of physical fitness, and especially that of the young. The subject was first introduced by the Chancellor of the Exchequer in an address to the Conservative Party at Margate on October 2, and was afterwards mentioned in the King's Speech to Parliament on November 3. As on neither of these occasions was any reference made to the subject of national nutrition, and as no responsible minister can be unaware of the relation between national nutrition and national health, one can only assume that the Government does not propose to attack the major issue, with all its far-reaching implications.

However, as Mr. Gladstone said, it is always best to take the charitable view, especially in politics, and it may be that the Government took its cue from the recent disclosure that recruiting for the Army has been seriously affected by the large proportion of rejections on medical grounds. In the Lords' debate, this aspect was emphasized by Field-Marshal Lord Milne, who recalled that in 1932 no less than 57 per cent of would-be recruits was refused from this cause, and that about 25 per cent is usually rejected by the recruiting officers prior to medical examination. Lord Milne urged the necessity for improved and extended physical education of a non-military type, and regretted that, outside the Services, there is a great shortage of qualified instructors.

Although it is to some extent fallacious to argue from a section of the community to the whole community—for recruits are not drawn from the better-to-do classes who are well-nourished from infancy onwards and have ample opportunities for regular physical exercise—no one will deny the value of a good physique; but adequate nourishment is of prior importance. This view was well brought out by Lord Horder. Fitness can never be obtained by physical measures, be they educational or recreative; more basic and imperative are food, shelter, air and leisure. The Ministries of Health and Labour, and the Board of Education must continue their present good work; their methods, however, must be intensified and expedited, and more co-operation is needed. Government offices are necessarily departmental: why must they be so compartmental? The national interest must be aroused; and the cost need not frighten us; it would be very small compared with the cost of revolutions elsewhere. So far we have spent nothing on bloodshed, and we have retained the greatest of all our assets—individual freedom. Regimentation is not wanted; if our people are given the modest requirements of security at home and security of sustenance, their sturdy common sense will do the rest. Democracy, and especially a democracy asked to be physically fit, advances on its stomach.

Lord Dawson of Penn asked that the subject be viewed from the wider point of view of eugenics. Although we are to some extent neglecting the laws of sound breeding, and hence must be careful, it would be wrong to say that as a nation we are deteriorating. Inspection of our elementary schools, notably in London, would corroborate this view; but deficiencies do exist, more particularly among adolescents in factories, and are to be seen among hikers and Territorials, who, although they may be good at games, yet possess bodily defects that bode ill for their future health. The boys and girls of to-day may be taller, stouter and heavier than their predecessors, but mere bulk of frame is not evidence of fitness. The demands on our race are greater than ever; and the defects which compel us to take stock of the present situation go deeper than political considerations. By correcting Nature's methods of a high birth-rate and a high death-rate, by allowing the unfit to survive and multiply their kind, we have incurred the heavy responsibility of exercising selection ourselves, so as to prevent the unfit from vitiating the race. While securing for the child of average abilities every opportunity in the limited sphere of usefulness for which it is cast, we should sieve out the fittest at the ages of, say, fifteen and sixteen or seventeen years, and spare no expense in pushing them forward; and at each stage, mind and character must be tested as well as body.

By saving our unfit children we are harming the community, but we are striving to repair the damage by having fewer and fitter children. It is a fact that the smaller families of to-day have a higher proportion of fitter children; and the mothers of those children appear to be better than those of any previous generation. Contraception is very closely related to the infant death-rate. Whereas formerly twelve pregnancies resulted in five children reared, to-day they result in ten; so that unless families are to become impossibly large, contraception must be practised. At the same time, we do not want too small a population; an appeal for adequate parenthood is needed, and would be answered if it were based on reasoned arguments. The inherently unfit, including the 250,000 mental defectives, should be discouraged from reproduction. The medical profession is always being exhorted to think in terms of prevention; why therefore should it not use measures to prevent the birth of children who are not wanted, who are a misery to themselves and their parents, and damaging to the race? To-day doctors dare not offer relief from the dangers of parenthood owing to the operation of a law which was passed centuries ago to prevent maiming as an escape from military service. That law was never meant to apply to any skilled profession, and medical men should be exempted from i scope.

The Earl of Listowel maintained that malnutr tion is the root cause of poor physique; he quote Sir John Orr's findings to the effect that abou half the population is suffering from inadequat nourishment, and stated that increased attentio to sports or physical training can never mitigat the ill effects of a bad diet. The main problem, h said, is how to increase the purchasing power o the working-class family and to reduce the cost o foods that are essential to health.

The discussion is thus seen to have covered wide field and to have been remarkable for th contributions of the two eminent medical me who took part in it. On the whole, perhaps to little attention was given to the underlyin economic aspects of the problems involved. I was, for example, not pointed out that increase physical exercise must entail an increased consumption of energy-producing foods: the huma engine must have more fuel if it takes i more oxygen; and the extra supply of food must be made accessible. The Government fortunately, does not contemplate compulsion but it realizes that "financial aid will have t be considered", though the main burden is to fall on local authorities and on existing voluntary institutions.

Another omission was any reference to the urgent need of a census of distribution and consumption. If, as many believe, adequate nutrition can only be achieved by raising wages or lowering prices, in lieu of Government subsidies and doles in cash or kind, it is of the utmost importance to know the causes and the extent of the wastes that are now alleged to occur in distribution and consumption; and accurate statistical data on these points are seriously lacking. While such a census is being compiled, progress could be made by undertaking some accurate social-economic experiments like that which was carried out last year by the Potato Marketing Board at Bishop Auckland.

Lastly, poverty is one of the main causes of ill-health and poor physique not only because it involves deprivation of certain essential foodstuffs and a bad environment, but also because it imposes a great mental strain upon those who suffer from it. This truth must have been in the mind of Rousseau when he wrote, nearly two hundred years ago, that "Un corps débile affaiblit l'âme".

The Receding Horizon

The Realm of the Nebulae
By Edwin Hubble. (Yale University: Mrs. Hepsa Ely Silliman Memorial Lectures.) Pp. xiii +210 +15 plates. (London: Oxford University Press, 1936.) 12*s.* 6*d.* net.

"THE history of astronomy is a history of receding horizons." So the author tells us in his first chapter, and sets to work to record, in simple language and with much charm, the story of the recent enlargement of the horizon of the visible universe. This is so obviously a task for giant telescopes, that we naturally expect to find that the great bulk of the work has been done at Mount Wilson. Indeed the author himself has contributed the lion's share, but he has gathered round him a group of very able collaborators, and their labours and thoughts have been so interwoven that "the individual often speaks for the group".

It is a chapter of scientific history which has stirred the imagination not only of professional astronomers, but also of the public at large. The greatest popular appeal is undoubtedly made by the immense size of the now known universe, and its corollary—the relative insignificance of our home in space—although it is not easy to see how a further million million-fold increase in the volume of the visible universe can add much to what Galileo had already achieved in 1610. So recently as twenty years ago, many astronomers were inclined to regard the spiral nebulæ as members of the Galactic System, thereby limiting the visible universe to a radius of perhaps 50,000 light years. Dr. Hubble now tells us (p. 191) that the average distance of the faintest visible nebulæ is of the order of 500,000,000 light-years: "images of still fainter nebulæ, which cannot be distinguished from stars, are recorded on the photographic plates", but "it is improbable that any object has been recorded whose distance is double the average distance mentioned above".

These nebulæ have an average mass of about 10^{11} suns, and each shines with the light of about 10^{9} suns (p. 180). Within the limiting horizon at 500 million light-years' distance, about 100 million nebulæ are to be expected (p. 191), which means that nebulæ are scattered over the face of the sky at the rate of some 2,400 for every square degree. In the direction of the galactic poles, where the obscuring matter between us and outer space is least, some such number can actually be seen telescopically, so that in these directions we actually see more nebulæ than stars (p. 191). The nebulæ are to all appearances receding from us at immense speeds, those which are already farthest away running fastest; their speeds are about 101 miles per second for every million light-years of distance. If this relation between distance and speed were exact, nebulæ at the limiting distance of 500 million light-years would be receding at 50,500 miles a second, but nebulæ at a greater distance than about 250 million light-years do not emit enough light for their speeds to be deduced spectroscopically, so that the highest speeds so far definitely recorded are 24,500 and 26,000 miles a second—about a seventh of the velocity of light—from clusters in Boötes and Ursa Major respectively.

Such is the arresting feast of 'plums' which Dr. Hubble might have served up in sensational setting had he elected to play the sensation-monger. He has preferred, and we will all thank him, to give a straightforward record of patient and often laborious work, carried through with a skill, persistence and flair which often remind us of Faraday. He sees the whole exploration as "a case history of scientific research in a rather simple form" (p. 6), and this determines the style of his record.

A few pages of general astronomy, written to put the layman in a position to understand what follows, introduce us to novæ, Cepheid variables and the period-luminosity law for the latter. After this the record is chronological. In 1914 Slipher published a list of radial velocities of nebulæ, and in 1917 various photographic plates were found to carry records of a number of novæ which had appeared in the Andromeda nebula from 1885 on. The extreme faintness of the novæ and the large speeds of the nebulæ both suggested that the latter must be very remote, and almost certainly beyond the confines of the Galactic System. In 1924 the question was decisively settled by Hubble himself. He succeeded in resolving parts of a few of the nearest nebulæ into swarms of stars, and as these included a number of Cepheid variables, the distances of the nebulæ could at once be calculated from the periods of these variables. The distances proved to be nearly a million light-years, showing that the nebulæ were well outside the galaxy.

The next big advance was the classification of nebulæ into standard types, and the discovery, again by Hubble himself, that all the nebulæ of any one type exhibited the same surface-brightness. This suggested that all nebulæ of the same type were similar articles, and so gave a means of estimating the distances of all nebulæ whose type could be determined. This in turn made it possible to plot out the distribution of nebulæ in space.

Finally, we come to a discussion of the apparent recessions of the nebulæ, for which the author prefers the non-committal description "reddening of the light". The main labourer in this part of the field has been Milton Humason, using the remarkable Rayton lens of focal ratio f 0·6. The still more speedy f 0·35 lens designed by R. J. Bracey is not yet in use. Humason has measured the velocities of about 150 nebulæ and clusters of nebulæ, and their close agreement with the velocity-distance relation (101 miles a second for each million light-years of distance) is very remarkable, especially in the case of the clusters, where the superposed random motions of individual nebulæ average out.

So far the author has been an observer writing solely of observers and observations, but he is now compelled (a little regretfully ?) to admit the impossibility of keeping observation and theory in distinct compartments.

> "As we look out into space, we look back into time. The light left the twenty-first magnitude nebulæ perhaps 120 million years before it passed the twentieth magnitude nebulæ, and 250 million years before it reached the 18·5 magnitude nebulæ During these immense periods the nebulæ, if red shifts were velocity-shifts, would have receded to appreciably greater distances than those estimated from their apparent faintness. Thus the observed distribution would require corrections to reduce it to a 'simultaneous description'. Attempts to determine the corrections . . . force the research into the field of relativistic cosmology".

This leads to an all too brief discussion—only four pages—of cosmology, in which the author reaches the arresting conclusion that two schemes at most are consistent with the observed distribution of nebulæ in space. In one, the so-called "velocity-shifts" do not result from velocities at all, so that the observed reddening of the light must be the result of some "hitherto unrecognised principle whose implications are unknown". In the second, the universe is "very small". "In order to save the velocity-shifts, we would be forced to conclude that the universe is so small that we are now observing a large fraction of the whole." And this second alternative seems almost—but not quite—ruled out by the low density of matter in space.

Thus the book ends, as the author says, "on a note of uncertainty. And necessarily so. With increasing distance our knowledge fades, and fades rapidly. Eventually we reach the dim boundary—the utmost limits of our telescopes. There we measure shadows, and we search among ghostly errors of measurement for landmarks that are scarcely more substantial".

In this way, after conducting us to the absolute frontiers both of knowledge and of the astronomical universe, Dr. Hubble leaves us. We regretfully but gratefully take our farewell, with the hope that many years of health and vigour may be in store for him, to enable him to carry on his work with a yet larger telescope, and perchance to stretch the visible universe to many times its present dimensions. J. H. J.

Evolution of the Elephants

Proboscidea:
a Monograph of the Discovery, Evolution, Migration and Extinction of the Mastodonts and Elephants of the World. By Prof. Henry Fairfield Osborn. Edited by Mabel Rice Percy. Vol. 1: Moeritherioidea, Deinotherioidea, Mastodontoidea (Published on the J. Pierpont Morgan Fund by the Trustees of the American Museum of Natural History.) Pp. xl+802+13 plates. (New York: American Museum Press, 1936.) 5 dollars.

SINCE the discoveries of the late Dr. C. W. Andrews and Mr. H. J. L. Beadnell in Egypt at the beginning of this century, the origin and evolution of the elephants seem to have become clear. They began at the dawn of the Tertiary period in northern Africa as small amphibious pig-shaped hoofed mammals, with a nearly complete set of teeth but the second pair of incisors above and below growing large to become tusks and predominate over the others. In the course of ages, while the primitive elephants developed into larger and less amphibious animals with longer legs, the neck always remained short, so that the head and jaws had to lengthen to reach the ground. The bone of the lower jaw continually lengthened for this purpose, but that of the upper jaw did not do so, and the extension of the face was thus left entirely without hard parts. Throughout the middle portion of the Tertiary period, the long soft face was supported only by the rigid lower jaw. Then in the elephants of later Tertiary times the lower jaw began to shorten, until eventually it left the soft face hanging downwards as the familiar proboscis.

About thirty years ago, the late Prof. H. F. Osborn started to recount this fascinating story in detail. After that time he devoted much labour to the collection, study and description of the requisite fossils; and when he died in 1935 he had nearly completed an exhaustive volume on the subject, which has just been published by the American Museum of Natural History with the aid of the J. Pierpont Morgan fund. It is one of the most handsome contributions ever made to palæontology, beautifully printed and excellently illustrated.

At the outset, Prof. Osborn remarks that his selection of generic names may give "a shock to many zoologists", but he has decided to respect "soundly established usage and commonsense". His nomenclature can therefore be readily understood by those who are familiar with the classic writings on Proboscidea. The technical definitions of species, genera and higher groups are supplemented by numerous discussions of relationships; and there are useful synoptical tables of comparison, measurements, and geological and geographical distribution. Most important of all perhaps are the remarkable illustrations, which include photographic reproductions of nearly all the published figures of fossil proboscidean remains, besides numerous new figures that are often conveniently arranged in groups for comparison. To these are added maps showing the distribution of the various species, genera and families, and also striking restorations of the possible appearance of the extinct proboscideans when they were alive.

The small *Moeritherium*, of which the greater part of the skeleton has been found in the Upper Eocene and Lower Oligocene deposits of Egypt, is still the only known ancestral proboscidean in which the face has not yet begun to develop into a proboscis. Its skeleton seems to show that the animal was more adapted for an aquatic life than the hippopotamus, and it probably fed on succulent plants mainly under water. The many resemblances of *Moeritherium* to the aquatic mammals of the order Sirenia are thus very interesting, and there cannot be much doubt that common ancestors of the proboscideans and sirenians existed somewhere during the Cretaceous period. As neither *Moeritherium* nor any of its allies has hitherto been discovered outside Egypt, Africa still appears to be the region in which the search for these ancestors may be most hopefully made.

Contemporary with the latest species of *Moeritherium* in the Lower Oligocene of Egypt are two more advanced proboscideans, *Palæomastodon* and *Phiomia*, in which there is a long soft face supported by the elongated front of the lower jaw. As might be expected, the species of these genera are larger than those of *Moeritherium* and they seem to have lived in forests, hence the comparative scarcity of their fossil remains. Very curiously, it is difficult to regard them as the direct descendants of *Moeritherium* which flourished earlier in the same region, and Prof. Osborn considers that they represent the beginning of two distinct groups of mastodonts which are traceable in later Tertiary rocks of both the Old and New World.

A little later, in the Lower Miocene of Africa, Europe and Asia, *Deinotherium* suddenly appears. It ranges upwards to the Middle Pliocene in Europe and even to the Pleistocene in Africa, but it does not appear to have reached America. Although the species increase in size until the latest and largest attain the dimensions of the largest true elephants, they all keep comparatively small crushing teeth much like those of the primitive *Moeritherium*, and all have lost the upper tusks. As the crushing teeth are adapted for succulent food, and as the downwardly turned lower tusks might well be used to hold on to a bank, *Deinotherium* was long supposed to have been an aquatic animal; but Prof. Osborn has pointed out that the skeleton which has been discovered in recent years is as completely adapted for life on land as that of the ordinary elephants. It is therefore interesting to observe that many of the true mastodonts—the Rhynchorostrinæ of both the Old and New World—are now known to have had the same downwardly directed lower tusks.

The mastodonts ended everywhere in large animals with a short skull and lower jaw and a freely hanging proboscis, like the corresponding parts of a typical elephant. All their earlier representatives, however, had the long soft face resting on the bone of the elongated lower jaw, and they exhibited astonishing variety in this arrangement. The account of the variations occupies the greater part of Prof. Osborn's volume, and it suggests that there were several distinct lineages of primitive mastodonts evolving in nearly parallel directions. In some, such as *Platybelodon* from the Upper Miocene of Mongolia and an allied genus from the Pliocene of Nebraska, the lower tusks become large and flat, with a sharp edge, giving the front of the lower jaw the appearance of a shovel. These tusks are strengthened with a bundle of parallel cylindrical rods of dentine which occupy the ordinary position of the pulp cavity. In some mastodonts, such as *Serridentinus*, the lower tusks are comparatively small, while in others the long and slender lower jaw loses its tusks. Sometimes, as in *Megabelodon* from the Lower Pliocene of Nebraska, the slender tuskless lower jaw expands at the end into a 'spoonbill' where the roughened bone seems to have been covered with a hard dermal pad. In several lineages there is an ultimate tendency to the shortening of the lower jaw, but it is at present impossible to decide which became extinct and which led to the mastodonts with a completed proboscis.

The best known of the later mastodonts with an elephant-like proboscis is still the *Mastodon americanus*, to which Prof. Osborn devotes thirty well-illustrated pages. It occurs both in the preglacial Pleistocene formations and in many postglacial deposits in North America, and the molar teeth in the latest variety seem to differ from the earlier teeth in having sharper ridges. Teeth from southern Russia and China have been ascribed to the same species, but Prof. Osborn decided that these were wrongly named.

The next best known later mastodonts are those from the Pleistocene of South America, which are no longer referred to *Mastodon*, but to two or three distinct genera. Prof. Osborn thinks that the immediate ancestors of these proboscideans are recognizable in the Pliocene of North America, whence they must have migrated.

In the present volume, Prof. Osborn makes a great addition to our knowledge of the fossil Proboscidea, and provides an indispensable work of reference which will take its place among the classics of palæontology. Our only regret is that the printing of the volume began so long ago as 1924, and an appendix of nearly sixty pages, bringing the subject up to date, makes much of the text obsolete. The student must begin by reading the appendix, and then annotate the volume where the annotation has not already been done by footnotes or disturbing intercalations in black type. Even the reading is not easy, owing to the method of compilation, frequent repetition, and lack of literary style. A second volume, on the typical elephants, is due to be published next year, and we may express the hope that when it was unfortunately left by the author, the printing had not progressed too far to avoid some of the difficulties which the first volume presents.

A. S. W.

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THE different aspects of the task which faces a reviewer of scientific works may be grouped roughly under three heads. He should tell his readers in some detail the topics dealt with in the work under review; he should explain something of its scope; and he should attempt, with becoming modesty, to assess the value of the contribution made by the author to the spread or to the advancement of knowledge. Exigencies of space warrant some modification of this process when one is attempting an omnibus review. It is impossible, for example, to analyse separately the contents of twelve volumes, and the titles must be taken as indicating sufficiently clearly the topics dealt with.

The scope of the volumes may best be illustrated from a consideration of the audiences to whom such works may, or may not be expected to appeal. Taking the series before us as a whole, the volumes which comprise it are admirably fitted to assist students who are members of adult education classes of one or other of the many types in existence; they will assist workers in one branch of science to learn something of what is happening in regions unfamiliar to them; they are very suitable for a school library; and they will certainly prove useful aids to the inquiring layman who would know something of the trend of scientific thought in this restless universe of ours. The series is not likely to be of much use to the specialist or to the honours student seeking that conspectus of his subject which it is part of his business to make for himself. He may, however, find the volumes of very deep interest as illustrating the difficult art of presenting technical topics in elementary, and yet accurate, fashion.

Finally, have the authors succeeded in their task of limning an accurate and convincing picture of the state of existing knowledge of the topics with which they have concerned themselves? Obviously, an author who deals with sciences which have broken away from the simpler traditions of the nineteenth century and which employ a highly specialized jargon is, on a surface view, faced with a problem much more difficult than that which confronts an author dealing with a science qualitative in its outlook, and employing a not very highly specialized language. This is not to say that complex notions and arguments are the exclusive possession of him who employs a mathematical or logical notation. Far from it. Such a technique, once acquired, may become a potent weapon for saving thought and for grinding out results in purely mechanical fashion. Contrariwise, some most difficult and involved arguments may be developed without the aid of a single symbol. Still, when an argument is essentially mathematical, is fundamentally complex, and presents novel ideas, the task of the writer who would tell the story in simple language is not an enviable one.

The authors of the works under notice must be deemed to have succeeded in their task. The treatment is, in most instances, a little discursive in character, but that can scarcely be reckoned a fault, having regard to the audience to which the volumes may be supposed to appeal. They leave the reader with a clear picture of the subject-matter, and, while providing plenty of background, they do not in general overwhelm him with a mass of unessential detail.

This is not to assert that the volumes are completely free from error. On the contrary, there are, here and there, examples of unevenness of presentation and of obscurities of statement which may, occasionally, be positively misleading. The practice followed in some of the illustrations, of placing side by side examples of large-scale and of microscopic objects without the slightest indication of the magnification employed, is very much to be deprecated.

It is, perhaps, scarcely fair to single out for special mention one of a dozen good companions, but it is impossible to conclude this review without remarking on the admirable qualities of the volume on "Heredity and Variation".

The series is well produced and illustrated, and offers remarkably good fare at a very low cost.

N. F.
A. F.

Molecules and Morphogenesis

Order and Life
By Joseph Needham. (The Terry Lectures for 1935.) Pp. x+175. (Cambridge: At the University Press; New Haven, Conn.: Yale University Press, 1936.) 8*s*. 6*d*. net.

IN another context, Dr. Needham himself has likened the biochemist and the embryologist to the gangs drilling a tunnel from each end, and now just about to establish contact with one another. In fact, this contact may be said to have occurred, for knowledge of the chemical structure of protein molecules bids fair to throw light on the structure and properties of fibres (not excluding muscle); and the properties of liquid crystals can now be ascribed to certain living units.

Dr. Needham, whose researches entitle him to a place in the gangs of workers at both ends of the tunnel, has put forward a suggestion which may prove to be the turning point in the experimental attack on a problem of great topical interest and importance; namely, the morphogenetic fields, which he compares with the zone of influence which surrounds molecules possessed of the property of inducing orientation in neighbouring molecules. Cholesteric paracrystals have this property, and sterol-like substances are now known to be concerned in the morphogenetic activities of the 'organizer'.

The author's attitude to the philosophical position of biology is of great interest. Philosophers may find difficulty in accepting what they will probably believe to be Dr. Needham's attitude towards the Aristotelian distinction between matter and form. But Dr. Needham has done an inestimable service to 'natural philosophy' in emphasizing that the organizing relations in virtue of which organisms are more than the sums of their organs are legitimate objects for experimental analysis, and in showing that there is no haven for vitalism either in the indeterminacy principle of physical theory or in the mistaken notion that analysis of living organisms kills them and yields knowledge only of inorganic matter.

Dr. Needham pleads with logically irresistible eloquence for the recognition of the validity of a "biological level", and introduces to Western readers the often neglected writings of Marxist philosophers on this point. No doubt some biologists will discover that they have been thinking along similar lines. No biologist can afford not to read and ponder over this book.

G. R. DE BEER.

Mathematics for Technical Students

By Frederick G. W. Brown. Part 1 (First Year Course). Pp. x+215+xviii. 3*s.* Part 2 (Second Year Course). Pp. x+217–491+xxv. 3*s.* 6*d.* (London: Macmillan and Co., Ltd., 1936.)

IT is to be hoped that all teachers of mathematics in technical schools and evening institutes will have the opportunity of seeing these two books; for they provide a preliminary two-year course in mathematics which is exactly what is wanted at the present time.

After a revision of the simple operations of arithmetic, the student is introduced to the notation of algebra and made to see the value of this new weapon, until, finally, he should be able to solve arithmetical problems by means of a simple equation. This is followed by a short informal course of theoretical geometry; time spent on this section will be amply rewarded in the later stages of the course.

The concluding chapters of Part 1 deal with applications of previous work to the area of simple rectilinear figures and circles and to the volume of bodies of uniform cross-section. Some teachers will no doubt prefer to take this work earlier in the course—and there is much to be said for this view; teachers will find no difficulty in doing this.

Part 2 is necessarily more formal in character than Part 1. The first three chapters deal with logarithms and their many applications, plenty of useful exercises being provided; simple equations in two unknowns, fractions, harder fractions and quadratic equations complete the work in algebra. The remaining chapters deal with numerical trigonometry, harder mensuration and graphs, and applications of Simpson's rule. This last chapter could serve as a link in an introduction to the calculus for those students who proceed further with mathematics.

Typical sets of examination papers and useful mathematical tables are provided at the end of the book.

Teachers in evening schools have many problems to meet: the minimum number of students to form a class, intermittent attendance, the weariness of students who have done a day's work and the difficulty of an adequate supply of text-books; but if evening school students could handle and use these two volumes, examiners would soon find a considerable improvement in elementary mathematics.

L. C.

A Text-Book of Physical Chemistry

By Sylvanus J. Smith. Pp. xii+355. (London: Macmillan and Co., Ltd., 1936.) 5*s.* 6*d.*

THIS book is intended primarily to provide a course of physical chemistry for students preparing for the Higher School Certificate Examinations in science, also for candidates for university open scholarships, and for the First Examination for medical degrees. Such students will find the book very useful. In its 345 pages of text, the author more than covers the field of physical chemistry required by these examinations.

The subject matter is generally brought right up to date, but the older theories are also given their fair place. The section on the structure of the atomic nucleus, however, should now include a mention of the modern theory of its constitution from protons and neutrons. The excellent chapters on catalysis and colloids touch on many important industrial applications. A good selection of examination questions is given at the end of each chapter, with answers to the numerical examples in the appendix. The text is illustrated throughout with clear and helpful diagrams. Fig. 87 cannot correctly be described as the "Bunsen-Roscoe Actinometer" since it shows a mercury meniscus used in contact with chlorine gas.

The treatment is neither too elementary nor too advanced, and seems to be just the right standard required by the examinations for which the book is written

Graphical Solutions

By Prof. Charles O. Mackey. Pp. vii+130. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 12*s.* 6*d.* net.

GRAPHICAL and mechanical representations of practical equations are especially useful to the engineer, and this volume has been written to provide a systematic course in the subject. The first four chapters are devoted to stationary adjacent and sliding scales; network or intersection and alignment charts for equations in three variables and combinations of all these methods of solution. In the final chapter, the fitting of equations to experimental data is discussed. The treatment is quite elementary and involves only a working knowledge of logarithms, algebra and plane geometry, while a little calculus is required in the section on empirical equations. With the volume is provided a very clear reproduction of the logarithmic scales prepared by the late Prof. Lipka.

To those who have to deal with practical graphical computation, this book should prove very useful, instructive and interesting.

Sammlung chemischer und chemischtechnischer Vorträge

Begründet von F. B. Ahrens. Herausgegeben von Prof. Dr. R. Pummerer-Erlangen. Neue Folge Heft 33: Die Azoxyverbindungen: eine Monographie. Von Dr. Eugen Müller. Pp. 40. (Stuttgart: Ferdinand Enke, 1936.) 3.40 gold marks.

THE mode of representing the structure of the important class of the azoxy-compounds has recently undergone a change, based originally on chemical evidence provided by Angeli, and confirmed by the isolation of optically active substances by Marvel and E. Muller. The new formulation is a consequence also of the physical properties of the substances. The present monograph sets out clearly and accurately the grounds for the present representation of the structure of the azoxy-compounds, with full references to the literature. It is a useful contribution to the literature on the organic chemistry of nitrogen.

Science in Development*

By the Right Hon. Lord Rutherford, O.M., F.R.S.

IN surveying the great tide of advance in the physical sciences during the past forty years, it is not always recognized how much the progress of discovery has been influenced, and indeed in many cases controlled, by the improvement of laboratory technique and by the development of new instruments and methods of measurement.

To appreciate the rapid changes which have occurred, it is probably simplest to contrast the laboratory equipment of to-day with that available at some well-defined epoch in the past. I choose for this purpose the year 1895, that turning point in the history of physics, which saw the discovery of X-rays, to be followed in quick succession by the discoveries of radioactivity and of the electron. This choice of year seems to me convenient as it marks a natural dividing line between the older and the newer physics.

First of all, I should like to refer to the great advantages to research in general that have followed from the invention of an efficient form of lead accumulator. Before the commercial manufacture of the accumulator, the experimenter had to rely on primary batteries for the supply of electric current in his investigations. The Daniell cell or corresponding battery was used for small currents—as, for example, in comparing resistances by the Wheatstone bridge. For the supply of currents of the order of an ampere or more, Grove's cells were often used, but these had only a working life of a few hours and had to be freshly prepared each day. When I first began some investigations on the magnetic properties of iron in 1893 at Canterbury College, Christchurch, New Zealand, I found it necessary to prepare each morning a battery of about a dozen Grove cells. This involved the cleaning and amalgamation of the zinc plates and adding the necessary acids. Fortunately, large platinum plates for the electrodes were available. I found this battery of low internal resistance a very convenient means of obtaining substantial and steady currents, but after several hours' work the battery showed obvious signs of exhaustion and accurate work with it was impossible.

In order to illustrate the provision for research forty years ago, I shall take as an example the Cavendish Laboratory, which was directed by Sir J. J. Thomson, who was then on the verge of beginning his famous experiments on the electrical conductivity in gases produced by X-rays and his investigations of the nature of the cathode rays. The equipment of the Cavendish Laboratory both for teaching and research was probably typical of the better European physical laboratories of that time. Largely due to the labours of the late Sir Richard Glazebrook and of Sir William Napier Shaw, a well-organized system of laboratory instruction had been arranged for students, and this was extended and elaborated through the years by that genius in the design of laboratory apparatus for teaching purposes, Dr. G. F. C. Searle.

While the provision for teaching and research was in general excellent in the older sciences of optics, heat, sound and properties of matter, in contrast with to-day the amount of electrical apparatus, particularly on the measuring side, was sparse and in some cases almost non-existent. Apart from reflecting galvanometers of the moving magnet and moving coil types and a tangent galvanometer, there was no portable instrument for measuring current except one very crude form of ammeter. The only portable method of measuring voltage was a rather ponderous Cardew voltmeter of the hot wire type, which was of very limited utility and accuracy. It was not until a few years later that those admirable instruments for measuring current and voltage designed by the late Mr. Edward Weston of the United States came into laboratory use. To-day, hundreds of measuring instruments of this or similar types are required in electrical research, and indeed a single experimenter may feel himself hardly used if a dozen of these instruments are not available, with appropriate wire rheostats to control the voltages and current.

Apparatus for work in electrostatics was more plentiful, including a number of types of quadrant electrometer, which, however, were usually both unreliable and capricious instruments. The quadrants were large and the needle unnecessarily heavy. The moving system was often supported by a silk fibre and the position of the needle controlled by a small magnet attached to it. A platinum wire was attached to the bottom of the needle and dipped in strong sulphuric acid, which formed the inner coating of a small glass condenser. In order to obtain a reasonable sensitivity, the needle and condenser required to be charged to a fairly high potential. This was done by charging the jar with a spark or two from an electrophorus or from a charged Leyden jar. Unless very special precautions were taken with the insulation, the charge on the condenser leaked away rapidly and the sensitivity of the electrometer varied markedly from hour to hour, while the zero of the needle was very unsteady. Under these conditions, it was difficult to make observations over any but a short period with any accuracy. Lord Kelvin, the pioneer in the construction of quadrant electrometers, had designed a more elaborate and more serviceable instrument in which the potential of the charge given to the needle could be brought to a definite value by the use of an attracted disk electrometer incorporated with the instrument. One of these electrometers, which was available in the Laboratory, was made after great effort to work satisfactorily by Prof. J. S. Townsend, and was used by him in his well-known researches on the electrification of gases and on the properties of ions in gases. This, I believe, was the first time this instrument, which was of moderate sensitivity, had been used in systematic researches of importance.

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* From the twelfth annual Norman Lockyer Lecture of the British Science Guild, delivered on November 12.

A great advance was made about 1900 when Dozalek designed a quadrant electrometer with a fine quartz suspension and a very light needle, which gave a good sensitivity when the needle was charged to the comparatively low potential of a few hundred volts.

In place of the quadrant electrometer, the tilted electroscope designed by C. T. R. Wilson in 1903 was often used. This had a low capacity and a voltage sensitivity comparable with an electrometer. Recently a very sensitive form of this instrument has been designed by H. Carmichael and used for experiments on the bursts of ionization produced by the cosmic rays. After the Great War, still more sensitive electrometers were designed; for example, a modified quadrant by Compton, and a binant electrometer of high sensitivity by Hofmann, while a robust and portable type of string electrometer of good sensitivity designed by Lindemann has proved very serviceable in many directions. At this stage, I must not omit to mention the extraordinary utility of a modified form of the gold leaf electroscope for measurement of ionization, particularly in the study of the radioactive bodies. This instrument, which had been used for detecting charge for a century or more, was developed into an accurate measuring instrument largely due to the modifications introduced by C. T. R. Wilson. In course of time the electroscope displaced the quadrant electrometer for measuring the periods of decay of radioactive bodies and for a study of the α-, β- and γ-rays.

The changes in forms of apparatus so far mentioned did not involve any essential new principle, but were rather the result of improvement in design to increase their sensitivity and reliability, and to adapt the form of the instrument to meet the needs of investigators. To this period, however belongs the development of an instrument which to my mind is the most original and wonderful in scientific history—I refer to the 'cloud' or 'expansion' chamber of C. T. R. Wilson. I had the good fortune to be present in 1895 in the Cavendish Laboratory when Wilson was examining the formation of water drops in damp dust-free air by sudden adiabatic expansion of the gas. When X-rays were discovered, Wilson at once showed that the ions produced by the X-rays in their passage through the gas acted as nuclei for the condensation of water upon them under certain conditions of supersaturation. A cloud of visible water drops was formed and in a sense each ion was rendered visible by the water drop formed round it.

The next important advance was made in 1912, when Wilson devised the modern type of expansion chamber and showed that the tracks of individual α-particles and fast electrons are rendered visible by the trail of water drops formed on the ions liberated by the passage of these flying particles through the gas. It was a wonderful advance to be able to see, so to speak, the details of the adventures of these particles in their flight through the gas. Anyone with imagination who has seen the beautiful stereoscopic photographs of the trails of swift α-particles, protons or electrons, cannot but marvel at the perfection of detail with which their short but strenuous lives are recorded. The cloud chamber has proved an invaluable aid to research in many directions and has become all-important in recent work on artificial transmutation. This instrument provides in a sense a final court of appeal in which the experimenter may place his trust. I cannot imagine anyone with the most vivid scientific imagination who could have predicted the possibility of an instrument endowed with such unique powers and potentialities.

HIGH VACUA

Of all changes in laboratory apparatus and technique in the period under review, none has been more revolutionary in type or of more importance to the progress of science and industry in many directions than the improvements in methods of rapid production of high vacua. Vacuum research has a long history and has persistently engaged the attention of scientific men from the year 1643, when Torricelli, the assistant of Galileo, made the first mercury barometer. The first mechanical air pump was devised by von Guericke in 1650. It was a simple type of suction pump with a well-fitting plunger and automatic leather valves, and was probably able to reduce the pressure of air in a sealed container to between 1/100 and 1/1,000 of an atmosphere.

While mechanical pumps were improved, no great advance in principle or practice of producing high vacua took place for nearly two hundred years. To be sure, many investigations were made, for example, by Hawksbee, to investigate the beautiful glow discharges observed when an electrical spark passed through a vessel containing gas at very low pressure. While mechanical pumps were often used for special purposes, the Torricelli principle was more popular and effective in producing a good vacuum.

The most important stage in the subsequent advance was the invention in 1855 of the mercury pump proper by Geissler, who used it for exhausting discharge tubes in order to illustrate the striking luminous effects which arise when the electric discharge from an induction coil is passed through the low-pressure gas contained in the tube. Such Geissler tubes were long used for illustrations in lectures, and replicas of them may still be seen to-day. The invention of the mercury pump gave the possibility of producing a really good vacuum by long-continued pumping. The advantage over the mechanical pump was due primarily to the elimination of the mechanical valve and the dead space. The mercury pump was used by Hittorf for studying the marked changes in the appearance of the electric discharge as the pressure of gas was decreased to the lowest value obtainable. He observed the conditions of production of the now well-known cathode rays and was, I think, the first experimenter to appreciate that, in order to maintain a permanently good vacuum in a sealed tube, it was necessary to 'degas' the walls of the tube and electrodes by frequent heating and long-continued bombardment by the electric discharge. In this way he produced, for the first time, a tube with so good a vacuum that an induction coil failed to produce any visible discharge through the highly rarefied gas.

The work of Hittorf was extended and improved upon by Sir William Crookes, who used a modified form of mercury pump invented by Sprengel in 1865, which could readily be made automatic in action. A number of modifications of Geissler's original pump were made from time to time, and of these the pump devised by Toepler in 1862 came into general use towards the end of the nineteenth century. When I first came to the Cavendish Laboratory in 1895, modified forms of Toepler pump, made by that skilled glassblower Mr. Everett, were in general use. One of these pumps was used by Sir J. J. Thomson in his famous experiments which proved the nature of the cathode rays. In those days, it was usual to employ a one- or two-cylinder Fleuss pump for preliminary pumping of the vessel to a pressure below 1 mm. This pump was a greatly improved form of the original mechanical air pump of von Guericke. The moving piston and working parts were covered with a layer of oil. The small quantity of air entrapped by the upward motion of the piston was forced with the oil through a spring valve. By these modifications, the efficiency of the pump in reaching a low pressure was much increased. Under good conditions a vacuum as low as 1/50 mm. could be obtained. It should be borne in mind that the production of a good cathode ray vacuum in a discharge tube in the old days was a lengthy and laborious process with the slow-acting Toepler or Sprengel pumps. Several hours pumping was required to produce a good vacuum by these methods, while to-day, with our fast diffusion pumps, a similar result can be obtained in a few minutes or even seconds. It is of interest to record that the X-ray tubes first used for radiographic purposes were all painfully exhausted by one of these early forms of mercury pump.

From the point of view of ease and simplicity in maintaining a good vacuum, the discovery of Sir James Dewar in 1904 that specially prepared charcoal was a strong absorbent of gases at low temperature has proved of great importance to science. The tube to be exhausted was connected with a side tube containing charcoal. After preliminary exhaustion with a mechanical air pump, the charcoal was immersed in liquid air, when the residual gases in the tube were rapidly absorbed by the charcoal and a high vacuum produced which could be maintained for hours. This method of producing a controllable degree of vacuum was widely used for many years in our laboratories. For example, this method was employed by Sir J. J. Thomson in his well-known experiments on the positive rays, and on account of its simplicity is still used by Aston in his investigations with the mass-spectrograph.

The last thirty years have seen great changes in our methods of rapid production of high vacua, and many new and ingenious types of fast pumps have been invented. This rapid development has been in large measure due to the remarkable powers of invention shown by Dr. Gaede, who has designed a whole series of pumps of great scientific and technical interest.

The first glass diffusion pump employing a stream of mercury vapour was described by him in 1915, and has been followed by a succession of designs of increasing efficiency. This pump, which has the advantage of containing no movable parts, can be constructed either of glass or metal, and a great variety of forms have been used, particularly in the case of small glass pumps for ordinary laboratory use. Improvements in the design of the all-metal diffusion pump to ensure higher pumping speeds were early made by Langmuir in the United States and by Kaye in Great Britain. Although there are great varieties of these pumps both as regards size, form and construction, they all depend on the same general principle. The gas to be removed diffuses through a suitable aperture into a stream of hot mercury vapour which carries the gas away with it, the mercury vapour being afterwards condensed and the gas removed by a backing pump. The speed of exhaustion of these pumps is astoundingly fast, and theoretically there is no limit to the degree of vacuum that can be obtained. In general, a single-stage pump requires the pressure to be reduced by a fore pump from 1/10 to 1/100 mm. before the pump comes into action. Gaede has designed a 3-stage all-steel pump which begins to operate at a pressure of 20 mm. and has a high speed of exhaustion.

In the mercury diffusion pumps it is usual to employ a liquid air trap to prevent the back diffusion of the mercury vapour into the vessel to be exhausted. This is a disadvantage both from the point of view of economics and of efficiency in pumping, and has been got over by replacing mercury by a special oil which has a negligibly small vapour pressure at ordinary temperatures, so that liquid air is dispensed with. The first oil diffusion pump was constructed in Great Britain by Mr. C. R. Burch of the Metropolitan-Vickers Research Laboratory, using special oil obtained by molecular distillation. These pumps are very efficient and are very widely used, particularly for large sizes of pump where great volumes of gas have to be rapidly removed.

The invention and development of the diffusion pump has given to science a new and extraordinarily effective instrument for the rapid attainment of the highest degree of vacuum. Not only has its use greatly simplified investigations in very high vacua, but also it has made possible many new technical developments. With the aid of these fast pumps, we can maintain large vessels at such a low pressure, even when gases are pouring in through a small opening, that voltages of the order of 1 million volts can be applied without the passage of a discharge. This has made it possible to obtain streams of very fast particles, for example, protons and deuterons, which have proved so effective in studying the transmutation of the elements.

I have already mentioned incidentally some of the more fundamental discoveries that have resulted from a study of the electric discharge through rarefied gases; for example, the production and nature of the cathode rays, the discovery of the X-rays and the development of new methods of analysis of the charged atoms and molecules produced in the discharge tube. The resolving power of this method of chemical analysis has been so improved by Aston that it has been found possible not only to show the isotopic constitution of many of the ordinary elements, but also to determine the relative masses of the atoms with high precision. The use of high vacua led to the investigation by O. W. Richardson of the copious emission of electrons from incandescent bodies—a discovery from which has originated many important industrial applications. In general, the study of processes in very high vacua has added much to our knowledge in many directions. The pioneer work of Langmuir on chemical reactions at very low pressures and on adsorption phenomena has opened a new and important field of inquiry which is still being developed. Much light has been thrown on the formation of monomolecular films on surfaces and their importance in catalytic reactions, and in general on the nature of chemical and physical forces which come into play. The use of molecular rays by Stern and Gerlach was only made possible by high vacuum technique.

I have so far only spoken of methods of producing high vacua, but in the course of this development not only have reliable methods been devised for measurements *in situ* of the residual pressure of the gas, but also great advances have been made in industrial laboratories in the technique of making metal seals with glass, for example, copper, steel and tungsten. This has made possible the production on a commercial scale of robust tubes of combined glass and metal such as are used for high-power rectifiers and oscillators. In addition, the industrial laboratories have been responsible for many improvements in technique. Many new kinds of glass have been produced and methods devised for graded glass joints, such as pyrex to soft glass and silica to pyrex. The high-frequency eddy current heater for degassing metal parts *in situ* has proved of great value, while the technique for degassing tubes, whether by heat or the electrical discharge or both together, has been highly developed. Special machines have been devised for rapid exhaustion and sealing of glass bulbs. The production of low vapour pressure oils and greases has made possible the efficient and economical oil diffusion pump and improved methods for air-tight joints.

In the development of high vacua, the mutual reaction between science and industry is illustrated in a striking way. The pioneer work of the physicist led to the development of methods of producing high vacua and to many new discoveries of the properties of matter in rarefied gases. These new methods have been applied to industry in a great variety of ways, and in turn have provided the physicist not only with improved forms of apparatus but also with many new technical devices which have made possible still further progress in pure physics. For example, the production on a commercial scale of efficient amplifiers, thyratrons and rectifiers, has provided the physicist with new and powerful weapons for extending his investigations in many directions. These developments have made possible not only the production of streams of swift particles for work on transmutation, but also methods of automatic counting of the swift particles which result from the transformations. These new counting methods owe much to the ingenuity of Dr. Wynn-Williams. On account of these great improvements in technique and methods, progress in our knowledge has been so accelerated in the last few years that it is not easy for the investigator to keep in close touch with the rapidity of advance of new knowledge.

There have also followed great improvements in the efficient production of X-rays, and I must not omit to mention the development by Coolidge of the hot cathode, highly exhausted X-ray tube, known by his name, which has proved so valuable both for scientific and medical purposes. I could give many other illustrations of the beneficial effects of this close mutual relation between the workers in our university and technical laboratories —a happy relation which cannot fail to be of good augury for the future.

J. L. Macadam: Father of Modern Road-Making

By Dr. R. Quarendon

THE centenary of the death of J. L. Macadam comes at a particularly fitting time, because the history of the roads is passing through a stage very similar to that which marked the years of Macadam's greatest activity. Then, as now, transport was being handicapped by the lack of modern highways, and the march of progress hindered by out-of-date conditions.

The roads were in many cases little better than they had been in the Middle Ages. Two hundred years of neglect, ignorance and prejudice had left them in an appalling state of disrepair. Journeys which now take hours lasted for days or even weeks, and were undertaken only after anxious consideration.

Parliament had done its best to suppress the wheeled vehicle, or to regulate it as a nuisance. Act after Act was passed restricting the loads to be carried, the number of horses per wagon, and the size and shape of the wheels. Excepting the 22,000 miles of turnpikes, the repair of the roads was in the hands of the parishes, who were empowered to conscript labour—known as 'statute labour'—whose services were given with the greatest unwillingness. The 1,100 turnpike trusts were run in many cases by ignorant and incompetent men who took the revenues but spent little on repairs.

Lacking engineering training, Macadam seems to have developed his method from first principles. It was at thirty years of age, after having gained a fortune as an agent for the sale of prizes in the American War of Independence, that he returned to Scotland to begin his experiments. As magistrate, deputy lieutenant and road trustee for Ayrshire, he was able to give considerable time to this work. His efforts met with the greatest opposition, in spite of the fact that it was his own money which was being spent on the investigation. The Scots people did not want a hard metalled road. They preferred to drive their cattle and geese to market over the soft earth roads which then prevailed.

For many years, Macadam was unable to test his ideas on a suitable scale. In 1798 he was appointed agent for revictualling the Navy in the western ports, and his duties afforded little time for road research. It was not until 1815, when he became surveyor-general of the Bristol roads, that the opportunity for which he had been waiting arrived.

The usual method of making a road in those days was to dig earth from ditches cut along the side, and to pile it in the middle, in the pious hope that the traffic would beat it into a hard surface. Sometimes gravel was thrown on top, but in wet weather the earth and gravel soon became churned into a pebbly mud. Although he was a pioneer of his day, all Macadam really did was to provide a durable, properly drained bed of road metal. He excavated the earth to a depth of 6–10 inches, according to the nature of the subsoil, and filled in the trench with layers of stone broken to one-inch cubes. The traffic was allowed to consolidate the broken stone until it knit together to form a hard smooth surface impervious to water.

Macadam's methods differed from those of his contemporary Telford in two ways. He used no large blocks of stone as a foundation, because he maintained that a soft, elastic base which 'gave' a little would withstand heavy traffic much better. Neither would he have gravel or similar binding material in the surface layer, as Telford recommended.

Many roads which are nowadays described as 'macadam' are not macadam at all, according to the strict letter of the method described by the inventor of the process. They are laid with small material mixed with the larger pieces to act as a binder, a thing which Macadam absolutely forbade. His was a counsel of perfection, however, because unless the stones have the correct shape they will not bed down without admixture to form the regular mosaic characteristic of the true macadam.

Macadam's energy and persistence gradually bore fruit. The enormous improvement of the roads under his jurisdiction became generally known, and in 1823 he described his methods in evidence before a committee of the House of Commons. As a result, macadam replaced the granite causeways in many of London's important streets, in spite of the dismal predictions of people who opposed the change. Southey wrote that "macadamising the streets of London is likely to prove quackadamising", but that opinion was probably due more to his admiration for Telford than to any critical examination of the available facts.

Before recognition came to him, Macadam spent £5,000 out of his own pocket in developing his method, and travelled 30,000 miles to help officials and others who asked for his advice. The greatly increased speed of the coaches gives a striking proof of the soundness of his ideas, which made English roads the best in the world. Whereas the journey from London to Edinburgh used to take 14–16 days, the time had fallen by 1830 to 40 hours—a remarkable improvement. In recognition of his services, Parliament voted him £10,000, which he accepted, and he was offered a knighthood, which he declined. His son accepted the honour in his stead.

Macadam described his researches in his memoir: "A Practical Essay on the Scientific Repair and Preservation of Public Roads", published in 1819. Other works on the same subject appeared from his pen. He died on November 26, 1836, in his eighty-first year at Moffat, near Telford's birthplace, on one of his frequent visits to the scenes of his boyhood.

Although many of Macadam's roads remain, they can no longer compete with the concrete 'speedways' of the modern era. They belong to a quieter age, when the horse jogged leisurely along the country lanes, and the passengers had time to notice the honeysuckle in the hedgerows. Yet they were our roads for more than a century, and it will be many years before the man who made them is forgotten.

Obituary

Prof. W. A. Parks, F.R.S.

The death occurred in Toronto, on October 3, of Prof. W. A. Parks, professor of geology in the University of Toronto. William Arthur Parks was born in Hamilton, Ontario, in 1868, and educated in Bowmanville High School and the University of Toronto. With his university he was to be associated for the rest of his life, and his career is a long list of ascending responsibilities. He graduated B.A. in 1892, became a 'fellow of geology' in the following year, and was in turn instructor, lecturer and, in 1905, associate professor. In 1913 he was appointed director of the newly constituted Royal Ontario Museum of Palæontology, an institution which has greatly developed under his guidance. From 1916 until 1922, Dr. Parks was professor of palæontology and in the latter year he was promoted to the full chair of geology.

With his large department and his museum ever increasing in importance, Prof. Parks was fully occupied, yet he found time to conduct expeditions in northern Ontario and to undertake research in various directions. He was particularly interested in American Stromatoporoidea and also published a series of papers on the geology and palæontology of the Toronto district. He was also interested in, and published a comprehensive account of, the building and ornamental stones of Canada.

In his later years, attracted by the rich material in his museum, Prof. Parks turned to vertebrate palæontology and described many new genera and species of highly interesting dinosaurs. Despite these numerous activities he found time for service on outside bodies. He was president of Section C (Geology) of the British Association at Southampton in 1925, president of the Royal Society of Canada, 1925–26, president of the Palæontological Society of America, 1926–27, and president of the Royal Canadian Institute, 1928–29. His talents were recognized in Great Britain by his election to the Royal Society in 1934.

For the last few years, Prof. Parks had patiently borne much serious illness, but his interest in his science and in his newly and greatly extended museum was not diminished. His death is a great loss to Canadian geology, and the sympathy of all who knew his pleasant and kindly personality will go out to his widow and his son. W. E. S.

Mr. D. A. Jones

MR. DANIEL ANGELL JONES, formerly secretary and afterwards president of the British Bryological Society, who died at Bristol on October 6 in his seventy-sixth year, has long been a familiar figure among Welsh botanists. Whilst he was a schoolmaster at Harlech his assistance was often invoked by botanists interested in the flora of North Wales, especially of Merionethshire and Carnarvonshire. His keen eye and wonderful memory of detail, locality and habitat were well known to phanerogamic botanists, and in the detection of bryophytes and lichens he was unrivalled.

During the present century, the story of Mr. Jones's life is largely linked up with that of the British Bryological Society. In 1895, a number of bryological enthusiasts formed the Moss Exchange Club. The main purpose was the exchange of specimens, but supplementary to this there was a desire to extend the knowledge of the distribution of bryophytes in Great Britain, as nothing in regard to this had been published since the issue of the second edition of the London Catalogue of British Mosses in 1881. In 1907, Mr. Jones took charge as secretary of the beginner's section (Section II) and continued that work until 1922, when both sections became merged as the British Bryological Society. He became secretary of this and continued as such until the early part of this year, when he felt compelled to resign on account of ill-health. The knowledge of the vice-comital distribution of bryophytes increased rapidly, and this increase was greatly contributed to by Mr. Jones. The "Census Catalogues of British Hepatics" (1905) and of "Mosses" (1907) were followed by a second edition for "Hepatics" in 1913 and a third in 1926, and a second edition for "Mosses" in 1930.

During the Great War, Mr. Jones was a Government lecturer on agriculture in connexion with University College, Aberystwyth, for which the University of Wales bestowed on him the degree of M.Sc. in 1918. In 1925, he was elected an associate of the Linnean Society, of which he had previously been a fellow (1897–1912). He became vice-president of the British Bryological Society in 1933 and president in 1935.

Jones was born in Liverpool on July 14, 1861, was a schoolmaster at Machynlleth for about six years, then at Harlech until he retired in 1924. After ten months spent in the study of bryophytes and lichens on the Continent, chiefly on the Riviera, he lived four years at Cheltenham, and the last five years of his life were spent at Bristol. His sense of humour, good fellowship and almost uncanny power of detecting rare or strange plants, rendered his presence amongst bryologists or lichenologists delightful and stimulating. W. W.

Mr. Marius Maxwell

BY the untimely death at the age of forty-eight years of Marius Maxwell, which occurred on November 2 at Nice in an accident to an aeroplane which he was piloting, the British Museum (Natural History) and those interested in the study of natural history have lost a keen supporter.

Maxwell had lived a most adventurous life and the manner of his death will come as no surprise to those who knew him best. He was a very generous donor to the Natural History Museum, and many of the specimens which he collected in his early days in Java and northern India have found a permanent home in the National Collection. Chief amongst these may be mentioned the skull of the record Javan rhinoceros (*Rhinoceros sondaicus*) which carries a horn of 10¾ in., and two skulls of the pygmy hog (*Porcula salvanius*) from Bhutan. Amongst his East African donations premier place must be given to the mounted head of a magnificent bull elephant which carries exceptionally long and slender tusks.

In 1911 Maxwell first visited Kenya Colony on a hunting trip between Nakuru and Lake Baringo, when the vast accumulation of game which he found in that country so impressed him that he determined to return later on a photographic expedition. The opportunity to re-visit East Africa did not come for another ten years, when in 1921 he conducted an expedition to the Masai Province and took some wonderful photographs of elephants and giraffes. One of the elephant photographs shows an old bull standing in the attitude of alarm with its ears widely spread; this photograph was taken at a range of 8 yards. It was there that he secured the amazing series of photographs of three elephants sauntering in a forest clearing, when he walked out into full view of the animals and proceeded to take about a dozen snapshots quite at close quarters. The giraffe photographs were some of the first photographs of galloping giraffe to be taken from a pursuing car, and Mr. Maxwell estimated the speed of these animals, when fully extended, as 28–32 miles an hour.

After a short trip to India on business, Maxwell returned to Mombasa in the spring of 1922 and went on another photographic expedition, first to Lake Natron and around the Tanganyika border in the south, and secondly up in the Northern Frontier Province along the Northern Guaso Nyiro. In the latter locality he obtained some excellent photographs of buffalo, elephant and hippopotamus. One close-up of a buffalo is especially awe-inspiring, as it shows the animal debating in its mind whether to charge or not. The elephant photographs taken in the region of the Lorian Swamp and at Abbas Wen are some of the most remarkable records ever made of these animals; this is especially true of the group of advancing elephants which forms the frontispiece of Maxwell's monumental work entitled "Stalking Big Game with a Camera", published in 1924 by the Medici Society. This volume is very handsomely illustrated by a large number of photogravure reproductions of Maxwell's photographs, and will remain for all time a standard work on the subject of East African big game. The volume contains an introduction by Sir Sidney Harmer, and in addition to the chapters on elephants, giraffes, rhinoceroses, buffaloes and hippopotamuses, also has an interesting appendix on the ancestry of the African elephant, and the relationship of primitive elephants to primitive man. The volume concludes with a chapter on some of Maxwell's experiences in hunting elephants in India. This *édition de luxe* was followed a year later by a somewhat smaller and cheaper volume containing the same text and illustrations.

Always seeking after new experiences, in 1925 Marius Maxwell visited the Birunga Mountains north-east of Lake Kivu, in the Eastern Belgian Congo, to study and photograph the Eastern gorilla. He was accompanied by Mr. J. H. Barnes, the well-known white hunter, who had been with him on his two previous trips in Kenya Colony. Although not having very great luck in photographing the gorilla itself, he took some very interesting photographs of the gorilla forests, of their sleeping platforms and of gorilla shelters. Further, he secured a unique snapshot of a female gorilla carrying on her back a young one; this, I think, is the only pictorial record of this method of juvenile transport in this species.

Maxwell had graduated at Zurich and took up the profession of engineering, specializing in the machinery concerned with the manufacture of cane-sugar, and he erected many sugar factories in India. Latterly, he had interested himself in coffee-farming, and lived on a large estate at Thika Bridge in Kenya Colony. He married in 1929 Miss Winifred Ramsay.

GUY DOLLMAN.

Lieut.-Colonel Robert Knowles, C.I.E.

It is no exaggeration to say that tropical medicine has sustained a grievous loss through the early decease, on August 3 at fifty-two years of age, of Robert Knowles after a brave struggle with prolonged ill-health, aggravated by exceptionally hard work which a keen sense of duty would not allow him to relax.

After completing his medical studies at Cambridge and St. Mary's Hospital, Knowles took the first place at his entrance into the Indian Medical Service in 1908 in its palmiest days, and, after some years in military employ, obtained his first opportunities for research under favourable conditions at the Kasauli Institute. Here he began a happy and successful collaboration with his friend, H. W. Acton, and they made important contributions on the subject of snake venoms. Here he also commenced his fruitful work on protozoology in connexion with the halteridium. After the interruption caused by the Great War, when he was severely wounded in Mesopotamia, he took charge of the recently founded Pasteur Research Institute in the beautiful hill station of Assam at Shillong, where his energies and organizing ability found ample scope, and where he commenced his important investigations on kala-azar.

When Sir Leonard Rogers had to return home a few months before he had completed the organization of the Calcutta School of Tropical Medicine, he asked that Knowles should succeed him, and once more he was an outstanding success, and soon became professor of protozoology, with his friend Acton as professor of bacteriology, and during the next sixteen years his work there can only be described as most remarkable. His most outstanding discovery was the demonstration, with the aid of L. E. Napier and R. O. A. Smith, that the sand-fly, *Phlebotomus argentipes*, was the long sought-for carrier of the infection of kala-azar. Later he did valuable work on a parasite of monkey malaria called *Plasmodium knowlesi* after him.

Knowles was equally distinguished for his medico-literary work, and was a clear and prolific writer, his work on medical protozoology being of exceptional merit, and those with Acton on the dysenteries of India, and with S. White on malarial literature in India were of great value. First as assistant editor with Sir John Megaw, and later as editor of the *Indian Medical Gazette*, he raised its standard and contributed invaluable summaries of the advances during each year, at the compilation of which he was a master.

Knowles's short, thickset figure, abounding in energy and enthusiasm, combined with the unselfish and cheerful manner in which he always found time to help any of his colleagues, British or Indian, makes his early loss quite irreparable to his innumerable friends.

Dr. W. F. Sheppard

Dr. W. F. Sheppard, late assistant secretary, Board of Education, died on October 12 in his seventy-third year. He went up to Trinity College, Cambridge, was Senior Wrangler in 1884 (Parts I and II) and was placed in Division I of Part III in 1885. He was elected a fellow of Trinity in 1887. For these particulars we are indebted to the obituary in *The Times*.

The name of Sheppard is well known to mathematical statisticians. In 1898 he published in the *Phil. Trans.* (A, **192**, 101) a memoir "On the Application of the Theory of Error to Cases of Normal Distribution and Normal Correlation", in which the theory is developed by very elegant geometrical methods. It was in this memoir that he gave the noteworthy theorem, that if a fourfold table is formed from a normal correlation table by division at the medians, the coefficient of correlation r is given by

$$r = \cos\left(1 - \frac{2n}{N}\right)\pi,$$

where n is the frequency in either of the positive quadrants.

Much of Dr. Sheppard's work, in the *Proceedings of the London Mathematical Society* and elsewhere, was concerned with the method of finite differences and its applications. By this method he derived the well-known 'Sheppard's corrections' for determining more accurately the moments of a grouped frequency distribution (*Proc. Math. Soc.*, **29**, and *Biometrika*, 5, 1907). For these, and for his tables of the ordinates and integral of the normal curve given in "Tables for Statisticians", his name is known to almost every student of the subject. But his work really covered a considerable range, and we may note, amongst others, papers "On the Statistical Rejection of Extreme Variations" (*Proc. Math. Soc.*, **31**), "On the Use of Auxiliary Curves in Statistics of Continuous Variation" (*J. Stat. Soc.*, **63**, 1900) and on "Graduation by Reduction of Mean Square Error" (*J. Inst. Actuaries*, **48**). Of recent years he does not seem to have written so much on statistical matters, but some time since he made a return to pure mathematics and published through the Oxford Press a small book, "From Determinant to Tensor" (1923).

G. UDNY YULE.

News and Views

Nobel Prize for Chemistry: Prof. P. Debye

THE award of the Nobel Prize for chemistry for 1936 to Prof. P. Debye will give great pleasure to his friends everywhere. Debye's contributions to science have been many, and have covered a wide range of subjects, but they all have certain features characteristic of the man who made them. He combines, in a remarkable way, ability in mathematical analysis with a sturdy sense of physical realities, so that he is able to make bold approximations without invalidating the formulæ at which he arrives. His early training as an engineer, followed by his training in theoretical physics under Sommerfeld, must have contributed to this striking combination of qualities. They have been shown equally by his all-important work on specific heats, on dipole moments in gases, and on the theory of strong electrolytes. He has made notable contributions to X-ray analysis, in particular the 'powder-method', the theory of scattering of X-rays by molecules, and the effect of temperature on X-ray diffraction. He is a delightful and inspiring lecturer. All who know him have the double pleasure of seeing the award so appropriately bestowed, and of being able to congratulate a kindly and delightful friend. Prof. Debye received the Royal Society's Rumford Medal in 1930, and in 1933 was elected a foreign member of the Society.

Nobel Prize for Physics: Prof. Victor F. Hess

THE Nobel Prize for physics for 1936 is divided equally between Prof. Victor F. Hess of Innsbruck for his work on cosmic radiation and Dr. C. D. Anderson of Pasadena for his discovery of the positron. It was Prof. Hess's experiments in manned balloons in 1912 which first definitely proved the existence of penetrating rays which enter the earth's atmosphere from outside. This conclusion followed from the discovery that the ionization in a closed ionization chamber at a height of 4,000 metres was greater than at sea-level, and above this increased rapidly. Hess also showed that the ionization due to this new radiation decreased neither during the night nor during an eclipse of the sun, thus showing that the rays cannot come directly from the sun, so long, at any rate, as the rays travel in straight or nearly straight paths. It was this pioneering work of Hess which led to the view that the penetrating rays were really cosmic in origin. In more recent years, Prof. Hess, besides contributing much to the subject of atmospheric electricity, has paid especial attention to the study of the variation of the intensity of the cosmic rays with time. This work demands very accurate measurements over a period of years, since the variations are complicated and small in magnitude. From these and other similar investigations, a small daily variation has been established with certainty, and probably also a quite small variation with sidereal time of the order of 0·1 per cent. The existence of such an effect was predicted by Compton as a consequence of the assumption that the rays had their origin outside the Galactic System, and about the expected variation was found from the measurements of Hess and Steinmaurer. Prof. Hess's work on cosmic rays has extended over a period of more than twenty-five years, and it is with very great pleasure that all workers in this field now see this work receiving its due recognition.

Dr. C. D. Anderson

DR. ANDERSON's discovery of the positive electron or positron arose also through the study of cosmic radiation. During an investigation of the properties of the rays by means of a cloud chamber in a strong magnetic field, Anderson found certain photographs which revealed the tracks of particles with about the same ionization, and so about the same mass, as electrons, but which were curved by the magnetic field in the direction corresponding to particles with a positive charge. This exceedingly important result was published in 1932 as a short communication to *Science*, in which Dr. Anderson wrote: "For the interpretation of these effects it seems necessary to call upon a positively charged particle having a mass comparable with that of an electron." Thus a new member was added to the select list of fundamental particles. Subsequent work has shown, not only that about half the cosmic ray particles are positrons, but that they are also often produced as one of the partners of pairs of positive and negative electrons, when gamma-rays of high energy are absorbed by matter. These positrons do not live long, as they readily combine with other negative electrons to form more radiation. The discovery of the positron provided the final proof of the validity of Dirac's theory of the electron, for this theory requires the existence of just such a particle.

Dr. Anderson has also contributed greatly to the study of cosmic radiation itself, particularly by his work on the energy spectrum of the rays and of their energy loss in passing through matter. In connexion with the latter, he has recently shown that electrons with energies at least up to 3×10^8 electron volts do suffer the large radiation energy losses which are predicted by theory. During the last year, Dr. Anderson took his apparatus to the top of Pike's Peak at an altitude of 4,300 metres, and there obtained a large number of cosmic ray photographs by the counter-controlled method. Among these are some of the finest shower photographs yet taken. It is interesting to note that Dr. Anderson's communication to *Science*, announcing the apparent existence of a positive electron, was only the fourth paper published by him. Dr. Anderson, who is only thirty-one years of age, must certainly be the youngest experimenter in recent decades to make a discovery of such first-class importance; and now he is also to be congratulated on being surely one of the youngest experimental physicists to receive a Nobel prize.

Edward Meyrick, F.R.S.

Mr. Edward Meyrick will reach the age of eighty-two years on November 24, and his many friends and correspondents all over the world will join with Nature in good wishes and congratulations on his effective life's work. In 1927, when awarded the Captain Scott Memorial Medal by the South African Biological Society, for his study of South African Microlepidoptera, the president justly remarked that "Mr. Meyrick's is an example of what can be done by a single individual, unsupported, with no financial backing, but devoted to a task that fills his life". Meyrick is a Wiltshireman, still residing at Thornhanger, Marlborough. He was a boy at Marlborough College from 1868 until 1873, and a classical scholar of Trinity College, Cambridge. From 1877 until 1886 he was a schoolmaster at Sydney, Australia, and at Christchurch in New Zealand. He returned to Marlborough College as an assistant master in 1887 and continued there until his retirement in 1914. During the last fifteen years of that period, he was president of the Marlborough College Natural History Society, which has been an inspiration to so many young naturalists, many of them now men of distinction. Marlborough is indeed one of the most fortunate of schools, situated in the beautiful valley of the Kennet between Savernake Forest and the wide and open chalk downs of Wiltshire, with its varied fauna and flora. The country-side is famous for dykes, barrows and hill-forts, and the county contains Stonehenge, Avebury, Old Sarum and Silbury; while the British 'mount' of Marlborough stands within the historic grounds of the College, once a British fort, once a castle, once a mansion, once the "Castle Inn" with its memories of Pitt, now a school, and always famous.

The duties of an assistant master at a public school are so arduous and exacting that it is rather rare for a schoolmaster to achieve the distinction of becoming a fellow of the Royal Society. Meyrick was elected in 1904, largely for his work on Australian Lepidoptera. About nine years later he published his "Handbook of British Lepidoptera" (Macmillan), and in 1927 "A Revised Handbook of British Lepidoptera" (Watkins and Doncaster). In these books Meyrick broke away from the older classification based on fugitive characteristics such as wing patterns and colours, and he depended largely, but not entirely, on the more permanent forms of the veins or neurations of the wings. He was familiar with the Microlepidoptera of South Africa, Australia and New Zealand, for he was a great traveller, and a student of the moths and butterflies of the whole world. His study of the insects of Australia and New Zealand caused him to reject the Wegener hypothesis that those regions, once united, had drifted a thousand miles apart. Meyrick had a large viewpoint as a naturalist, and the following have been termed, by Comstock, Meyrick's Laws, though perhaps laws is not quite the right word: "No new organ can be produced except as a modification of some previously existing structure." "A lost organ cannot be regained." "A rudimentary organ is rarely re-developed." Most of Meyrick's work will be permanent; other work has come and more will originate from the many pupils to whom he has handed on the lamp of wisdom and the torch of enthusiasm.

Dr. F. Simon

Dr. F. Simon, who has been appointed to succeed Prof. A. C. G. Egerton as reader in thermodynamics at Oxford (see p. 895), took his degree in Berlin in 1921. He was *Privatdozent* and extraordinary professor of physics there until 1931. From 1931 until 1933 he was director of the physical-chemical institute of the University of Breslau. He was in California for six months in 1932 as a visiting professor. During the last three years he has been working in the Clarendon Laboratory at Oxford on low temperature research, particularly on the production of very low temperatures by the magnetic cooling method, and on the properties of matter in the neighbourhood of the absolute zero.

J. L. Macadam (1756–1836)

The centenary of the death of John Loudon Macadam, which occurs on November 26 (see p. 869), is a reminder of the debt we owe to that group of men who at a critical time in our industrial history were instrumental in making vast improvements in our means of transport. As one of this group, Macadam has a place beside Brindley, the Duke of Bridgewater, Telford, Rennie, Metcalf, Smeaton and others. Macadam was born in Ayr on September 23, 1756. He lost his father in 1770 and as a boy of fourteen years of age was sent to an uncle in New York. Thirteen years later he returned home comparatively well off, and settled down to the life of a country gentleman in his native country. It was as such he began his experiments on road-making, which were eventually to bring him fame if not fortune. It is not a little extraordinary, however, that his main work was done after reaching the age of sixty years, when he was made surveyor-general of roads to the Bristol Turnpike Trust. He resigned this position when sixty-nine, and two years later Parliament appointed him Surveyor-General of Roads. This position he held until his death at Dumcrieff House, Moffat, on November 26, 1836. At one time it is said he had no fewer than three hundred surveyors working under him. The importance of his work was fittingly commemorated at Ayr on October 30 last, when a bronze tablet erected by the Institution of Municipal and County Engineers was unveiled by Mr. Hore-Belisha, the Minister for Transport, and a paper on "John Loudon Macadam, Roadmaker" was read by Mr. G. S. Barry, the County Surveyor, Ayrshire.

Memorial to the late Sir Walter Fletcher

ON November 11, the subscribers to the Sir Walter Fletcher Memorial Fund were invited by the Medical Research Council to view Miss Dora Clarke's portrait-bust of the late Sir Walter Morley Fletcher, secretary of the Council from 1914 until 1933. The ceremony was held at the National Institute for Medical Research, Hampstead, in the library of which the bust is to be placed permanently. Lord Balfour of Burleigh, chairman of the Council, presided. The chief speakers were Prof. G. M. Trevelyan and Sir Frederick Gowland Hopkins, the former dealing mainly with the personal aspect and the latter with Fletcher's scientific and administrative work. Sir Henry Dale, director of the Institute, then accepted custody of the bust. The total amount contributed to the Fund by more than five hundred separate subscribers is approximately £2,300. The remainder, after meeting the cost of the personal memorial, is being used for a Walter Fletcher Memorial Laboratory. This is being constructed at the Farm Laboratories of the National Institute at Mill Hill, and is to be used for research work in nutrition.

Grassland of Great Britain

AT a meeting of the Engineers Study Group on Economics held on November 10, Prof. R. G. Stapledon discussed methods of dealing with the problem of grassland in Great Britain. He exhibited a map of Wales, the result of a recent survey, and pointed out that there are only 16,000 acres of proper pastures (rye grass), although at least a third of the 153,000 acres under bracken is of high potential value. To make the best use of the 18,000,000 acres of rough hill grazing ground in Great Britain, Prof. Stapledon considers that it is necessary for the State to acquire and develop it. This, he believes, would be economically feasible over a period of 25–50 years, beginning at once with an area of not less than 200,000 acres. Agriculturally, the potentialities of the hill land not above the 150 ft. contour (in all, more than 14,500,000 acres) are enormous, at least 20 per cent of that area being amenable to radical improvement. Lowland grass could be used for drying and for wintering, and improved upland grass for summering, and the plough, oats and fatting crops everywhere. Roads and tracks should be constructed in connexion with land improvement and afforestation. Sir Richard Paget, who presided at the meeting, expressed his appreciation of the pioneer work of Prof. Stapledon, and Lord Northbourne, in opening the discussion, stressed the importance of preserving individual initiative.

Temples and Caste in Travancore

THE decision of the Maharajah of Travancore, announced by proclamation authorizing the opening of the temples controlled by the State to all Hindus, according to a Delhi dispatch in *The Times* of November 16, has been hailed by progressive opinion in India as "the greatest reform of Hinduism since Ramanuja's days". By this drastic action, which at once obliterates caste distinction in right of access to the sacred places of religion, and removes one of the most strongly resented marks of inferiority in the outcastes, the State of Travancore has opened a way to political unity which Hinduism at large would do well to accept as a guide and example. The exceptional position of the Rajah in relation to the State religion has endowed him with a power of initiative that was open to few others in India, and perhaps least of all to the British Raj; but whether the example of Travancore will be followed elsewhere will doubtless depend in no small degree upon the religious and political reaction to so serious an innovation. It is said that conservative opinion has already criticized the reform as rash and unsound, while maintaining that the views of Hinduism outside Travancore should have been considered—a claim, of which, in view of past events, it would be difficult to vindicate the political wisdom. On the other hand, the Nationalists and leading members of the Congress, with Mr. Gandhi, have hastened to congratulate the head of the State of Travancore on his decision.

Guide to Ancient Monuments

MR. ORMSBY-GORE'S promise on relinquishing office as First Commissioner of Works to complete the manuscript of that part of the official guide to ancient monuments then in hand, has now been redeemed by the publication of the volume covering East Anglia and the Midlands ("Illustrated Regional Guides to Ancient Monuments under the Ownership or Guardianship of H.M. Office of Works", vol. 3, East Anglia and Midlands. By the Right Hon. W. Ormsby-Gore. London: H.M. Stationery Office. Pp. 72. 1*s*. net). In method of treatment of both the prehistoric and the historic sections this volume follows the plan of its predecessors; but matter of general application in the various periods, which has been given in the earlier volumes, has been omitted. Although it may be agreed that nothing can make a stronger appeal to the historic imagination than Stonehenge and Avebury, which have already been described, the present volume in no other respect falls below those already issued in the importance and interest of the monuments which it includes. As a source of information relating to the industries of neolithic man, Grime's Graves is without rival; while the circle of Arbor Low in Derbyshire, and the megalithic barrows of the Cotswolds each hold a place in British prehistory, of which the importance needs no emphasis. It may be noted, however, that the latter are counted the oldest monuments under the guardianship of the Office of Works. Verulamium, since Dr. Mortimer Wheeler's excavations, is unique both as a British and a Romano-British site. In historic periods the abbeys of Shropshire and the castles, such as Framlingham, stand out among medieval buildings; while Kirby Hall, Northants, is one of the most important of the large country houses of Elizabethan and Jacobean times. For the first time, historic buildings belonging to the Crown appear. These are the Tower, Hampton Court, Kensington Palace, and the Chapter House of Westminster. Of the various periods into which English prehistory and history fall, the Saxon alone does not appear among the historic monuments under protection.

Ethnology of the Far East

THE authorities of the Raffles Museum, Singapore, have added a new series, to be known as Series B, to the Museum Bulletin. The present publication, which will now become Series A, hitherto has been devoted almost entirely to communications of a biological character. The new series will be anthropological, and for some time to come will be devoted largely to publication of the results of a scheme of research in the prehistory of the Malay Peninsula, for which the Carnegie Corporation of New York has voted a subvention extending over a period of three years. In the first issue of the new series are three reports on recent excavations—the first in Kedah by Mr. H. D. Collings, the second in a cave in Bukit Christamani by Mr. M. F. W. Tweedie, and the third on kitchen middens at Guak Kepeh, Wellesley Province, by Dr. P. V. van Stein Callenfels. The most important, as well as the longest, communication is from Dr. van Stein Callenfels, who, in "The Melanesian Civilization of Eastern Asia", contributes a detailed analysis of the Hoabinian stone age culture, so called from the early culture first distinguished in Tonkin, which he traces throughout the East so far as observed from China and Japan to Celebes, and analyses into three stages, in which he sees evidence for contacts between a people of a palæolithic type of culture with another in a protoneolithic stage. In incorporating the new evidence obtained under the present scheme in his analysis, and at the same time making use of the evidence afforded by earlier excavations in the Malay Peninsula, notwithstanding their defects in method, Dr. van Stein Callenfels also turns to the discussion of the position of Wadjak man, to whom he is inclined to assign a date later than the Pleistocene, but to regard him as a very old representative of the Melanesoid culture.

The Consumption of Statistics

IN his inaugural address on November 18 as president of the Royal Statistical Society, Lord Kennet urged the necessity for a more effective consumption of statistics. He affirmed that statistics—in the broad sense of the collection and methodical arrangement of facts—provide the one indispensable food from which the organs of Government can derive the motive power for the right conduct of the business of governing the nation. Decisions made without adequate statistical study on questions of the magnitude and complexity with which modern Governments have to deal, are not in the least likely to be even approximately correct, and the resulting policies and measures would be little better than the medicine-man's sympathetic magic carried out by incantation. Without doubt, then, the Government ought to be the most substantial consumers of statistics. If the Government consumes statistics—and it undoubtedly does to some extent both consume and digest them—the results of Government action seem to show that the metabolism is defective. What part of the organism is at fault? Lord Kennet classified the effective organs of Government as the Press, the wireless, the Civil Service, the Cabinet, the House of Commons, the voters at election time, the local authorities. Which of these is to blame? The fault must be directly attributed to the executive government, but the blame lies fundamentally with their masters, the people, whose national predilection is for 'muddling through', and who believe that scientific study has little practical value. Theory and practice are in reality not opposed but complementary to one another, and the widespread belief to the contrary is responsible for much of the mental lethargy which makes our conduct of affairs what it is—too often a fortuitous muddle.

Coal Gas Research

AT the eighth Autumn Research Meeting of the Institution of Gas Engineers held in London on November 3–4, the papers showed current trends of thought in the gas industries. The thirty-ninth report of the Joint Research Committee of the Institution and the University of Leeds gave the first instalment of a study of the complete gasification of coal in oxygen-steam mixtures. Such a process, if successful, might make the industry less dependent on the choice of coal, and less would be required. At the same time it would have far-reaching consequences on the distributions of fuel. This report contained a study of the conditions within a fuel bed during gasification. Three papers dealt with the sulphur impurity in coal gas. Coal gas is the purest fuel in general use, but this very purity renders possible its use in flueless apparatus, and the small quantity of sulphur compounds present may become noticeable even if innocuous. The paper shows that the coal gas of the future may be purified of sulphur compounds to a degree hitherto unknown. The paper by H. Hollings on the formation and removal of gum in coal gas reveals the solution of a baffling problem which has arisen following the use of the practice of drying gas before distribution. Traces of unsaturated hydrocarbons—almost inconceivably minute—condense or polymerize to form gummy substances which may cause trouble in appliances. The solution of this puzzle is a marked achievement of industrial chemical research. A. R. Bennett and H. Hartley described an instrument for measuring the radiation from heating appliances, which should be serviceable for other uses.

Air-Conditioned Flats

EATON HOUSE, Upper Grosvenor Street, London, W.1, has been converted into a building containing thirty luxury flats. They are equipped for electric cooking and refrigeration, and hot water is supplied from a central hot water plant in the basement. We learn from the *Electrician* of November 6 that each tenant has an air-conditioning plant completely under his own control. Both the temperature and humidity of the air can be adjusted by the tenant to any value he pleases. In each flat there is a condensing unit working in conjunction with an air-conditioner, consisting of a slow-speed fan and motor, heating coils, cooling and dehumidifying coils, air filter and humidifying spray for winter use. The air-conditioners are housed in cupboards in the kitchens of each flat and cleverly concealed. Each conditioner passes approximately 1,300 cub. ft. of air per minute. About twelve complete changes of air per hour are provided in the rooms. It is essential that the plants be practically inaudible as they are in operation twenty-four hours a day. This has been effected by mounting the units in pedestal anti-vibrators. The filtered fresh air enters through grilles in the walls, and as there is no need to open windows street noises, grime and dust can be kept out. A small wall panel in the hall of each flat carries the temperature and humidity control apparatus. It consists of a thermostat, humidistat and change-over rotary switch. An advantage of individual control is that if a flat be left empty, the entire plant can be switched off and thus save running costs. The equipment was designed and installed by York, Shipley, Ltd. of North Circular Road, London, N.W.2. For the electricity the tenants pay a small quarterly fixed charge and ½*d*. per unit.

Testing Switchgear

THE safety of every electricity supply system depends on its switchgear always being ready to operate. The main switches (circuit-breakers) must always be capable of making and breaking the current, and still remain fit for use. The development of the grid system has proved the necessity of being able to 'clear' a fault even when fed by enormous currents. For many years, the firms now constituting Associated Electrical Industries have had extensive experience of short-circuit tests made with generators having capacities up to 80,000 kilovolt amperes. In an article in *Electrical Industries* of October 14, a description is given of a testing station having a generator capable of giving 2,500,000 k.v.a. on short circuit. In order to meet the demand for more tests and for tests at higher powers, the companies interested combined to form a separate company known as the Switchgear Testing Co., Ltd., which now owns and operates the plant on their behalf. The testing station is situated at Trafford Park, Manchester. Ample space had to be provided to ensure personal safety, and, when 'testing to destruction', to avoid damage to property by explosion and fire. The station has three testing areas; two are covered over and used for testing up to 33 kv., and one is an open area, testing up to the grid voltage of 132 kv. The station has a complete equipment for measuring and recording phenomena. Its electromagnetic oscillograph has sixteen elements and is probably the only oscillograph of this kind in the world. It is satisfactory to know that these companies have taken a leading part in conjunction with other firms both in Great Britain and abroad in producing a standard specification for procedure in testing circuit breakers which is recognized internationally.

Marine Work in Ceylon

THE Administration Report of the Marine Biologist, Mr. A. H. Malpas, for 1935 (Part IV—Education, Science and Art (G), Marine Biology: published May 1936) shows that the inspection of the pearl banks again reveals an absence of sufficient spatfalls of both southern and northern paars to provide fisheries within the next three years, despite the presence of sexually mature oysters in sufficient quantity to repopulate the banks. Although conditions of the kind have always been attributed to adverse currents carrying away the free-swimming larvæ into deep water where they are lost, there seems to be some justification for the belief that hydrobiological conditions in the Gulf of Manaar are the more important factors in so far that adult pearl oysters can be stimulated to maximum spawning only under particular conditions of salinity and temperature, which are the exception, rather than the rule, and therefore the pelagic larvæ are not developed in sufficient numbers to produce spatfalls except when these conditions obtain. The scheme referred to in last year's report for the establishment of a Fisheries Research Station at Colombo combined with an aquarium has been modified, and the suggested aquarium available for the public abandoned, a more comprehensive scheme with experimental aquaria and provision for a fish hatchery on a fairly large scale being substituted. This will provide not only for facilities for investigating the bionomics of marine and freshwater animals of economic importance but also for experiments in hatching and rearing the more important freshwater food fishes.

The London School of Hygiene and Tropical Medicine

A REPORT by Sir Austen Chamberlain, chairman of the Court of Governors, giving a short account in non-technical terms of the work of the London School of Hygiene and Tropical Medicine (incorporating the Ross Institute) for the information of those who contribute to its maintenance, has been issued to subscribers. Commencing with a short history of the establishment of the London Tropical School in the hospital of the Seamen's Hospital Society at the Royal Albert Dock, its removal to Endsleigh Gardens, and finally its incorporation in the London

School of Hygiene in Keppel Street, Gower Street, the work of the School for the year ending July 31, 1936, is surveyed. The teaching and research work of the various departments are briefly summarized, as well as additions to, and organization of, the library and museum. The incorporation in the School of the Ross Institute of Tropical Hygiene, and the work this branch is doing, are also dealt with. The report is illustrated with a number of plates, and lists of subscribers and of research publications are included.

Work of the Building Research Board

AT the Building Exhibition, Olympia, 1936, an exhibit was arranged to give the public an opportunity of seeing the nature, methods and results of the investigations of the Building Research Board being carried on at Watford, at Teddington and at Princes Risborough. The D.S.I.R. has issued a descriptive pamphlet, "Building Research Exhibit—Olympia 1936" (Dept. of Scientific and Industrial Research, S.W.1), containing a short explanatory statement of the nature of the work being done in each section and briefly indicating the special features of the exhibit. One of these showed samples of light-weight aggregates with a chart of their physical properties and the methods of testing used. In another section their value for thermal insulation in building construction was demonstrated.

Genetics of the Pig

A MONOGRAPH by A. D. Buchanan Smith, O. J. Robison and D. M. Bryant dealing with this subject (Reprint from *Bibliogr. Genetica*, 12. The Hague: M. Nijhoff) is a summary of all that is known of the genetics of pigs and will be very serviceable to the geneticist as well as the practical breeder. Beginning with the chromosome number and the inheritance of colour in wild and domestic breeds, it goes on to hair and skin characters, blood groups, disease resistance, mental traits, sterility, intersexuality, numerous abnormalities and defects, conformation, productive qualities and methods of improvement in different countries. Twenty-one photographs of different breeds of pig are followed by a bibliography of 28 pages and an index which makes the information readily available.

The *Zoological Record*

THIS essential instrument of zoological research, published under the auspices of the Zoological Society of London, still requires further financial support. The statement of the 'Record Fund' in the report of the Council of the Zoological Society for 1935 shows that the sums received from the contributing societies were just sufficient to meet the loss on vol. 71 for 1934, and that the continuation of the *Zoological Record* is made possible only by the support given to it by the Zoological and other contributing societies. The British Association Committee formed for the support of the *Record* proposes that an annual grant of £50 should be repeated in 1937.

Breeding of King Penguins at Edinburgh Zoological Park

IN 1919, probably the first king penguin bred in captivity was hatched and reared in the Scottish National Zoological Park in Edinburgh, and since that time the number has been added to almost annually. Last year two were reared, and at present there are four king penguin chicks, all hatched at about the same time late in the summer. The work of incubation and rearing the chick is shared by both parents, but the part taken by the mother is almost negligible, the father being responsible for about nine-tenths of the performance.

Wild Animals in Poland

IN the Eastern Carpathians, the *Quarterly Information Bulletin* (Krakow, 1936) states, there still exist about three hundred bears, of which four were killed in 1935. The elk herds now number more than a thousand individuals, their welfare having been aided by the disappearance of an epidemic from which the herds suffered in the previous year, and from a decision to stop the cutting of timber in the elk territories, with the result that the herds, formerly compelled to emigrate, were able to winter in their established districts.

Child Neurology Research

A SPECIAL committee is to be formed with a grant from the fund established by Colonel Michael Friedsam and under the direction of Dr. Bernard Sachs, of New York, to stimulate research in child neurology and allied subjects. The committee is to be composed of two neurologists besides Dr. Sachs, two pædiatrists, one orthopædic surgeon and two laymen. Further information can be obtained from Dr. Bernard Sachs, 116 West Fifty-ninth Street, New York.

Canadian Minerals

THE mineral wealth of Canada is fully reviewed in the annual publication of the Department of Mines ("The Canadian Mineral Industry in 1935." Ottawa. 25 cents). Metals and metallic ores, industrial minerals and fuel are each arranged alphabetically, and under each is a review of producing localities, production, trade and prospective producing localities. Much important information is thus given in a readily accessible form.

Presentations to two Cambridge Botanists

AN executive committee has recently been formed at the University of Cambridge with the view of approaching resident members of the University, past students of the Botany School, and other British and Dominion botanists for subscriptions to a fund for obtaining the portraits, in oils, of Sir Albert Seward, formerly professor of botany, and Dr. F. F. Blackman, formerly reader in botany in the University, both of whom have now retired, for presentation to them. The presentations are intended as a token of personal esteem and appreciation of the great services they have rendered both to botany and to the University. Cheques should be sent to Prof. F. T. Brooks, Botany School, Cambridge, and should be crossed "Portrait Fund".

Announcements

PROF. F. G. DONNAN, professor of chemistry in the University of London, and Sir Albert Seward, formerly professor of botany in the University of Cambridge, have been elected honorary fellows of the National Institute of Sciences of India.

THE next International Congress of Microbiology will be held in 1939 at Atlantic City, New Haven, U.S.A.

THE Medical Research Council has made the following awards: Senior Fellowships to Dr. Frederick Murgatroyd, lecturer in protozoology in the Liverpool School of Tropical Medicine; and Dr. Cecil Hackett, recently engaged in investigations in the Northern Territory of Australia. Dr. Murgatroyd will work in West Africa on the chemotherapeutic treatment of trypanosomiasis, and Dr. Hackett in East Africa on the pathology and clinical manifestations of yaws. Junior Fellowships have been awarded to Gilbert B. Ludlam, clinical assistant in the Sheffield Royal Hospital, and Joel N. Strauss, formerly house physician in the Hospital for Tropical Diseases, London. These are tenable for three years, during the first two of which the holders will undergo training in Great Britain in tropical medicine and in the use of research methods.

THE following appointments and promotions have recently been made in the Colonial Service: W. E. Lewis, to be assistant conservator of forests, Nyasaland; T. W. Summers, to be assistant conservator of forests, Nigeria; L. C. M. Wedderburn, to be assistant conservator of forests, Nigeria; J. E. Turnbull, to be veterinary officer, Tanganyika; T. Bell, to be assistant manager, Government Stock Farm and Agricultural Station, Acre, Palestine; T. A. des Iles, to be veterinary officer, Tobago; D. P. Le Jeune, to be engineer, Water Supply Section, Geological Survey, Nigeria; W. F. Gwilliam (inspector of plants and produce, Gold Coast), to be agricultural officer, Nigeria; R. G. M. Willan (formerly assistant conservator of forests, Nigeria), to be assistant conservator of forests, Nyasaland; G. W. Butcher (chief electrician, Electrical Department, Falkland Islands), to be broadcast officer, Gold Coast; R. W. Donkin (inspector of produce, Zanzibar), to be inspector of produce, Gold Coast.

A STATE-SUPPORTED office for industrial hygiene has been established in West Virginia. Its first concern will be the supervision of silicosis.

THE central offices of the International Council for the Exploration of the Sea have been removed to the Charlottenlund Castle. The new address, therefore, is Charlottenlund Slot, Charlottenlund, Denmark, or, Postbox 20, Charlottenlund, Denmark.

WE are informed that among the presidents of Associations forming the executive committee of the International Union of Geodesy and Geophysics (see NATURE, Oct. 10, p. 650), there should have been included the name of J. A. Fleming, president of the International Association of Terrestrial Magnetism and Electricity. Prof. la Cour, one of the secretaries of the Associations, is from Denmark, and is succeeded by A. H. R. Goldie (Great Britain).

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A University demonstrator in mineralogy and petrology in the University of Cambridge—Dr. F. C. Phillips, Department of Mineralogy and Petrology, Downing Street, Cambridge (November 24).

A head of the Mining Department in the Whitwood Mining and Technical Institute—The Secretary, Education Offices, Castleford, York (November 28).

A scientific officer (electrical engineering or physics) in the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (Quote A.154.(a)) (November 28).

A research chemist in the Department of Clinical Investigations and Research in the Manchester Royal Infirmary—The Director (November 30).

A lecturer in biology in the London (Royal Free Hospital) School of Medicine for Women—The Warden, 8 Hunter Street, Brunswick Square, W.C.1 (December 4).

Chemists in the Department of the War Department Chemist—The Under-Secretary of State (C.5), The War Office, S.W.1 (December 5).

A temporary assistant (Grade III) in the Admiralty Chemical Pool for work on metals at an Admiralty establishment in Sheffield—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (quote No. *C.E.*7123/36) (December 11).

A principal of the Kadoorie Agricultural School, Tulkarm, Palestine—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, London, S.W.1 (December 15).

A second assistant petroleum technologist to the Government of Trinidad and Tobago—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, S.W.1 (December 17).

A professor of applied chemistry in the Andhra University, Waltair, South India—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (December 20).

A professor of chemistry in University College, Southampton—The Registrar (January 1).

A University professor of mechanical engineering in Benares Hindu University—The Pro-Vice-Chancellor (January 15).

A scientific research fellow in Girton College, Cambridge—The Secretary (February 1).

An executive engineer for the Public Works Department of Sierra Leone—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (Quote M/4572).

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 887.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Nature of the Excretion of Nitrogen Compounds from Legume Nodules

FURTHER to our earlier communications concerning the excretion of nitrogen compounds from the nodules of leguminous species, I wish to add the following: a distinct excretion occurs only in media capable of absorbing the excreted amino acids. In water cultures, whether plain or filled with glass beads, the excretion is quite negligible. Addition of cellulose to the liquid medium results in a clearly detectable excretion. A much more powerful excretion occurs, however, in media consisting of kaolin, sand or soil. These materials absorb the excreted amino acids to such an extent that their extraction from the medium with water is very tedious and difficult. On the basis of these observations, it seems that the distribution of the nitrogen compounds between the nodule and the external medium is determined by an equilibrium. The presence of absorbing materials shifts this equilibrium to the side of the medium, and causes the excretion to occur. On the other hand, the host plant also takes up nitrogenous matter from the nodules. The equilibrium is therefore a very complicated one, and the rate of excretion depends largely on the ability of the host plant to utilize the nitrogen compounds fixed and synthesized in the nodules. Our observation that the rate of excretion is the higher, the greater the quantity of sand, is in accordance with this view. We have shown earlier[1] that the air content of the medium influences largely the function of the nodule, although it apparently has no specific effect on excretion, as we assumed earlier.

TABLE I.

3-litre Woulff's bottles; 3·4 kgm. quartz sand; period of growth: May 2–June 9, 1932.
Nitrogen-free nutrient solution. The sand contained initially 2·7 mgm. N per kgm. sand.

	Culture No.	Inoculation	Dry weight		(N mgm.)*			Total fixed N (mgm.)	Excreted N (% of total fixed N.)
			Peas	Barley	Peas	Barley	Sand		
Exp. 1. One pea + one barley in each flask	1	Strain H IV	1·462	1·791	41·8	31·6	89·0	162·4	74·3
	2	,,	2·048	1·660	55·8	21·7	77·4	154·9	64·0
	3	,,	1·382	1·432	42·6	24·4	93·9	160·9	73·5
	4	,,	2·400	0 655	60·7	13·0	67·6	141·3	57·0
	5	None; control	0·297	0 063	6·4	0·7	10·0	—	—
Exp. 2. Two peas in each flask	1	Strain H IV	2·564	—	74·5	—	79·4	153·9	51·6
	2	,,	4·644	—	130·1	—	87·2	217·3	40·1
	3	,,	5·788	—	138·9	—	91·3	230·2	39·7
	4	,,	5·225	—	123·4	—	96·7	220·1	44·0
	5	None; control	0·512	—	14·4	—	9·5	—	—

* All nitrogen values for the inoculated cultures are given after subtraction of the corresponding values for the uninoculated controls.

TABLE II.

Sown May 22, 1934; peas harvested August 4, potatoes September 5. Nitrogen-free nutrient solution.

	4 peas + 1 potato		8 peas + 1 potato		Control not inoculated; 4 peas + 1 potato	
	Dry weight (gm.)	N (mgm.)*	Dry weight (gm.)	N (mgm.)*	Dry weight (gm.)	N (mgm.)*
Pea crop	7·117	169·1	25·310	640·2	1·495	30·4
Potato crop, tops	13·832	330·3	17·510	396·9	2·957	53·9
,, tubers and roots	25·410	287·9	33·173	332·1	8·940	92·4
,, total	39·242	618·2	50·683	729·0	11·897	146·3
Nitrogen in the sand		90·1		115·5		66·6

* Controls not subtracted.

Another fact which is likewise in accordance with the above view is that the rate of excretion seems to increase in associated cultures of inoculated legumes and some non-legumes capable of utilizing the excreted nitrogen compounds. In our sterile culture system in quartz sand, wheat and barley utilize the excreted diamino acid, but only very little aspartic acid. However, even under these conditions, for example, in associated cultures of peas and barley, the amount of nitrogen in the barley and in the sand is generally higher than the amount of nitrogen in sand in cultures of peas alone. This is shown in Table I.

The excretion is particularly powerful in ordinary pot cultures of legumes and non-legumes, when other bacteria decompose aspartic acid and thus enable the non-legumes to utilize the entire quantity of excreted nitrogen. This is especially the case in cultures of peas and potatoes. The latter plant takes up enormous amounts of nitrogenous matter, and may deprive the pea of nitrogen to such an extent that its growth is seriously impaired. Table II shows that the injury to the pea is the greater the less the number of peas in the culture.

It will be seen that in a culture with four peas to one potato plant, the potato has received from the pea nodules about 3·5 times more nitrogen than the peas themselves. Nitrogen in the potato crop has thus increased by 471·9 mgm. and in peas by 138·7 mgm. (after subtraction of the controls). The pea nodules have thus fixed nitrogen mainly for the benefit of the potato, at the expense of the pea. In another pot experiment in which low-nitrogen loam soil was used as the medium, the potato obtained from the nodules ten times more nitrogen than the peas.

Oats, wheat or barley are not able to deprive the peas of nitrogen to a similar extent, although in associated cultures of even these grasses and peas the growth of the latter is impaired with decreasing ratio of peas to non-legumes. This observation, made by us some years ago, is easily explained on the basis of the above view concerning the nature of excretion.

The extent of nitrogen fixation by inoculated legumes is thus not determined solely by the amount of nitrogen taken up by the legumes but also by the amount of nitrogen which is excreted from the nodules. I therefore wish to propose the following terms for general use:

Total fixed nitrogen=Nitrogen given up by the nodules to the host plants and the medium.

Extent of excretion=amount of nitrogen excreted into the medium, as a percentage of the total fixed nitrogen.

In associated cultures the excreted nitrogen naturally also includes the amount of nitrogen received by the non-legumes from the nodules of the legumes.

Our experiments show that the extent of excretion varies greatly with different strains of the nodule organisms. Preliminary observations also seem to indicate that a relatively low nitrate fertilization lowers the excretion much more than the nitrogen fixation. Further work is needed to throw more light on this question.

Further to our earlier communications on the nature of the excreted N-compounds, it should be mentioned that the excreted aspartic acid is the *l*-form. Small amounts of fumaric acid could also be isolated from the extract. The excreted amino-nitrogen can be determined quantitatively, both by the van Slyke method and also with ninhydrine at *p*H 7. This obviates the necessity of concentrating the extract.

Our work on the excretion of the nitrogen compounds from the nodules and on associated cultures of legumes and non-legumes will be published in the *Journal of Agricultural Science*, while our investigations on the chemical nature of the excreted compounds will be described in the *Biochemical Journal*.

ARTTURI I. VIRTANEN.

Laboratory of the Foundation
for Chemical Research,
Helsingfors.
Oct. 13.

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[1] Virtanen and v. Hausen, *J. Agric. Sci.*, ii, 25, 278 (1935).

Identification of Vitamins by Molecular Distillation

WHEN oils containing vitamins are submitted to molecular distillation[1], the fractions removed as the temperature rises contain successively more vitamin until a maximum is reached, after which the potency falls rapidly to zero because all the vitamin has been eliminated. The elimination follows a simple law and the ideal *elimination curve* possesses a slightly skew shape which is easily recognizable. Deviations from the shape indicate imperfect conditions of distillation or the presence of more than one form of the vitamin. The maximum of the curve can be located with an accuracy of ± 2° C., and is as definite a characteristic as a boiling point, if less precise. Separate elimination curves can be detected for more than one material if the maxima are 5° C. apart. When two potent materials yield different maxima, it is proof that they are different substances. Coincident maxima provide only partial evidence that the substances are identical. When oils containing traces of many impurities are distilled, their maxima occur in a fixed order, and if one can be identified, the others may be recognized. This enables dyes, etc., to serve as distillation pilots. For example, when traces of Celanthrene Red 3B and dimethyl-amino-anthraquinone are distilled with an oil containing the free vitamins A and D, the reddest fraction is found to hold the most vitamin A, and the bluest, the most vitamin D. The elimination curves of the two vitamins correspond almost exactly with those of the dyes (Fig. 1).

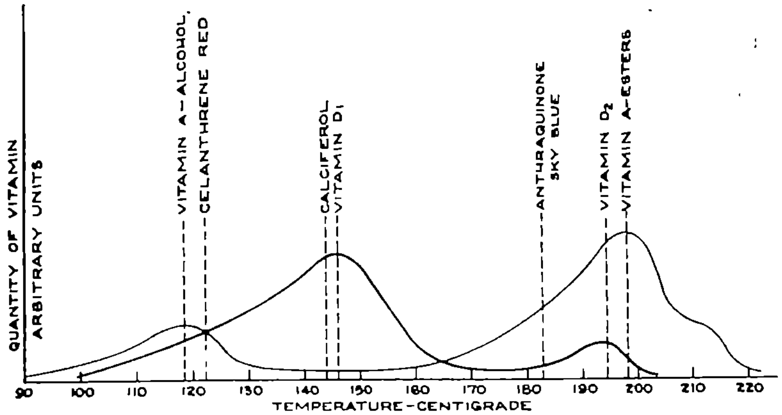

FIG. 1.

Elimination curves can be found more accurately if the distillation is made from an oil which yields a constant quantity of distillate for each equal increment of the absolute temperature. Such an oil can be made by esterifying glycerin with a mixture of fatty acids. By mixing various fish oils with this constant yield oil, it has been found that the vitamin A in the cod liver and halibut liver oils exists almost entirely in the form of esters. The distortion of the curve shows that the esters are derived from most of the fatty acids present. A very small quantity of vitamin A alcohol is also found, the quantity increasing with the lower grades of oil. The vitamin D in cod liver oil yields a maximum halfway between the vitamin A alcohol and esters. The maximum is accompanied by a second high-boiling maximum which grows in relative size as the distillation is performed more quickly and carefully. Evidently vitamin D occurs partly free and partly as a mixture of esters, the esters surviving for only a few seconds at the temperature of distillation.

The maxima of free vitamin D and calciferol are found to coincide within 5° (Fig. 1). Nevertheless, when a mixture of the two is distilled, the maximum is not increased in height, but instead, two new maxima appear separated by 20°. Evidently calciferol and free vitamin D react, producing other antirachitic substances.

Recently, by studying some substituted di-aminoanthraquinones, it has been determined that the maxima are shifted about 5° C. for each additional carbon atom in the side chain. Calciferol is reported by Windaus *et al.*[2] to differ from vitamin D_3 by one carbon atom and one double bond in the side chain. It should be possible to settle the point by measurements of the elimination maxima; and this work is in progress.

The elimination method is being applied to the antirachitic vitamins in various fish oils; the distribution of the esters is found to differ greatly from one fish to another. Should there be more than one form[3] of the vitamin (in yellow fin tunny liver, for example) and if the second differs by one or more carbon atoms in the side chain, a distortion of the elimination curve should reveal the fact.

A fuller description of the work will be published with acknowledgments to those who are contributing.

K. HICKMAN.

Research Laboratories,
Eastman Kodak Co.,
Rochester, New York.
Oct. 9.

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[1] C. R. Burch, *Proc. Roy. Soc.*, A, 123, 271 (1929). E. W. Washburn, *Bur. Stand. J. Research*, 2, 476 (1929). F. E. Carr, Brit. Pat., 415,088; Hickman, U.S. Pat. 1,995,559.

[2] See A. L. Bacharach, NATURE, 138, 387 (Sept. 5, 1936).

[3] C. E. Bills, "Symposia on Quantitative Biology", 3 (1935).

Intermolecular Forces and O—H Absorption Bands in Alcohols at 3μ

THE liquid aliphatic alcohols show in the region of 3 μ two C–H bands, 2870–2890 cm.$^{-1}$ and 2950–2970 cm.$^{-1}$, and a very large and intense band at about 3350 cm.$^{-1}$, which is generally attributed to a fundamental O–H vibration. If we dilute to a very small concentration, we observe for ethyl alcohol in carbon tetrachloride that, at normal temperature, in passing from a concentration of 3·33 mol/lit. to 0·005 mol/lit. and keeping the product concentration by thickness constant, the C–H bands retain their intensity, whereas the large O–H band, which absorbed 90 per cent, has disappeared completely at a concentration of 0·02 mol/lit. A new narrow and well-defined band appears then at 3640 cm.$^{-1}$, and its intensity grows with dilution. The molar extinction coefficient passes from 4, for a concentration 0·05 mol/lit., to 15 for a concentration 0·005, instead of remaining constant. The results for alcohol in carbon disulphide are in complete agreement with those mentioned above.

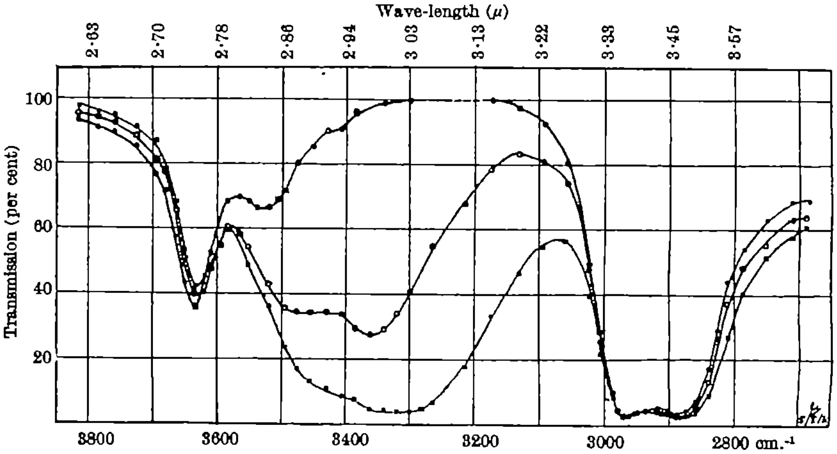

FIG. 1. Absorption of a 5 mm. layer of ethyl alcohol (0 1 mol/lit.) in carbon tetrachloride Bottom curve, at 0° C; middle curve, at 20° C.; top curve, at 70° C.

In our opinion, the band at 3640 cm.$^{-1}$ corresponds to the O–H vibration in the isolated alcohol molecule. With dilution the relative number of monomolecules grows, and this explains the increase in intensity of the band. This result is in agreement with the polarization measurements of C. P. Smyth, continued by K. L. Wolf, as well as his measurements of heat of mixing[1].

The large band which disappears with dilution is, on the contrary, due to intermolecular actions, for example, the hydrogen atom of one molecule vibrating with the oxygen atom belonging to another one (hydrogen bond, as interpreted by Sidgwick[2]).

Temperature effect measurements confirm our opinion. Fig. 1 shows that at 0° the O–H monomolecular band at 3640 cm.$^{-1}$ absorbs 56 per cent and the large band at 3350 cm.$^{-1}$ showing the influence of intermolecular forces absorbs 96 per cent. If we raise the temperature to 70°, the intensity of the two C–H bands remains exactly the same, whereas the band at 3350 cm.$^{-1}$ only absorbs a small percentage, and the intensity of the O–H band of the monomolecules increases and absorbs 64 per cent. Similar measurements on solutions of methyl, butyl, amyl and heptyl alcohols confirm this result.

It seems possible that the large band at 3350 cm.$^{-1}$ can be decomposed into two bands corresponding to different molecular aggregations (polymers).

J. ERRERA.
P. MOLLET.

University,
Brussels.
Oct. 5.

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[1] C. P. Smyth, "Dielectric Constant and Molecular Structure" (New York, 1931). K. L. Wolf, *Trans. Far. Soc.*, Edinburgh Meeting 1936; in the press.

[2] N. V. Sidgwick, "The Electronic Theory of Valency" (1927).

Ultra-violet Luminescence of Sodium Chloride

SINCE the fluorescence and phosphorescence of sodium chloride are extremely weak in the ultra-violet, there have been few investigations of them until now[1]. Our measurements were carried out by a very sensitive photon counter. Samples of clear sodium chloride crystals were exposed to X-rays of 50 kv. and then irradiated by visible light for periods of a few seconds. Investigating the radiations of such crystals with the photon counter, we found a distinct ultra-violet phosphorescence which is remarkably changed if the crystal is plastically deformed.

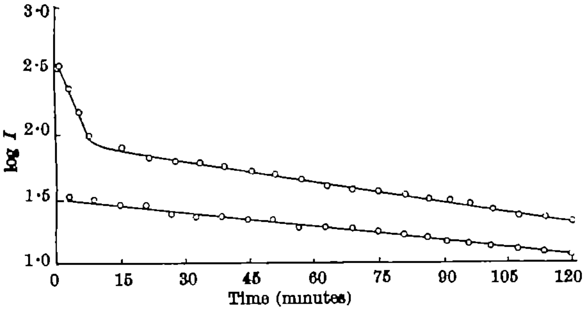

FIG. 1.

Fig. 1 shows the results. Curve I represents the decay of the intensity I of the ultra-violet phosphorescence of a sample of sodium chloride, which is perfectly free from deformation. Curve II shows the same for a crystal which was plastically deformed (bent) after irradiation with X-rays.

Comparing the two curves, it is evident that in the case of the bent crystal there are two monochromatic components in the ultra-violet phosphorescence of sodium chloride. One of these has a short half-life and is only present in deformed crystals while the other one (large half-life) is noticeable in all cases.

We have investigated the wave-length of these two components by means of a quartz monochromator. Component I has the wave-length $\lambda = 2350$ A.; while for component II, $\lambda = 2950$ A.

Comparing these results with the absorption measurements of Hilsch and Pohl[2] we find that component I ($\lambda = 2350$ A.) corresponds to a transition of the electron from the level of the F-centres (*Farb-Zentren*) to the ground-level, whereas component II ($\lambda = 2950$ A.) corresponds to a transition from the level of the F-centres to the level of the U-centres. It is interesting to find that the transition probability of component II is greatly dependent on the degree of deformation of the crystal.

Finally, we measured the excitation curve of the ultra-violet fluorescence of sodium chloride and we got more information about the origin of component II. The results of these investigations will be published later.

M. SCHEIN.
M. L. KATZ.

Physical Institute,
University,
Odessa.
Sept. 18.

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[1] J. O. Perrine, *Phys. Rev.*, 22, 48 (1923). W. Kudrjawzewa, *Z. Phys.*, 90, 489 (1934). Otto Glaser and F. E. Beasley, *Phys. Rev.*, 47, 570 (1935).

[2] R. Hilsch and R. Pohl, *Götting. Nach.*, 46, 322 (1933), 52, 406 (1933); 1, 115 (1934).

Ultra-violet Band Systems of the Emitters GeCl and GeBr

THE available data for the band systems of diatomic halides of Group IV(b) elements are fragmentary and give conflicting indications of the nature of the ground states, for which either $^2\Sigma$ or $^2\Pi$ is theoretically possible, and the latter has been regarded as more probable[1]. We have recently made observations of band systems of GeCl and GeBr, which seem to clarify the situation considerably.

Through the kindness of Sir Gilbert Morgan and Dr. G. R. Davies, we have been able to use a quantity of their germanium and germanium dioxide for the preparation of the tetrachloride and tetrabromide. Heavy-current tube-discharges through the vapours of these compounds develop the desired band systems with sufficient intensity to be photographed in a quartz Littrow spectrograph (Hilger's E 1). Each system consists of bands degraded towards shorter wave-lengths, the band-heads being represented approximately by:

$$\text{GeCl}: \nu = \left\{\begin{matrix}33{,}992\cdot2\\33{,}017\cdot2\end{matrix}\right\} + (526\cdot6\,u' - 0\cdot3\,u'^2) - (408\cdot4\,u'' - 1\cdot6\,u''^2)$$

$$\text{GeBr}: \nu = \left\{\begin{matrix}33{,}413\cdot4\\32{,}263\cdot4\end{matrix}\right\} + (388\cdot7\,u' - 0\cdot7\,u'^2) - (296\cdot6\,u'' - 0\cdot9\,u''^2)$$

where $u' = v' + \frac{1}{2}$ and $u'' = v'' + \frac{1}{2}$.

The observed electronic separation in germanium chloride is, as would be expected, intermediate between those in the lowest states of SiCl[2] and SnCl[3,4] and smaller than that in GeBr. Analogy suggests that these two separations of 975 cm.$^{-1}$ and 1150 cm.$^{-1}$ occur in the lower (presumably the ground) states of GeCl and GeBr. The first of these emitters has the same number of electrons and nearly the same mass as SiBr, the lower electronic state of which is apparently single[5], while the second stands in the same relation to SnCl, the lowest state of which is known[4] to be $^2\Pi$. For each of these iso-electronic pairs certain similarities in the results of analysis of the band systems are to be expected, and are, in fact, observed, except in regard to the lack of electronic doubling in SiBr.

A possible explanation of the apparent anomaly in the lower state of SiBr may lie in the fact that the electronic separation to be expected is of the order 400–450 cm.$^{-1}$, which is rather near the separations of the vibrational levels, $424\cdot6u'' - 1\cdot3u''^2$, and may thus be difficult to recognize; and if it happened to lie between, say, 420 and 425 cm.$^{-1}$, it might well pass entirely unnoticed in the analysis of the band system with the dispersion hitherto employed. A study of the intensities of the bands seems to support this suggested explanation. The further apparently anomalous case of the lead halides[6,7] has already been discussed.

1. Electronic energy ν_e of upper state

	F	Cl	Br
Si	34,639	34,103	33,570
Ge	—	33,992	33,413
Sn	—	33,582	—
Pb	32,565	21,867	20,884

2. Electronic interval $\delta\nu_e$ in lower state

	F	Cl	Br
Si	161	208	—
Ge	—	975	1,150
Sn	—	2,360	—
Pb	—	—	—

3. Value of ω_e'

	F	Cl	Br
Si	1011·2	(698·7)	578·3
Ge	—	526·6	383·7
Sn	—	432·5	—
Pb	397·8	228·6	152·5

4. Value of ω_e''

	F	Cl	Br
Si	856·7	535·4	424·6
Ge	—	408·4	296·6
Sn	—	353·5	—
Pb	506·9	304·2	207·5

The above tables of data for this *MX* group show that the electronic separations $\delta\nu_e$ in the lower states, the electronic energies ν_e of corresponding upper states, and the vibrational frequencies ω_e' and ω_e'', all have the expected trends as the mass of M or X is increased, namely, a slight decrease of ν_e, an increase in $\delta\nu_e$, and decreases of ω_e' and ω_e''.

L. A. BASHFORD.
H. V. A. BRISCOE.
W. JEVONS.

Imperial College,
London, S.W.7.
Oct. 22.

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[1] R. K. Asundi and R. Samuel, *Proc. Ind. Acad. Sci.*, **3**, 346 (1936).
[2] W. Jevons, *Proc. Phys Soc*, **48** 563 (1936).
[3] W Jevons, *Proc. Roy. Soc.*, A, **110**, 365 (1926)
[4] W. F. C. Ferguson, *Phys. Rev.*, **32**, 607 (1929).
[5] E. Miescher, *Helv. Phys. Acta*, **8**, 587 (1935).
[6] G. D Rochester, *Proc. Roy. Soc.*, A, **153**, 407 (1936).
[7] F. Morgan, *Phys. Rev*, **49**, 47 (1936).

SINCE writing the foregoing letter, we have obtained evidence for the correctness of the explanation there suggested of the apparent lack of electronic doubling in the lower state of SiBr. Some time ago we obtained spectrograms in the Hilger *E* 1 instrument of a heavy-current tube-discharge through $SiBr_4$ vapour in order to see whether an alternative to Miescher's arrangement (*loc. cit.*) of the SiBr band-system was possible. Miescher's analysis was confirmed, but several of the band-heads were found to have a companion, about 4 cm.$^{-1}$ towards the red, which he did not record. The additional heads could not be included in Miescher's analysis or be explained as a Br isotope effect or be ignored. It now appears that they constitute a fragment (including 1 → 0, 0 → 0 and 0 → 1 band-heads) of the expected sub-system, and are accounted for by the smaller of the two independent coefficients in the following provisional formula for the whole system,

$$\nu = \begin{Bmatrix} 33{,}571\cdot 2 \\ 33{,}147\cdot 2 \end{Bmatrix} + (574\cdot 8u' - 4\cdot 0u'^2) - (424\cdot 7u'' - 1\cdot 4u''^2).$$

Apart from the inclusion of this smaller coefficient, the formula differs only slightly from Miescher's. Comparison with other band systems of the same group of emitters suggests that the electronic separation of 424 cm.$^{-1}$ now observed belongs to the lower ($^2\Pi$) state. Thus the anomaly to which we referred disappears.

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H. V. A. BRISCOE.
W. JEVONS.

Oct. 30.

Geometrical Constitution of Silicichloroform

POLARIZATION measurements of Raman lines of chloroform made by Cabannes[1] and discussed by him show that this molecule has not a perfect pyramidal symmetry. On the other hand, recent electron diffraction measurements discussed by Degard[2] are not able to fix with precision the position of the carbon atom in the chloroform molecule. Is it so, also, for silicichloroform ? To measure the state of polarization of the Raman lines of silicichloroform we employed the same method as that used by Cabannes. Optical parts of the instrument were made by the Société Belge d'Optique ; we have to thank M. Cailler, director of that company, for his kindness. The spectrograph used was a Hilger *E* 443. The following results were obtained :

$HCCl_3$	ω :	261	758	365	667	1218	3019
	ϱ :	0·7	0·68	0·22	0·06	6/7	0·32
$HSiCl_3$	ω :	179	587	250	489	799	2258
	ϱ :	0·846	0·74	0·29	0·056	0·79	0·20

It appears that conclusions similar to those for chloroform apply in the case of silicichloroform. The number of Raman lines is in favour of a pyramidal structure of $SiCl_3$. Their classification compared with that of chloroform is given in the above table. The value of 0·846 and 0·740 given for 179 and 587 are greater than 0·7 and 0·68 for chloroform, showing that the $SiCl_3$ pyramid is more regular than the CCl_3 pyramid.

We have also examined silicichloroform by electron diffraction methods, using for this purpose a de Laszlo apparatus. We obtained the following results :

$$\text{Si–Cl} = 2\cdot 05\ \text{A.} \quad \text{Cl–Cl} = 3\cdot 39\ \text{A.}$$

The distance Cl–Cl is not quite in agreement with that given by L. O. Brockway[3], but agrees well with some preliminary unpublished results obtained by the X-ray diffraction method which have been very kindly communicated to us by Pirenne in Liège. Both distances, Si–Cl and Cl–Cl, show that $SiCl_3$ must be a pyramid of height 0·65 A. and angle ClSiCl = 113° 30′.

MARC DE HEMPTINNE.
J. WOUTERS.

Physical Laboratory,
University, Louvain.
Oct. 21.

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[1] Cabannes et Rousset, *Ann. Phys.*, **19**, 229 (1933).
[2] Degard, *Soc. Chim. Belg.*, **45**, 15 (1936).
[3] L. O. Brockway, *Rev. Mod. Phys.*, **8**, 231 (1936).

Natural Selection

IN NATURE of October 17, there appears a letter by my friend Prof. Hale Carpenter entitled "Insect Coloration and Natural Selection", written in answer to one of mine on natural selection published in these columns a few weeks previously. I maintained that "natural selection" was an "explanation" neither of mimicry nor of any other biological phenomenon whatever. Prof. Carpenter does not meet my arguments, but merely reiterates his conviction that natural selection is the only explanation which will enable us to account for mimicry.

I wish to restate my main argument more concisely and particularly. 'Natural selection', that is, the survival of the few amongst the many born, is a mere truism which we all accept. But 'natural selection' *as an explanation of evolution* implies the constant occurrence of random heritable variations in all directions, so that any conceivable demand of the environment may be met by some variation. In a word, it is the doctrine of evolution by pure chance.

Do such random heritable variations really occur ? The experimental evidence entirely negatives this assumption. Ordinary fluctuating variations which can be graphically represented on a 'curve of error' are certainly not inherited. This has been proved by the 'pure line investigations' carried out by Johannsen on the bean, by Agar on the crustacean *Simocephalus* and by Jennings on the protozoan *Paramecium.* When the same results are reached by the examination of a flowering plant, a crustacean and a protist—organisms belonging to as diverse groups of living things as could be well imagined—it is surely just to conclude that these results express a universal law.

However, heritable deviations from the normal, formerly known as 'sports' but now as 'mutations', undoubtedly do crop up in the farmyard and in the cultivated field and garden. Can they furnish the material on which 'natural selection' can work so as to produce evolution ? The answer from experiment is again decidedly no ! Mutations have been produced by subjecting the eggs of insects to heat and to X-rays. These agents kill a large number of eggs; some survive unhurt and a few are half-killed and give rise to mutations. Mohr, the greatest European authority on *Drosophila* work, arranged all the mutations observed in this insect on a scale which he compared to the colours of the spectrum: the slightest were at the red end and the most pronounced at the violet end. All produced a loss of viability and vigour which was proportionate to the extent of the mutation. That such weakened specimens could ever give rise to a new natural race is utterly incredible.

I am aware that desperate attempts have been made by the apostles of chance to save the situation. It has been asserted that mutations may be very small, and that there is no proof that such mutations affect the health of the individual. Hence they may be even beneficial. This seems to one to be equivalent to saying that a pimple is of a totally different nature from a boil because it does not noticeably raise the temperature. The best disproof of the theory that any mutation can be beneficial and even give rise to a racial character is the well-known fact of reversion. When any mutant is returned to wild natural conditions and *survives*, it goes back to the original wild type. A beautiful example of this reversion was furnished me by a very distinguished botanical colleague. The common flowering plant *Calceolaria* is a native of Mexico and produces bright yellow flowers. As all are aware, gorgeously coloured garden varieties of this flower are cultivated. My friend in visiting the hill stations of India saw these varieties in the gardens of the residents there: the plants had in many cases escaped on to the hillsides and, in every case, had reverted to the wild *Calceolaria* and produced yellow flowers.

Thus the 'selectionist' is shut in between the jaws of a vice and deprived of the material for evolution. The only escape is by means of the heritability of long-continued acquired habit, which has now been amply demonstrated. That evolution, so far as structure is concerned, is an infinitely slow process was shown by Woltereck, when he demonstrated that 16,000 years has been required to convert the small Crustacea inhabiting the post-glacial lakes of Bavaria—not into new species—but into new varieties.

When, therefore, Prof. Carpenter asks how I account for the colours and shapes of the insect mimics, I reply that I do not attempt such a futile task in the present state of our knowledge. Only when we know in infinite detail the steps of the process by which the mimicking pattern has been produced can the task be profitably attempted. If Prof. Carpenter really wishes to know how the evolution of colour proceeded, let him go to the museum at Tring. There he will see trays containing hundreds of insects of the *same* species; different trays are taken from adjoining localities, and as one passes along them one sees the gradual change of colour with locality, until if one compares the end terms in the series one seems to be looking at two different species.

I shall conclude by giving one charming instance of "evolution by natural selection" supplied me by a friend and colleague on the staff of the Plymouth Marine Biological Station. The angler fish, as all marine biologists know, fishes for its prey by a flexible rod with a bait at the end. The rod is one of the dorsal spines: the bait a bit of glittering skin. But the angler is not an indiscriminate devourer of all that comes its way. When it sees a sea-bream approaching, it lays back its rod into a groove and makes no attempt to catch the fish, which has a row of hard dorsal spines and is a most unpleasant morsel to swallow. But when the angler sees a pollack, it erects the rod and dangles the bait so as to lure the fish within reach of its powerful jaws—for the pollack is a soft-spined fish. So we see how by a series of "beneficent mutations" hard spines have been gradually acquired by the sea-bream in order to protect it against the angler.

The only difficulties about this explanation are: (1) that hard spines are an original and primitive characteristic of teleostean fish and date back to the Mesozoic epoch, and are also characteristic of many families that never have any opportunity of coming into contact with an angler; (2) that the unprotected pollack are one of the most abundant species of fish, which exist and swarm in countless millions in all northern seas and are quite indifferent to the toll levied on their numbers by the angler.

Selectionist theories tested in the field wear a very different aspect from that which they exhibit in the study.

E. W. MACBRIDE.

West Bank,
near Alton,
Hampshire.
Nov. 2.

Regeneration in Arachnida

IN view of the remarks made by Mr. T. H. Savory[1] on the failure of a harvestman (Opiliones) and of *Pholcus Phalangioides* (a spider) to regenerate lost limbs, the following observations appear relevant.

In 1932 and 1933 it was found that four males of the spider *Theridion ovatum* Cl. (*Phyllonethis lineata*) failed to regenerate front legs removed one and two days after the penultimate cast. Fourteen males failed to regenerate first legs and thirteen to regenerate lost palpi. In one male there was no regeneration at all of a palp lost in the anti-penultimate instar. With *Linyphia triangularis* Cl., four males failed to regenerate front legs and in one case second legs, but in only three cases were the results significant (the amputations being then made thirteen and fourteen days before the last moult). Eight males failed to regenerate palpi the femora of which were severed; two cases were significant. The palpi of two males were partly regenerated after amputation of the joint between femur and tibia; one specimen found without a palp in the penultimate instar developed an incomplete one after the last moult. These were all the experiments made.

Cases of non-regeneration in *Dolomedes* are recorded by Bonnet[2], who deals with the whole question of regeneration in great detail and points out that a limb is regenerated as a rule if the interval between the amputation and the following moult is not less than three quarters of the time separating the moults.

Savory states that failure to regenerate a leg "might be related to the contrast between the length of the limbs and the shortness of the cephalothorax, within which it would be impossible to develop a leg long enough to be useful when exposed by ecdysis". This would imply that the new limb is developed within the cephalothorax, whereas it was shown first by Blackwall[3] and most recently and conclusively by Bonnet[2] that the new limb is formed spirally within the remaining part of the old one, even if the coxa alone remains.

It is scarcely likely therefore that the relative size of cephalothorax and legs has much to do with the problem. Moreover the palpi which, especially in the male spider, are of the greatest use, are sometimes not replaced, and they are comparatively small compared with the cephalothorax.

G. H. Locket.

Science Schools,
Harrow.
Oct. 29

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[1] T. H. Savory, Nature, 138, 550 (1936).

[2] P. Bonnet, *Bull Soc. d'Hist. Nat. Toulouse*, ii, 59, 287–700 (1930).

[3] J. Blackwall, *Ann. Mag Nat. Hist*, 15, 234 (1845).

The Common Stick Insect

Since 1910, we have bred a continuous supply of the common stick insect (*Carausius*). These are lodged in a glass rectangular case 18½ in. × 9 in. × 15½ in. fitted with a movable glass front. Two glass vases holding ivy leaves in water furnish food and moisture for the insects. The debris is removed from the case once a fortnight, when fresh food and water are supplied. The eggs which lie about in the debris are picked out and placed in a small box which is kept inside the cage, so that they are subject to the same temperature and moisture conditions as the adults. There is always a mixed population of insects in the cage, ranging from newly hatched individuals to one year old adults.

We found that during the very sunny months of the year, the excessive transpiration of the ivy leaves made the air in the chamber too damp and so favoured the growth of mould over debris and elsewhere. To afford more efficient ventilation, we removed the glass sliding door and replaced this by a piece of cotton veiling of 1/16 in. hexagonal mesh. This was not new material. It had been washed several times, but it was quite strong. The adults particularly made their way to the netting and clung to it.

On account of the exigencies of vacation in 1936, the stick insects had been left unattended for three weeks. At the end of that time, all the ivy had been consumed. Small holes were noted in the net when the food supplies were renewed. The netting was replaced. At the end of another three weeks, the food supplies were all eaten and the netting had been attacked more vigorously. On this occasion several holes were ½ in. in diameter, and the smaller holes ¼ in. in diameter were evenly disposed all over its area. Judging by the absence of fibrous material around these holes, it seems certain that the cellulose is eaten by the insects. (A specimen of the netting was kindly examined in the Textile Research Laboratory of Leeds and pronounced to be cellulose.) This experiment slightly modified was repeated, one isolated adult making a hole of diameter 1 in. The insects make no attempt to escape by these holes, whether or no because of anatomical impossibility we have not been able to decide.

Younger adults were then used for the experiment. They similarly attacked the material greedily.

Lastly, a piece of twill calico well washed was placed in front of the cage and the insects were given sufficient food. This also has been attacked, though as one would expect, the holes are smaller and are not produced so quickly.

Carmela Hayes.

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Dowanhill, Glasgow.
Nov. 1.

Raman Effect in Absolute Perchloric Acid

According to recent views, hundred per cent liquid oxacids are pseudo-homogeneous substances, composed of covalent hydroxyl compounds partly associated by means of the unsaturated hydroxyl group. In a few cases, some of the acid molecules may act as proton acceptors, thus forming an acidium salt, accounting for the electroconductivity of the pure acid.

Thus in the case of pure perchloric acid, we have following equlibria :

$$2\mathrm{HOClO_3} \rightleftarrows (\mathrm{HOClO_3})_2 \rightleftarrows [(\mathrm{HO})_2\mathrm{ClO_2}]^+ + [\mathrm{ClO_4}]^-$$

If a little water be added, there is competition for protons between $HOClO_3$ and H_2O molecules, with water being successful, since it is a stronger acceptor than perchloric acid. In this way, a solid hydronium salt may be formed, the X-ray diffraction pattern of which is, according to Volmer[1], the same as that of ammonium perchlorate. If further water be added, it is used for the hydration of the hydronium and perchloric ions.

$$\underbrace{\mathrm{HOClO_3} + \mathrm{H_2O}}_{\mathrm{H}^+} \rightarrow [\mathrm{H_3O}]^+[\mathrm{ClO_4}]^- \rightarrow [\mathrm{H(H_2O)}_x]^+[\mathrm{ClO_4(H_2O)}_y]^-$$

If this be true, the Raman spectrum of absolute perchloric acid must be quite different from that of perchloric acid in solution, and some information regarding the nature of the molecules and ions present may be obtained.

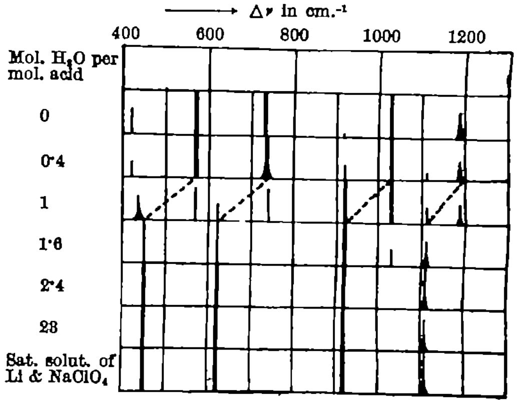

Fig. 1.

Fig. 1 represents the results of our examination of perchloric acid solutions : molten monohydrate (at 50° C.), pure perchloric acid and saturated solutions of lithium and sodium perchlorates. The figures clearly show that perchloric acid solutions up to 70 per cent (2·4 mols. of water) produce exactly the same Raman lines ($\Delta\nu$ = 450, 620, 922, 1110 cm.$^{-1}$) as the salt solutions. The nature of the radical corresponding to these lines, which is the ClO_4^- ion, is consequently identical in both cases. When the concentration of perchloric acid becomes higher, all these lines diminish in intensity, while other new lines appear and increase in intensity. The spectrum of pure perchloric acid shows four main lines of frequency number 570, 730, 1026, 1190 cm.$^{-1}$, which have the same aspect and relative intensity as the corresponding lines of the ClO_4^- ion. Therefore, the structure of the perchloric acid molecule cannot be very different from that of the perchloric ion, being a point-symmetrical one; only the binding forces are greater. Furthermore, the fact that the strongest line of the perchloric ion ($\Delta\nu = 922$ cm.$^{-1}$) persists even in the pure acid, suggests that the formation of an acidium salt is real, though the lines due to its cation are failing. In fact, the addition of a proton to the acid molecule changes but little the vibrating masses, and probably causes only a slight shift of some of the lines towards lower frequencies. The broadening and shifting of line 730 cm.$^{-1}$ is perhaps due to the disappearance of the complex cation.

In connexion with the presence of an acidium salt, the associated molecules give rise to a vibration of low frequency ($\Delta\nu = 422$ cm.$^{-1}$). Owing to the weakness of this line and to the great fluidity of pure perchloric acid, this association cannot be very strong. In presence of water, the association diminishes, while the acidium salt disappears. When both an acid and a water molecule are present, the following molecules and ions exist side by side:

$$(HOClO_3)_2,\ HOClO_3,\ ClO_4^-.$$

Consequently, the hydronium salt is not a homogeneous one. Even in solutions containing 1·6 H_2O molecules, there exist undissociated acid molecules. We think that this may be the case in solutions of perchloric acid of concentration higher than 72·3 per cent (2 mols. H_2O). The acid of constant boiling point would have therefore the composition $[H(H_2O)_2]^+[ClO_4]^-$.

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Oct. 21.

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[1] *Lieb. Ann.*, 440, 200 (1924).

Points from Foregoing Letters

EXPERIMENTS by Prof. A. I. Virtanen show that legume nodules excrete more nitrogen compounds in the presence of kaolin, sand or soil than in water cultures. The excretion is helped by the presence of other plants (barley, potatoes). The author considers that the distribution of the nitrogen compounds between the nodule and the external medium is determined by an equilibrium, and the removal of the compounds, either by adsorption on sand, etc., or their utilization by other plants, leads to further secretion. In certain circumstances, potatoes when grown with peas actually acquire more nitrogen compounds than the peas themselves.

Identification of vitamins present in oils by means of special vacuum ('molecular') distillation is reported by Dr. K. Hickman. The amount of vitamin distilled with the oil over a range of temperature follows a typical 'elimination' curve, and the presence of different vitamins or vitamin compounds can be detected by irregularities in the curve. With this method the author finds that vitamin A in cod liver and halibut liver oils exists almost entirely in the form of esters, while vitamin D (in cod liver oil) occurs partly free and partly as a mixture of esters.

Prof. J. Errera and Dr. P. Mollet bring forward evidence to show that the large absorption band at about 3350 cm.$^{-1}$ in liquid alcohols is not the fundamental O–H band of the isolated molecule, for it is strongly affected by intermolecular forces. The O–H band of the monomolecule appears in dilute solutions or at higher temperature at 3640 cm.$^{-1}$.

Curves showing the ultra-violet luminescence of crystals of sodium chloride, normal and deformed, which were exposed to X-rays and then irradiated by visible light, are submitted by Prof. M. Schein and M. L. Katz. The normal crystals emit ultra-violet light of wave-length 2350 A., while the deformed crystals give, in addition, ultra-violet light of wave-length 2950 A., but of shorter duration. The measurements were carried out by means of photon counters.

L. A. Bashford, Prof. H. V. A. Briscoe and Dr. W. Jevons announce the discovery and analysis of an ultra-violet band system of both GeCl and GeBr, and find that the lower (presumably the ground) states are electronic doublets (probably $^2\Pi$), separations of which are of the orders to be expected from analogy with diatomic halides of other Group IV(b) elements. A possible explanation of the non-detection of a similar doubling in the lower state of SiBr is suggested. In a subsequent letter the authors state that they have observed this doubling in new SiBr spectrograms.

Measurements of the polarization of the Raman spectrum lines of silicichloroform, $HSiCl_3$, carried out by Prof. M. de Hemptinne and J. Wouters, indicate that the pyramidal arrangement of the $SiCl_3$ group of atoms, though not perfect, is more regular than that of the CCl_3 group in chloroform.

Reverting to the controversy around natural selection, Prof. E. W. MacBride states that it cannot explain evolution because ordinary random variations are not inheritable. Further, he considers that mutations can never be beneficial, but lead to loss of viability and consequently cannot produce new races. Prof. MacBride sees the solution of the evolution problem in the heritability of long-continued acquired habit, which, he states, has been amply demonstrated.

G. H. Locket supplies additional instances of spiders failing to regenerate lost limbs and feelers. He refers to opinions of previous investigators concerning the factors which may influence regeneration or the lack of it.

Sister Carmela Hayes reports observations on the common stick insect (*Carausius*) which show that these insects eat cellulose (in the form of calico) even when sufficient food, in the form of ivy leaves, is available.

Diagrams showing the Raman spectra of perchloric acid, pure and in various aqueous dilutions, also of saturated solutions of lithium and sodium perchlorates, are given by R. Fonteyne. From the identity of the lines produced by the salt solutions and solutions of the free acid up to seventy per cent concentration, and their similarity with those of pure perchloric acid, the author concludes that the structure of the perchloric acid molecule cannot be very different from that of the perchloric ion. He considers that when both acid and water are present, then $(HOClO_3)_2$, $HOClO_3$ and ClO_4^- exist side by side.

Research Items

South Indian Blood Groups

A STUDY of the blood groups of a jungle tribe (Pre-Dravidian), the Panīyans of Wynad, has been made by Mr. A. Aiyappan of the Government Museum, Madras (*Man*, November). This tribe was selected as being more isolated and in a purer state than most other Pre-Dravidians. No great degree of admixture with them has taken place, owing to the sexual jealousy of the tribal code. Until recently they were very wild. The Australians, Veddahs and Panīyans, notwithstanding close resemblances, are differentiated by several anatomical characters, especially of the face. The Panīyan is infantile and prognathous, whereas the Veddah is orthognathous; and the supraciliary ridges of the Panīyan are less prominent than in either Australian or Veddah. Nothing is known of the blood-typing of the Veddahs, and comparison is therefore restricted to the Australians. Two hundred and fifty Panīyans from three different settlements were tested. The following results were obtained: *O*, 20 per cent; *A*, 62·4 per cent; *B*, 7·6 per cent; *AB*, 10 per cent. The Australian figures are: *O*, 57 per cent; *A*, 38·5 per cent; *B*, 3 per cent; and *AB*, 1·5 per cent. Thus though there is no close resemblance between the two sets of data, they agree in having a low percentage of *B*. Von Eickstedt makes an interesting suggestion that the Pre-Dravidians may be regarded as the Palæ-Europid type, and this the blood grouping supports. In a correlation table the Panīyans will be placed very near the Lapps and other peoples of western Europe. The Panīyans show a much lower percentage of *O* than the Australians; but Cleland, typing a sample of central Australians, found 38·1 per cent *O* and 61·9 per cent *A*. If further research confirmed this bigger series, we should be able to say that serologically the Australians and Panīyans are closely linked.

Pawnee Archæology

THE Pawnee Indians of Nebraska and Kansas, who formerly occupied permanent villages in the Platte and Loup Valleys and on the Republican in the present State of Nebraska, have been known to the white man since 1541, when they may have been visited by Coronado, and certainly since 1673, when Marquette, the French Jesuit, noted them in his map at some distance north of the Kansa. They were the most numerous and powerful of the tribes constituting the Caddoan linguistic stock, and one of the most important in the Plains area. The tribal organization consisted of four endogamous bands, each functioning as an independent unit, but with the principal chief of the 'Grand' band acting as spokesman for the whole on occasion. One band, the Skidi or "Wolf" Pawnee, seems to have had a different ancestry, or to have been an earlier offshoot from the parent stock, as this branch was less closely bound to the others. A persistent tradition places their original habitat in the south or south-west, while another associates them with stone-built houses, although in fact there is no evidence of a Pueblo connexion. Archæological remains, surprisingly rich and numerous, have been discovered at many of the village sites formerly occupied by the tribe. These, with the documentary history and traditions of the tribe, have been made the subject of detailed examination by Mr. Waldo Rudolph Wedel (Bull. 112, Bureau Amer. Ethnol.). The conclusion at which he arrives is that the material traits in Pawnee culture are drawn in large measure from the east and south-east. They formerly constituted part of the south-east Woodland culture area in its more western peripheral phase, retaining and disseminating many of the traits they acquired throughout the period of their northern residence, until Plains culture disappeared before the European contact.

Treatment of Cancer with an Enzyme Solution

BULLETINS will be issued from time to time by the Hendry-Connell Research Foundation, which will unite in one publication the laboratory and clinical aspects of medical research pursued there. In *Bulletin* No. 1, August, 1936 (Kingston, Ont., Canada), the results to date of the treatment of cases of cancer with a preparation named 'Ensol' are detailed. This is a solution of proteolytic enzymes obtained by digesting malignant tissue, removed at operation, with a pure culture of an anærobic bacillus, *C. histolyticum*. After six days growth, the mixture is centrifuged and filtered through a Berkefeld filter candle to remove organisms, the filtrate obtained constituting the 'Ensol'. Experimentally, when placed upon carcinoma tissue, it produces rapid lysis or solution of the cancer cells. This preparation is injected into the patient, and appears to have no harmful effect. Dr. H. C. Connell contributes papers on the clinical results of 'Ensol' therapy. Patients to the number of 382—cases of inoperable cancer or who refused surgical interference—were treated with 'Ensol' alone. Of these, 180 (47 per cent) ultimately died, 106 (27·7 per cent) appeared to be permanently benefited, and of the remainder most were relieved, and only 13 showed no benefit. Other papers in the *Bulletin* deal with the reactions of 'Ensol', and with the cultural characters of *Clostridium histolyticum*.

The Pine Shoot Moth

FORESTRY COMMISSION BULLETIN No. 16 (H.M. Stationery Office. 1*s*. net) on the pine shoot moth (*Evetria buoliana*) in England is of special significance in connexion with afforestation schemes where conifers are involved. The authors, the late Mr. C. C. Brooks and Mr. J. M. B. Brown, discuss the life-history and possible means of circumventing the ravages of this insect. During the past few years, the Forestry Commission's plantations in East Anglia have suffered severely from its ravages. An investigation of the pest was begun in August 1928 at the Imperial Forestry Institute, Oxford, most of the data being obtained from the Brecklands area. The larva destroys the leading buds or shoots, and unequal growth, or distortion, of the trees is a common effect of its activities. An encouraging factor in the situation is that the Corsican pine suffers notably less from this insect than the Scots pine, and its planting, under certain conditions, is advocated.

Helisoma corpulentum and its Relatives in Canada

THE freshwater mollusc *Planorbis corpulentus* Say, now known as *Helisoma*, is the subject of an extensive monograph by F. C. Baker (Canada Department of Mines, National Museum of Canada, Bulletin No. 79, Biological Series No. 21, 1936. Contributions from the Museum of Natural History, University of Illinois, No. 75). By studying a large number of specimens, it has been possible to clear up a great deal of confusion with regard to this mollusc, and it is shown that the species is a composite one embracing several varieties and at least one additional species, which have been previously referred to *corpulentum*. The large snails of the genus *Helisoma* divide into two well-defined groups, *corpulentum* and *trivolvis*, around which several species and races arrange themselves. In a previous paper (*Ecology*, 11, 469; 1930) the author directed attention to the significant geographical distribution of certain species of freshwater molluscs in relation to the moraines of the last glacial invasion, the Wisconsin, when the country was greatly changed, many new species being evolved. The study of the helisomas of the *corpulentum-trivolvis* groups illustrates this well, and it is suggested that the parent stock of the large helisomas is probably the widely distributed *H. trivolvis* of the central and eastern part of the United States.

Bacterial Flora of Blow-fly Larvæ

WE have received from Dr. N. Balzam, ul. Nowolipki Nr. 21, m. 5, Warsaw, a short, preliminary communication on this subject. It appears that the larvæ of *Calliphora erythrocephala*, and also the young and older pupæ, contain numbers of bacteria—it is stated about two million per individual. In the course of metamorphosis they disappear from the larval alimentary canal and pass to the tissues of the nymph where they become localized, since they do not occur in the hæmolymph or the newly formed gut. On the last day of pupal development, rapid destruction of the bacteria takes place, and in the great majority of flies none is found several hours after hatching. Dr. Balzam supposes that a cellular or phagocytic activity explains the passage of the bacteria from the larval gut to the tissues of the nymph and their absence from the hæmolymph. The final result is that, owing to complete 'auto-sterilization', the young flies are free from bacteria, and, therefore, do not disseminate pathogenic germs derived from the larvæ. A full account of the work, it is stated, will appear in a coming issue of the *Annales de l'Institut Pasteur*.

Type Cultures of Micro-organisms

THE Medical Research Council has issued a fourth edition of the Catalogue of the National Collection of Type Cultures, maintained at the Lister Institute of Preventive Medicine, Chelsea Bridge Road, London, S.W.1. (*Special Rep. Series*, No. 214. London: H.M. Stationery Office. 2*s*. 6*d*. net). Five years have elapsed since the publication of the third edition of the Catalogue, and during this period a large number of species of bacteria and micro-fungi have been added to the Collection. In the present edition, the generic name *Bacillus* has been restricted to the spore-bearing rods, ærobic and anærobic. Most of the non-sporing rod-forms are listed under *Bacterium* except where well-recognized generic names are in common use, for example, the diphtheroids (*Corynebacterium*) and the organisms of undulant and abortus fevers (*Brucella*). The typhoid and para-typhoid bacilli and food-poisoning organisms are, however, placed under *Salmonella*, and the dysentery bacilli under *Bacterium*. It is pointed out that nomenclature is in a state of flux, and is now being considered by two or three committees. In respect of both bacteria and fungi, a number of synonyms is given for the convenience of those more familiar with the older systems of nomenclature. In addition to bacteria, yeasts, micro-fungi and *Actinomyces*, several strains of bacteriophage, and a few Protozoa and viruses are also stocked. Cultures may be obtained for a small fee on application to the Curator. In order to increase the services that may be rendered to microbiologists, it is requested that cultures be forwarded to the Curator, not only those of newly isolated species, but also fresh examples of types at present conserved in the Collection.

Role of Silicon in the Plant

A SERIES of papers upon this subject by A. Sreenivasan have recently appeared (*Proc. Indian Acad. Sci.*, 1, 2 and 3). The inquiry appears to have arisen out of the fact that the rice plant, which accumulates exceptionally large quantities of silicon in its ash, grows so satisfactorily under swamp conditions. This raised the question whether swamp conditions are particularly favourable for silicate supply and also raised anew the question as to the role of silicon in the plant. An extensive series of experiments with rice, grown both in swamp and dry soil conditions, showed that whilst both phosphate and silicate manurial treatments increase yield, silicate is particularly useful in raising the yield from manured and soils to practically the same level as that in swamp soils. The conclusion is reached that the swamp conditions, therefore, are suited to the rice plants because thus large amounts of silica are supplied to the plant which would otherwise remain unavailable. The role of silicon still remains obscure; the author points out that its accumulation may be a secondary result of growth in swamp conditions which are otherwise favourable to the plant, for example, on account of the resultant presentation of nitrogen to the root system in ammoniacal form. The mode of entry of silicon into the plant also remains obscure; but this detailed examination has cleared up many points as to the behaviour of silicates in the soil, to which they contribute both an alkali and a silicate gel, and as to their significance in the manurial treatment of the rice crop.

Gravity Measurements in Sweden

PART 2 of vol. 25 of *Archives of Mathematics, Astronomy and Physics* of the Swedish Academy of Sciences contains two communications which show that progress is being made in the determination of the geophysics of Sweden. The first, by Drs. G. Ising and T. Eeg-Olofsson, gives an account of the measurements of the gravitational acceleration in the extreme south of the country by a modified form of the quartz fibre torsion method used by Threlfall in Sydney, forty years ago. The horizontal quartz fibre is supported at its ends by the lower forked end of a rod suspended like a pendulum from a support at its upper end. The centre of the fibre has attached to it one end of a small rod of quartz 1·6 cm. long, and the fibre is twisted until the rod is nearly horizontal, when a very small change of gravity makes a considerable change in the position of the free end observed by microscope. The torsional constant of the fibre is kept constant by surrounding the apparatus with ice. The results show that the variations of gravity with latitude and height are nearly normal over chalk districts, but over the higher districts of Cambrian and Silurian rocks gravity exceeds the normal value by 0·04 or 0·05 C.G.S. units. The second communication, by Dr. G. S. Ljungdahl, on the magnetic anomalies, shows that they are much greater in Sweden than in France and that over the Baltic depression of 400 metres south-east of the island of Uto, the normal deviation of the compass to the west (about 5°) is reduced by 1°. The author hopes, as more results for gravity throughout Sweden become available, to trace further relations between regional anomalies of gravitation and the earth's magnetism.

Sound Insulation by Double Partitions

J. E. R. CONSTABLE, working in the National Physical Laboratory, has investigated the effect of introducing absorbent materials into the air space between light double partitions (*Proc. Phys. Soc.*, 48, 690; 1936). Previous work had shown that the efficiency of a double partition for sound insulation was mainly dependent on the spacing between the panels. A calculation showed that the transmission would be considerably reduced by absorbing, inside the space between the panels, the sound which is reflected back and forth there. Experiments made by introducing acoustic felt into the space between double walls of thin iron or aluminium produced improvements in sound insulation which were in agreement with calculation and were of the order of 10 decibels.

Entropy of Deuterium Oxide

THE calorimetric entropy of ordinary water does not agree with entropies calculated from band spectrum and reaction data. An explanation recently given by Pauling assumes a random orientation of hydrogen bonds in the crystal. The entropy of deuterium oxide ('heavy water') shows a similar discrepancy (E. A. Long and J. D. Kemp, *J. Amer. Chem. Soc.*, 58, 1829; 1936). The specimen had a density of 1·10781, corresponding with 99·92 atomic per cent, and a melting point of 276·92° K. The latent heat of fusion is 1,501 gm. cal. per mol. The calorimetric entropy of the liquid at 298·1° K. is 17·27 E.U.; the value which should be used in thermodynamical calculations is 0·806 E.U. higher on the basis of Pauling's theory. From the measured heat capacities and the known heat of sublimation, the calorimetric entropy of D_2O gas at 273·1° K. is 45·89 U.E. at 1 atm. pressure. The value from spectroscopic data is 46·66 E.U., giving a discrepancy of 0·77 E.U. between calorimetric and spectroscopic values. This is in good agreement with the theoretical value of 0·806, which is evidence for the correctness of Pauling's theory.

Indium

THE metal indium, belonging to Group III of the Periodic Table, has been very scarce. It is found in small amounts in certain zinc blendes, in zinc carbonate minerals, and in various ores of iron (including chalcopyrite, $Cu_2Fe_2S_4$), manganese and tin. It has also been found with cadmium and has been detected in all specimens of metallic tin examined by two investigators. F. M. Brewer and E. Baker (*J. Chem. Soc.*, 1286; 1936) now report that two rare tin minerals, cylindrite and franckeite, sulphides of lead, antimony and tin, have an indium content (0·1–1·0 per cent) much larger than any source yet reported. These minerals are confined to the Bolivian tin belt, where argentiferous thiostannates are found. Indium was also found in some silver minerals not containing tin. The same authors in a second paper (p. 1290) describe methods for the extraction of indium from cylindrite, chalcopyrite and metallic tin. Indium is coprecipitated with stannous sulphide. Since the boiling point of indium chloride is much higher than that of stannic chloride, they can be separated by distillation. Details of other methods are given.

High-Frequency Modulation of Ultra-Short Waves

THE development of television transmissions on ultra-short waves has necessitated the study of methods of modulating carrier waves of a few metres in length with modulation frequencies of the order of one megacycle per second. The usual methods of amplitude modulation employed for sound broadcasting at moderate carrier frequencies are not satisfactory, owing to the undesirable frequency modulation and vision distortion which accompany their use. Messrs. S. S. Banerjee and B. N. Singh, of the Physics Department, Benares Hindu University state, in a communication addressed to the Editor that they have recently been studying the use of short parallel-wire transmission lines in the modulation of ultra-short waves (wave-lengths 4–5 metres) by high frequencies of 1·5–3 megacycles per second. From the general equations applicable to such transmission lines, it can be shown that amplitude modulation free from frequency modulation is obtained when the length of the line is an integral multiple of a quarter of the length of the carrier wave. This condition, which is fairly critical, has been verified experimentally by the above investigators with the aid of a modified Lecher wire system previously adopted by Banerjee (*Phil. Mag.*, 19, 787; 1935) in connexion with the measurement of the radiation resistance of transmission lines. At the high modulation frequency employed, the effects of the carrier wave and side bands are adequately separated on the Lecher wire system. The detailed results of these investigations will be published elsewhere shortly.

Colours of Globular Clusters

THE problem of the absorption of light in space with the consequent 'reddening' effect of great distances, has been investigated by Stebbins and Whitford (*Astrophys. J.*, 84, 132) through a study o globular clusters. They have used a photo-electric cell attached to the 100-inch telescope at Mount Wilson, and determined the colours of 68 clusters by means of the integrated light intensities of each cluster through filters transmitting light of effective wave-length 4340A. and 4670A. The colour excesses show a marked correlation with space absorption a deduced from the number of extra-galactic nebulæ in the field, and also with galactic latitude; being of course, redder near the galactic equator where th absorption is greatest. The absorption was not found to be uniform, and the greatest measured colour excess was + 0·82 mag., corresponding to a photographic space absorption of about 3 magnitudes One effect of this absorption is that distances inferred from apparent magnitudes in clusters must b divided by four. When this correction is made, the diameter of our galaxy is found to be about 30,000 parsecs, which is of the same order as that of th Andromeda nebula.

Education for Rural Life

A JOINT session of Sections L (Educational Science) and M (Agriculture) was held on September 15 at the British Association meeting at Blackpool to discuss "Education for Rural Life". Papers were read by three representatives of each section.

Sir John Russell emphasized that education in rural areas must develop on lines different from that in towns. An important factor is the richer environment and greater body of natural experience open to the country child, but until recently there have been no enterprising teachers in rural areas to base their teaching on these facts. Local surroundings should be the basis of country education, and the syllabus of work done could accordingly be flexible and free. Realizing that the country child must live on and by the land, we should arrange that his education should be based directly on the life of the countryside. For this purpose, adequate land around rural schools is essential in order to provide for school gardening, playing fields and a school estate. School gardening was at one time a device to occupy the spare time of older boys; but now, in progressive areas, it has come to be the nucleus of the teaching in woodwork, drawing, composition and arithmetic: it has also attracted the interest of parents. Village surveys are being increasingly organized and have educated children in the history, geography and biology of their district. In the hands of good teachers who keep abreast of modern knowledge, education for rural life could be fuller, freer and less materialistic than the education ordinarily given in towns.

Mr. Henry Morris, director of education for Cambridgeshire, said that education for rural life must be independent of the great towns, the culture of which is largely commercialized. The solution, however, can not be found in a single village; but in groups of villages forming a region centred around a large village or small country town. Modern transport makes this easily possible. Even so, reorganization far more extensive than a Hadow reorganization of schools is required. The school buildings ought to house a senior school in the daytime and a community centre in the evening. Such a solution is provided in the village college, which focuses the social, cultural and artistic activities of the countryside in one centre, architecturally appropriate, where adults and children are freely educated. A village college can thus cater for drama, dancing, horticulture, public health and recreation and those communal activities in song and ceremony that enrich the corporate life. The planning of this college on a generous scale, with ample land and attractive buildings, requires foresight and experience. It needs considerable expenditure; but such expenditure would be socially beneficial in the highest degree, and above all, it would help us to make the fullest use of the leisure that applied science is making possible.

Prof. N. M. Comber dealt with the contribution of universities to education for rural life, and deprecated the brevity and elementary nature of the courses they provide in agriculture. Moreover, such courses emphasize practical and utilitarian matters; they should be broadened to include some study of cultural, social and recreational life of the countryside. The nation at large should endeavour to understand the significance and importance of the countryside, and some appreciation of rural life should be inculcated in the training courses for teachers.

Mr. T. S. Dymond referred to the influences on rural education of raising the school-leaving age. While many country schools are doing good work under the Hadow scheme of reorganization, large numbers fail to educate suitably the senior children. More individual work should be expected of them, more craft work should be introduced, particularly a variety of crafts such as carpentry, metal work, simple mechanics, dairying, fruit-bottling. In short, the education must be largely vocational. For those who are leaving school, some form of part-time continued education would be of great value, even if it took the form of young farmers' groups or women's institutes. Vocational work is valuable by cultivating the ability to acquire knowledge through experience, and thus stimulating self-reliance, initiative and a desire to learn.

Mr. G. W. Pierce, speaking as a village headmaster, claimed that the village school as it exists to-day is doomed. The new rural school will serve a wide area and will hold 220–280 children, but it must be located right in the countryside—the more rural the better. 8–10 acres of land are necessary in order to allow for ample playing fields and gardens. He deprecated the tendency of local education authorities to convey country children to the nearest town to be educated with town children; it is far better for town children to receive a rural education than for rural children to receive an urban education. The quality of the teaching staff is all important: the teachers must be interested in rural life, for a rural bias is essential in all subjects of the curriculum, particularly in arithmetic, gardening, science, handwork, cooking and geography. Practical work is of the first importance and should occupy at least half of the school hours. Further, it is educationally admirable that boys and girls should become interested in plant life and bird life.

Sir Arnold Wilson claimed that education for rural life involves in practice education for husbandry in all its branches. This implies that the teaching staff must be convinced believers in rural life. Agriculture is more vital to the nation than is generally realized: statistics show that agriculture offers very varied occupations and unrivalled scope for individual talent. Moreover, it is a healthy way of living. The passive idea of education is false; enthusiasm for doing should be inculcated. Germany shows a different outlook upon husbandry in every walk of life: there agricultural workers are being suitably trained, and country life is held in honour; there is no rigid distinction between school years and working years, and diplomas are awarded after suitable practical experience combined with a variety of instruction. The future of Great Britain depends on rural life, for it is in the country-side that food is produced, fresh air is abundant and a variety of occupations and experience is present. He believes that great help would be given in the enjoyment of the privileges of country life if the best part of education were given after the age of sixteen years.

Land Transport

IN his presidential address on October 15 to the Institute of Fuel (see NATURE, October 31, p. 752), Sir Philip Dawson dealt with the subject of transport on land. The end of the nineteenth century may be called the electrical age, but so far as Great Britain is concerned, since electrical power is mainly produced by steam, its application to traction only means the consumption of fuel transferred from the rolling vehicle to the power-house producing electricity. In countries where electricity can be produced by water-power, this agency may largely affect the total consumption of solid and liquid fuel. Hence the French call water-power *la houille blanche* (white coal). We are faced to-day with the fact that, despite the high efficiency in producing light, heat and power now obtained in the combustion of coal, the output of coal in Great Britain has diminished from 287 million tons in 1913 to 223 million tons in 1935.

In 1921, there were 269,000 horse-drawn vehicles on the roads; in 1934 there were only 23,000. There are now nearly 2,500,000 vehicles on the road propelled by internal combustion engines. The use of internal combustion engines burning heavy oil has been slowed down by the tax of 8*d*. per gallon imposed on Diesel oil. In Germany the use of this kind of engine is advancing rapidly. The risk of fire and explosion of heavy oil is much smaller than with petrol, and this would be a great advantage in time of war. Transport by road both for passengers and goods is rapidly increasing. This is due mainly to the increased facilities which the road offers both to the passenger and the trader. There were no less than 435,000 goods vehicles employed on the road last year. There are nearly twice as many people employed directly and indirectly in road transport as in railway transport. The motor-spirit and fuel-oil consumed last year exceeded two million tons, and increased by their taxation the revenue of the Government by forty million pounds. It is estimated that Germany will consume more than two million tons of light synthetic oil this year, more than half of which will be home-produced.

Much could be done in Great Britain to encourage the domestic supplies of petrol by the increased production of benzol by the gas and coke industries. Diesel-electric trains are coming into favour both in Germany and the United States. The great disadvantage of the steam locomotive as compared with Diesel and electric traction is that it consumes fuel when not actually performing useful work.

The electrification of railways, main line as well as suburban, is constantly increasing throughout the world. In Great Britain, the Southern Railway has made the greatest progress in this direction. All the electricity it uses for traction is supplied by the Grid from steam-operated power plants. Sir Philip quoted with approval the Weir report, which stated that electrification places in the hands of the traffic manager a new system which enables him to offer a more attractive transport proposition to the public and the characteristics of which are capable of extensive development. The adoption of electric haulage for metropolitan and suburban lines nearly always produces increased traffic. The additional cost of the increased train mileage has been much less than the increase in the revenue resulting therefrom. Even in countries where electricity is generated by steam, its largely increased use in industry and for haulage must bring about a decrease in the use of coal in consequence of the greater efficiency realized.

In conclusion, Sir Philip said that every effort must be made in Great Britain to utilize the thermal energy contained in coal for the production of all forms of power, so as no longer to have to rely on fuel imported from overseas, as we have to-day, for operating services which are vital to our national existence and commercial prosperity.

Maya Culture in the Highlands of Guatemala

THE Carnegie Institution of Washington, which under its Section of American Aboriginal History is conducting a comprehensive investigation of the anthropology of Central America, covering the archæology, history under Colonial administration, and physical characters and constitution, linguistics, and social conditions of the modern inhabitants, has undertaken a further investigation in the highland zone of Guatemala. Here a year of mound excavation has already made a substantial advance towards a settled chronological sequence in culture, which is one of the principal aims in present-day archæological research in Central America.

A mound in the neighbourhood of Guatemala city, to be known in future as "Haminaljuya", the "Hills of the Dead", is now being excavated by Dr. A. V. Kidder on behalf of the Institution and at the invitation of the distinguished archæologist, Dr. Antonio Villacorta, Minister of Public Education, and his son, Sr. Carlos Villacorta, director of the National Museum of Guatemala. This mound is one of a hundred situated within a restricted area of half a mile by one and a half miles. The area, as part of the highland region, is already characteristically known to archæologists as a source of material of the 'archaic' period, for which evidence is also forthcoming from other sites, such as the Valley of Mexico, and from the lowest levels of Uaxactun in the Province of Peten. Certain indications, however, had led Dr. S. K. Lothrop some years ago to infer that remains of a later period might occur in the area, perhaps even so late as the Maya Old Empire; and only last year Dr. Kidder himself, while pointing out that the highland region had served more as a highway for trade and migration than the lowland jungle country, suggested that its sites might be expected to provide extremely valuable information as to the chronological interrelation of the various ancient cultures, particularly as it was probable that stratified remains would be discovered.

These prognostications, it is stated in a preliminary report on the first season's excavation of the mound issued by the Carnegie Institution (*Bull.*, 4, 6), have been strikingly verified. Even so far as operations have proceeded up to the present, it is evident that occupation of the mound was far more prolonged than had been thought probable. The mound presents resemblances to the third of the four sequent stages in the tentative classification of the culture of the lowland city of Uaxactun, the oldest site yet excavated in the Maya area. This would bring Kaminaljuya at least down to the Old Empire; but finds from the site also present resemblances to those from Teotihuacan, the Toltec city in the Valley of Mexico.

Not only, then, does the evidence of the finds from Kaminaljuya reduce Dr. Lothrop's inference to proved fact, but it also has provided the stratified remains which Dr. Kidder desired. Quite apart, however, from their importance as evidence for cultural sequence, the finds are of an exceptional intrinsic interest. Not the least surprising result of the investigation was that after two pyramids superimposed upon a third had been revealed, still another was found beneath the third. Each of the outer three showed certain differences. The two outer pyramids, for example, rose to a surmounting platform by terraces, the third (reckoning here, as elsewhere, from the interior outward) showing three levels, whereas the second rises steeply in a single slope, and still carries a balustrade of twelve steep steps, while this feature in the third pyramid had been torn away when it was dismantled for the building of the fourth.

In examining the place of the stairway in the third pyramid, three tombs were brought to light; and a fourth, still unexamined, was found under the staircase of the second pyramid. The burials in the three tombs, which have been opened, have produced a wealth of objects, personal ornaments in jade, crystal and other material, pottery, including some remarkable painted ware, obsidian spear-heads, and other funerary offerings, which when more carefully examined at leisure will certainly throw much new light on Maya art, burial customs and culture generally.

The tombs were great square pits, vertically sided, dug in the volcanic deposit, and measuring twelve feet square and twelve feet deep. Originally they were roofed with logs, which, when found, had rotted away and let down stones and earth on the contents. An interesting feature of these tombs is the arrangement of the body, which, with attendant circumstances, suggests the interment of a high priest or ruling chief. In the first tomb the personage interred had been placed in a sitting position in the centre of the floor. On three sides of the skeleton lay single human skulls and on the fourth the skull of a jaguar. In the second (Tomb III) the principal skeleton was that of a middle-aged male. The body had again been placed in the middle of the tomb in a sitting posture with the legs crossed. It had been loaded with ornaments, and at the side was a heap of pottery, in which were two human effigies in clay. At the feet of the skeleton lay the bones of a young woman and vessels for serving food, a milling stone for grinding corn, and other utensils. In a corner were the bones of a small dog. With the principal personage of the third tomb (Tomb II) were two others, possibly slaves. All were in the sitting position, facing south. This was in some ways the richest tomb of all and contained many unique pieces of pottery.

Dr. Kidder suggests in connexion with the burials, basing his opinion upon the evident character of the interment, that the custom of building pyramids superimposed one upon another may have been due to the custom of demolishing the pyramid, of which the deceased had charge at the time of his death, and preparatory to building another for his successor.

Developments in British Telegraph Services

IN a paper read to the Institution of Electrical Engineers on November 19 by L. H. Harris, E. H. Jolley and F. D. Morrell, details are given of many of the engineering developments which have taken place in the inland telegraph service of the British Isles during the last few years.

It is now clear to engineers that the use of underground cables solely for direct current telegraphy is wasteful and that modern developments in amplifiers and filters enable a direct current cable to carry many more circuits. In 1929, the international council (C.C.I.T.) standardized the speed of the teleprinter, and two years later the spacing of the carrier frequencies to be used for voice-frequency telegraph working was also standardized. In 1931 the Post Office installed and operated a London–Dundee 12-channel system, developed and manufactured in Great Britain, which met completely the requirements laid down by the C.C.I.T. A year later the London–Glasgow–Belfast 18-channel system was installed. The introduction of demand telephone trunk working created a shortage of trunk telephone circuits and it was decided to convert practically the whole of the inter-urban telegraph network to voice-frequency working. The telegraph cables thus thrown idle were used for telephone purposes. The number of voice-frequency telegraph channels has doubled during the last three years. The revolution in the methods used in telegraphy has been very thorough. By 1934 scarcely an item of traditional telegraph plant remained in the inland service.

Cable companies, news agencies and newspapers make considerable use of these circuits for speeds up to 100 words per minute. Voice-frequency channels are nearly always used, and even such important circuits as direct extensions of Atlantic cables are employed in this way. An increasing number of newspaper companies now rents telephone circuits on which they provide or rent equipment for alternative speech or pictures and multi-channel voice-frequency telegraphy.

The telex service, which gives the alternative of teleprinter working to speech over the telephone network, as distinct from a separate teleprinter exchange system, has also progressed. One of the latest developments of the private teleprinter services has been the introduction of broadcast systems. In these, facilities are provided and maintained, up to the limit of the number of machines at the central office, by which the renter can transmit simultaneously to any reasonable number of outstations. News agencies and police services are finding these methods very useful.

The 18 frequencies used by the carrier currents in the voice-frequency channels are the odd multiples of 60 cycles from 420 to 2,460. The currents are generated by a multi-frequency machine, driven by a motor fitted with a centrifugal governor which regulates the field current and controls the speed to within ± 0·25 per cent. Great progress has been made in standardizing 80 volts for all telegraphic purposes, and in eliminating the 24, 40 and 120 volts employed for local and main-line batteries when direct current was used. The maintenance of the voice-frequency network is carried out by the ordinary repeater-station staff, who rapidly have become familiar with the new methods. The average duration of interruptions of commercial circuits due to causes which can be attributed to the voice-frequency method do not exceed five minutes per week. In the case of private wire renters, they report faults directly by telephone using the voice-frequency terminal.

It has not been found necessary to make use of sub-audio (infra-acoustic) circuits in the British Isles, except for a few cases in which submarine cables are involved. The London–Jersey duplex teleprinter circuit is one of these cases. It is in series (composited) with the Channel Islands telephone circuit consisting of a single core unloaded submarine cable. Two duplex teleprinter circuits have been installed in the continuously loaded submarine telephone cable between Blackpool and Port Erin (Isle of Man). These circuits are noteworthy as they use only seven volts for transmission so as to avoid the risk of affecting the loading material used in the cable. Neglect of this gives rise to 'cross-talk' due to minute changes in the inductance.

The difficulties experienced at first in maintaining teleprinter speeds constant have been overcome. The difference in the speeds now seldom exceeds one per cent. The speed is checked by means of stroboscopes and synchroscopes. The latter instruments have been found to be much the more accurate. In the case of telephony, voice-frequency signalling methods and improvements in transmission technique have led to development in the direction of extending the automatic system to include the trunk circuits. This avoids the delays and costs of intermediate operating. Similarly in telegraphy, the elimination of probably 50 per cent of the operating transactions and delays would be possible by means of through automatic switching from the sending to the receiving office. The present voice-frequency network makes a framework for such a scheme which would have been quite impracticable under the old physical line conditions.

Telegraphy is now in a position to share in the rapid advances recently made in the telephone field. The teleprinter with its typewriter keyboard, the elimination of the distance factor by voice-frequency methods and the cheaper private wire telegraphic rentals should prove a boon to the commercial world.

Humboldt's Plan in 1836 for a World Magnetic Survey

EARLY in 1836 Alexander von Humboldt sent a letter to the Duke of Sussex, as president of the Royal Society, inviting the co-operation of the Society in the organization of a world magnetic survey. The letter was referred to Christie and Airy, whose report was read to the Royal Society on November 24, 1836. As von Humboldt's suggestions had a great influence on the steps afterwards taken, a few extracts from the report are given here:

"In this letter," said Christie and Airy, "M. de Humboldt developes a plan for the observation of the Phenomena of Terrestrial Magnetism worthy of the great and philosophic mind whence it has emanated and one from which may be anticipated the establishment of the theory of these phenomena. . . . The Baron de Humboldt and MM. Arago and H. Kupffer having, by the co-operation of many zealous observers, succeeded in establishing permanent magnetic stations extending from Paris to China, M. de Humboldt solicits, through His Royal Highness the President, the powerful influence of the Royal Society in extending the plan by the establishment of new stations. The plan which he proposes . . . is that magnetical observations, whether of the direction of the horizontal and inclined needles, or for the determination of the variations of the magnetic force, should be made simultaneously at all stations, at short intervals of time, for a certain number of hours and at fixed periods of the year precisely similar to the plan which has been recommended and adopted by Sir John Herschel with reference to observations of the barometer and thermometer." He also "considers that it deeply interests the advancement of mathematical and physical sciences that, under the auspices of His Royal Highness the President, the Royal Society should exert its influence in extending the line of simultaneous observations, and in establishing permanent magnetic stations in the tropical regions on both sides of the equator, in high southern latitudes and in Canada. . . . Should the proposition meet with their concurrence he begs that the Royal Society will enter into direct communication with the Royal Society of Gottingen, the Royal Institute of France and the Imperial Academy of Russia, to adopt the most proper measures to combine what is proposed to be established with what already exists".

After a full review of the subject, Christie and Airy went on to say, "By referring to M. de Humboldt's letter, it will be seen that the plan of observation so comprehensively conceived by him, has been most powerfully and liberally patronized by the Governments of France, of Prussia, of Hanover, of Denmark and of Russia; indeed it is quite manifest that a plan so extensive in its nature must be far beyond the means of individuals, and even of scientific societies, unaided by the governments under which they flourish. . . . To suppose . . . that the Government of this, the first maritime and commercial nation of the globe, should hesitate to patronize such an undertaking . . . would imply that our Government is not alive either to the interests or to the scientific character of the country, and would show that we had little attended to the history, even in our own time, of scientific research, which has been so liberally promoted by the Government. . . . We therefore feel assured that, when it shall have been represented to the Government that the plan of observation advocated by the Baron de Humboldt is eminently calculated to advance our knowledge of the laws which govern some of the most interesting phenomena in physical science . . . that the patronage to the undertaking which is so essential to its prosecution will be most readily accorded. . . ."

Educational Topics and Events

CAMBRIDGE.—M. Krook, research student of Gonville and Caius College, has been elected to an Isaac Newton studentship, and E. N. Rowland, of Gonville and Caius College, to an additional Isaac Newton studentship.

Prof. W. V. D. Hodge, Lowndean professor of astronomy and geometry, has been elected into a non-stipendiary fellowship at Pembroke College.

GLASGOW.—Dr. William Marshall Smart, chief assistant in the Observatory and lecturer in mathematics in the University of Cambridge, has been appointed regius professor of astronomy, in succession to Prof. Ludwig Becker, who has resigned.

Mr. Oliver Shewell Franks, fellow and prælector in philosophy of Queen's College, Oxford, has been elected to the chair of moral philosophy rendered vacant by the death of Prof. A. A. Bowman.

Dr. John Dougall has been appointed Gibson lecturer in the history of mathematics.

Sir Frederick Crombie Gardiner has given £10,000, and the trustees of his brother, the late Mr. William G. Gardiner, of Moraig, Stirling, have also allocated £10,000 to the University, towards the provision of a new Medical Institute to be erected in connexion with the Western Infirmary. This is to be known as the "Gardiner Medical Institute" and will be at the disposal of the regius professor of medicine for the purpose of teaching and research.

In a recent address to the General Council of the University, the new Principal, Sir Hector Hetherington, mentioned that during the last six years, whereas £130,000 has been received for scholarships, only £47,000 has been received for general expenditure on lands, buildings, equipment, etc. He pointed out that, at present, aid to the University is more important and beneficial than the provision of additional scholarships.

LONDON.—The following degrees have been conferred: D.Sc. in chemistry on E. E. Jelley, for published works on chemical microscopy and photographic chemistry; D.Sc. (engineering) on R. W. Bailey, for published works on creep and stress in metals, etc.

OXFORD.—Dr. Simon Flexner, director of the Rockefeller Institute for Medical Research, has been appointed George Eastman visiting professor for the academic year 1937–38.

Prof. R. V. Southwell has been elected a member of Hebdomadal Council.

Lord Nuffield has been elected an honorary fellow of Pembroke College.

Dr. F. Simon, of Balliol College, has been appointed University reader in thermodynamics for five years from October 1.

It is proposed to confer the honorary degree of D.Sc. early next year on Dr. J. D. Pollock, chairman of the Metal Industries Company and of the British Oxygen Company, and a Carnegie Trustee.

SHEFFIELD.—Prof. F. C. Lea, formerly professor of mechanical engineering, and Prof. J. Husband, formerly professor of civil engineering, have been given the title of emeritus professor.

The following appointments have recently been made: Dr. K. Mellanby, Sorby fellow, as honorary lecturer in zoology; Mrs. H. Mellanby, as honorary research assistant in the Department of Zoology; Mr. J. E. Stanworth and Mr. F. R. Harris, as research fellows in the Department of Glass Technology.

Dr. J. C. Paisley has resigned his post of junior assistant bacteriologist.

A NUMBER of Commonwealth Research Fellowships, tenable by British subjects at certain American universities, are offered for award in 1937 by the Commonwealth Fund of New York. Twenty-four Ordinary Fellowships are offered to candidates living in Great Britain or Northern Ireland who are graduates of a university therein. Two Dominion Fellowships are available to British candidates living in a British Dominion or Colony who are graduates of a Colonial university. There are also five Service Fellowships tenable by British candidates holding appointments overseas under the British Government or a British Colonial Government, and three Home Civil Service Fellowships tenable by candidates holding appointments in the Home Civil Service. The Fellowships are tenable for two years, and are not open to women. Further information can be obtained from the Secretary, Commonwealth Fund Fellowships, 35 Portman Square, London, W.1.

"AN Educational Platform for 1936", formulated at Stanford University, California, last July by the Dean of the School of Education as a result of a conference held there on "Curriculum and Guidance", has been published in *School and Society* (Sept. 5). It is a fairly comprehensive reasoned statement of principles, aims and aspirations, and is valuable as an indication of some trends of thought in academic circles in the western States of America. The impact of the recent rapid advances in technological science on a society unprepared to readjust its institutions, which are consequently "jarred to their very foundations", calls for a concentration of effort on the part of educators to fit the younger generation and, so far as possible, the community at large, to take part in the social advances indispensable for the preservation of a democratic State. Hence the educational programme must stress the study of present conditions and the potentialities of the future, the study of the past being ancillary thereto, and the teacher's position shifting from that of merely transmitting information about things which have been done to one of dynamic influence in social evolution. Associated with this is the development of what is referred to as "the guidance service" to aid the student in defining his goals — vocational, social-civic, recreational and health. But guidance should imply more than mere counsel. The 'platform' envisages school education as an *apprenticeship* for worthy adult life, including the actual doing under supervision of things which constitute desirable living. This implies provision for participation in many varied activities outside courses of formal study. The last item in the proposals calls for a thorough-going broadening and raising of the standards of teacher-training institutions.

Societies and Academies

Edinburgh

Royal Society, November 2

E. B. Bailey and W. J. McCallien: Perthshire tectonics; Schiehallion to Glen Lyon. E. M. Anderson's stratigraphy has been confirmed, with minor additions. The Dalradian boundary has been shown to be a slide affected by considerable overfolding. This overfolding has brought into one and the same district Dalradian with and without a Blair Atholl component. Other slides include the Schiehallion slide, as spectacular as any thrust in the North-West Highlands. Large-scale inversion is a commonplace in the district. Often the older Blair Atholl Series is found downfolded into the younger Perthshire Quartzite Series. The Loch Tay inversion extends fifteen miles across the strike. All the big recumbent folding and refolding is towards the south-east.

Ralph Dennell: Feeding mechanism of *Apseudes talpa* and the evolution of the peracaridan feeding mechanisms. The almost hemispherical maxillipedal epipodite of *Apseudes talpa* closely enwraps the base of the second thoracic limb. A valvular flap, on its anterior border, lying outside a typical Malacostracan filter exit, enables the epipodite to draw a filter current from the filter chamber. The maxilla bears minute, but typical, filter setæ; but the maxillipedal brushing setæ are largely prevented from scraping them by a lower row of maxillary setæ. Fine food particles are retained mainly by the brushing setæ, and not by the filter setæ. The probable evolution of the feeding mechanisms of the Peracarida is described.

Mabel S. Fraser: The vascular supply to the follicle-bearing Ranunculaceæ. The main point emerging from this detailed study is the variation in the vascular supply to the carpellary whorl—a variation which is particularly marked in the acyclic group. In a single gynæcium there may be variation in the origin of the carpellary bundles and also in the number of traces entering each carpel. Thus no basic formula could be established for any one species. No evidence was found in support of the theory of carpel polymorphism as applied to this group. The tendency towards a basic five-trace supply to the carpel is noted, and the author is inclined to support the view expressed by Eames, that the primitive carpel was probably a palmate sporophyll, with a basic five-trace supply.

W. J. van Stockum: The gravitational field of a distribution of particles rotating about an axis of symmetry. The gravitational equations are considered in the interior of a rotating axially symmetric distribution of particles which are describing their paths without mutual interaction. The general solution of the equations is shown to depend upon an arbitrary solution of the equation

$$\frac{\delta^2 V}{\delta r^2} + \frac{\delta^2 V}{\delta z^2} - \frac{1}{r}\frac{\delta V}{\delta r} = 0.$$

As an example, the gravitational field of an infinite rotating cylinder is considered in detail.

T. M. MacRobert: Some formulæ for the associated Legendre functions of the second kind, with corresponding formulæ for the Bessel functions. The generalized Bessel's integral is employed to evaluate a number of integrals and series involving Bessel functions regarded as functions of their orders. Corresponding results are also obtained for the Legendre functions of the second kind.

Paris

Academy of Sciences, October 26 (*C.R.*, 203, 753–832).

Robert Esnault-Pelterie: The extension of the principle of the limit law in dimensional analysis.

Nikola Obrechkoff: A theorem of Laguerre.

Ottokar Borůvka: Singular matrices. Admitting priority of Ed. Weyr.

Serge Bucheguennce: The surfaces of Bianchi.

Werner Fenchel: Generalization of a theorem of Brunn and Minkowski concerning convex bodies.

Jean Dieudonné: The zeros of derivatives of rational fractions.

Pierre Boos: The properties of symmetry of the integral curves of differential systems of the second order.

Robert d'Adhémar: The moment of initial impulse and the inclination of the rifling grooves. The periods of virtual instability of projectiles.

René Lucas: The specific heats of liquids and gases. By taking into account the existence of transversal waves, hitherto neglected, it is possible to develop a quantic theory of the specific heat of liquids analogous with that of solids.

James Basset and Maurice Dodé: The solubility of nitrogen in water at ultra-pressures up to 4,500 kgm./cm.^{2}. Starting with a certain pressure, about 300 kgm./cm.^{2}, the solubility of nitrogen in water diminishes as the pressure is increased. The possible effects of traces of oil derived from the compressor is discussed, and it is proposed to repeat the experiments with an apparatus excluding this possible source of error.

Félix Cernuschi: The conservation of energy and Shankland's experiment. An argument that the results of Shankland, assumed to be exact, do not necessarily imply the abandonment of the law of conservation of energy.

Pierre Jacquinot and Gaston Dupouy: New measurements of the variation of the deviations with the field in the Zeeman effect with mercury.

Léon Bloch, Eugène Bloch and Pierre Herreng: The absorption spectra of sulphur dioxide and of hydrogen sulphide in the Schumann region.

Georges Bruhat and Pierre Guénard: Study of the circular dichroism of solutions of camphor in organic solvents. The solvents used were carbon tetrachloride, hexane, cyclohexane and benzene. The only effect of the change of solvent, in the absorption region, is a displacement as a whole, without appreciable modification, of the curves of dichroism and rotatory dispersion.

Joseph Hrdlička, Miloslav A. Valouch and Ladislav Zachoval: Contribution to the study of the Debye-Sears effect.

Maurice Curie and Pierre Preiswerk: The activation of thulium by slow neutrons.

Joseph Wiemann: The Raman effect and organic chemistry: the structure of the 'oses' and the Raman effect. Solutions of xylose, glucose, sorbose, arabinose, galactose, lævulose, rhamnose, and mannose were examined, and none of these gave a line corresponding with the C : O linkage, from which it would appear that none of these, in solution, has either an aldehydic or ketonic structure.

Emile Carrière and Raymond Lautié: The formation of the molybdenum oxides Mo_3O_8 and Mo_2O_5.

Martin Battegay and Gerard Mangeney: The aldehydes of 1.nitro 2.methylanthraquinone.

J. A. Gautier: A new series of *N*.hydroxyalkoxyl-α-pyridones.

Marc Tiffeneau and Mlle. J. Gutman: Molecular transformation in the cyclanic series. Isomerization of the epoxides derived from 1.benzyl 4.methyl 1.cyclohexene and 1.benzylidene 4.methyl cyclohexane.

Joseph Hoch: The action of organo-magnesium compounds on the ketoximes.

Henri Moureu and Maurice Dodé: Remarks concerning the mechanism of the formation of the monochlorhydrins of glycols. Studies on the kinetics of the reaction between water, chlorine and ethylene with formation of ethylene chlorhydrin. The results do not support the hypothesis that ethylene oxide is an intermediate product.

Alfred Maillard: The proportion of deuterium in the light hydrocarbons from petrols of various sources of origin. The petrols have been burnt in an internal combustion motor and the water condensed from the escaping gases. The heavy hydrogen from natural hydrocarbons varies with the origin, and is about double that found in ordinary water.

Jacques Fromaget: The syntectonic origin of the conglomerates and limestone breccias of the north-west of Tonkin.

M. and Mme. Fernand Moreau: The antagonism of some cations in cultures of *Saprolegnia*.

Mlle. Marie Thérèse Gertrude: The elaboration of carbon material by plants in aquatic media.

Jean Cheymol: Results on the structure of verbenaloside. It is a lactone, and salts of the corresponding acid have been prepared. It is also a ketone and contains a methoxy group.

Robert Weill: The cnidome of the cladonemides *Eleutheria dichotoma* and *Cladonema radiatum*; its cycle and interpretation.

Jean Brouardel: Nuclear phenomena of conjugation in *Trichodina patellæ*.

Pierre Drach: Allometric growth and sexual dimorphism in the Brachyura.

Roger Husson: The fauna of artificial subterranean cavities.

Albert Vandel: The mode of distribution of the sexes in *Trichoniscus* (*Spiloniscus*) *provisorius* (2). Deuterogene females and monogene females.

Constantin Levaditi, Mlle. Rachel Schoen and Louis Reinié: The experimental reproduction of lymphogranulomatous conjunctivitis (disease of Nicolas and Favre) in the chimpanzee.

Paul Durand, Paul Giroud, Edouard Larrivé and André Mestrallet: The experimental transmission to man of "maladie des porchers".

Cracow

Polish Academy of Science and Letters, October 5.

W. Sierpinski: A theorem on definite functions in any infinite ensembles.

Mlle. H. Plamitzer: Contribution to the method called *regula falsi*.

S. K. Zaremba: Contribution to the discrimination of the singular points of ordinary differential equations.

K. Guminski: The luminescence of barrier anodes of aluminium. Study of the influence of the concentration of the electrolyte on the intensity of the luminescence of the anode, the distribution of the intensity in the spectrum of this emission in the case of an anode of pure aluminium, and the effect on this distribution of the addition of other metals to the aluminium.

K. Dziewonski, L. Sternbach and A. Strauchen: The reactions of β-naphthylamine with thiourea.

J. Szaflarski: The thermal conditions of the *Zmarzle Stawy* in the High Tatra.

W. Friedberg: *Terebralia bidentata* = *Cerithium lignitarum* in the Miocene of Poland. Specimens of *C. lignitarum* collected near Zalesce (Volhynie), except that they are slightly smaller, correspond with *T. bidentata*.

J. Zacwilichowski: A new method of obtaining aberrant forms of Lepidoptera under the influence of chemical reagents. Changes of colour can be produced by injecting the chrysalids with suitable chemical reagents. The results may serve in the analysis of the genesis and causes of aberrations in the Lepidoptera.

J. Gallera: A case of embryonic triplogenesis.

St. Zarnecki: The migrations of young sea trout from Dunajec to the sea.

Sydney

Royal Society of New South Wales, September 2.

C. A. Sussmilch: Evidence of a change of sea-level at Botany Bay. A borehole, drilled near Spring Street, Botany, some few years ago, passed through six successive beds of peat, five of which are below sea-level, the depth of the lowest being 87 ft. below sea-level. Afterwards a well was sunk to a depth of fifty feet, and at the bottom of this, which is 24 ft. below sea-level, a number of well-preserved tree stumps were found *in situ*. The peat beds have resulted from the accumulation of layers of terrestrial vegetation above sea-level, and their occurrence now below sea-level indicates a change of sea-level of a minimum amount of 87 ft. The presence of the tree stumps *in situ* supports this. The occurrence of six different beds of peat, separated from one another by beds of sand, suggests that the movement was an intermittent one, each bed of peat representing a pause in the movement. It is considered that the movement was a rising of sea-level, rather than a subsidence of the land.

W. M. Holman: A study of phosphate solubility in certain New South Wales soils. Recently, Gaarder has used the solubility of the soil P_2O_5 at different *p*H values as a means of determining the nature of the combinations of P_2O_5 in the soil. The phosphate status of certain N.S.W. soils was examined by determining the solubility at different *p*H values within the *p*H range 1·5–8·5 of both native and added P_2O_5. In a black soil from Edgeroi, P_2O_5 is combined largely as basic calcium phosphate. Typical red soils from the western wheat districts are poor in respect to soluble P_2O_5, but have little capacity to remove P_2O_5 from solution. In certain red clay soils from Lismore, no P_2O_5 is soluble under the experimental conditions within the *p*H range 3–8. A large excess of sesquioxide colloids, chiefly hydrated Fe_2O_3, is responsible. When silicic acid colloid is added to these soils, the sesquioxides are deactivated and P_2O_5 is liberated.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, November 23

Royal Geographical Society, at 5.30.—Geographical film on "The Mount Everest Expedition of 1936", by members of the Expedition.

Tuesday, November 24

Royal Society of Arts, at 4.30.—H. E. Laffer: "The Empire Wine Industry".

British School of Archæology in Jerusalem, at 5.0—(in the Rooms of the Society of Antiquaries, Burlington House, W.1).—An open public meeting.

The Right Hon. W. Ormsby-Gore, M.P.: Address.

P. L. O. Guy: Description of the proposed archæological survey of Palestine.

Chadwick Public Lecture, at 5.15—(in the Great Hall. British Medical Association, Tavistock Square, W.C.1), —Sir Francis Fremantle: "The Doctor's Mandate in Parliament".*

Wednesday, November 25

Bedford College for Women, at 5.15.—Prof. John Jewkes: "Social Policy and the Depressed Areas".*

Royal Society of Arts, at 8.—Lady Hart Dyke: "The Lullingstone Silk Farm".

Friday, November 27

Royal Institution, at 9.—Prof. Edward Mellanby, F.R.S.: "Recent Advances in the Treatment of Disease".

Saturday, November 28

Newnham College, Cambridge, at 5.—Lord Rutherford, F.R.S.: "Modern Alchemy" (Henry Sidgwick Memorial Lecture).

Official Publications Received

Great Britain and Ireland

Medical Research Council. Special Report Series, No. 216: Medical Uses of Radium, Summary of Reports from Research Centres for 1935. Pp. 38+5 plates. (London: H.M. Stationery Office.) 1*s*. net. [3010

The Economic Proceedings of the Royal Dublin Society. Vol. 3, No. 2: The Influence of Chemical Composition of Butterfat on the Firmness of Butter By J. Lyons. Pp. 19–38 (Dublin · Hodges, Figgis and Co.; London. Williams and Norgate, Ltd) 1*s*. [3110

Transactions of the Institution of Chemical Engineers. Vol. 13, 1935 Pp. v+235. (London: Institution of Chemical Engineers.) [211

Battersea Polytechnic. Report on the Work of the Session 1935–36 by the Principal, being the 43rd Annual Report presented to the Governing Body. Pp. 38. (London: Battersea Polytechnic) [411

Proceedings of the Royal Irish Academy. Vol. 43, Section A, No. 4: Glow Discharges in Helium. By K. G. Emeleus, F. D. Greene and E Montgomery. Pp. 35–47. 1*s*. Vol. 43, Section B, No. 5: Turbellaria of Ireland. By Rowland Southern. Pp. 43–72. 1*s*. Vol. 43, Section B, No. 6: Observations on the Structure of the Pulmonary Alveolar Wall in the Adult Rat, Guinea-Pig and Rabbit. By Stephen Shea. Pp. 73–81. 1*s*. (Dublin: Hodges, Figgis and Co.; London · Williams and Norgate, Ltd) [611

North-East Coast Institution of Engineers and Shipbuilders. Catalogue of Parsons Exhibition, November 1936–January 1937, at the Municipal Museum of Science and Industry, Newcastle-upon-Tyne, in connexion with the first Parsons Memorial Lecture held 6th November 1936. Pp. viii+26. (Newcastle-upon-Tyne. North-East Coast Institution of Engineers and Shipbuilders.) 6*d*. [611

Hull Museum Publications No. 188 · Silver Roman Coins from South Ferriby, by B. H. St J. O'Neil, and Bronze Roman Coins from South Ferriby, by J. W. E. Pearce. Pp. ii+22+10+3 plates. No. 189: Excavations at the Roman Town at Brough, E. Yorkshire, 1935. By Philip Corder and the Rev. Thomas Romans. Pp. 40. 1*s*. 2*d*. No. 190 Record of Additions Edited by Thomas Sheppard. Pp. 20. (Hull: Hull Museum.) [611

International Tin Research and Development Council. Bulletin No 4: Tin Plate and Tin Cans in the United States. Pp 144. (London: International Tin Research and Development Council.) Free. [611

Royal Commission on the Private Manufacture of and Trading in Arms (1935–36). Report (Cmd. 5292) Pp. 101. (London: H.M. Stationery Office.) 1*s*. 6*d*. net. [611

Eton College Natural History Society. Seventh Annual Report, 1935–36. Pp. 47+10 plates. (Eton: Eton College.) To non-Members, 2*s*. 6*d*. [911

Other Countries

U.S. Department of the Interior: Office of Education. Bulletin, 1935, No 2: Statistics of State School Systems, 1933–34; being Chapter 2 of the Biennial Survey of Education in the United States, 1932–34. Prepared by David T. Blose and W. S. Deffenbaugh. Pp. vi+111. (Washington, D.C. · Government Printing Office.) 10 cents. [211

Smithsonian Miscellaneous Collections. Vol. 95, No. 14 · Morphology of the Insect Abdomen. Part 3: The Male Genitalia (including Arthropods other than Insects). By R. E. Snodgrass. (Publication 3396.) Pp. ii+96. Vol. 95, No. 18 · Two Original Photographic Negatives of Abraham Lincoln. By Alexander Wetmore. (Publication 3400.) Pp. ii+2+4 plates. (Washington, D.C: Smithsonian Institution.) [211

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 88 A Taxonomic and Distributional Study of some Diatoms from Siam and the Federated Malay States. By Ruth Patrick. Pp. 367–470+1 plate. The Amphibians and Reptiles of the Mexican Expedition of 1934 By Emmett Reid Dunn. Pp. 471–477 (Philadelphia Academy of Natural Sciences.) [211

The Queen Victoria Memorial, Salisbury Annual Report for the Year ended 31st March 1936. Pp. 16. (Salisbury: Rhodesian Printing and Publishing Co, Ltd.) [311

Proceedings of the United States National Museum. Vol. 84, No. 2998. Report on the Fishes collected by H. C. Raven in Lake Tanganyika in 1920. By George S. Myers. Pp 16 (Washington, D.C.: Government Printing Office.) [311

Zweites Koppen-Heft der Annalen der Hydrographie und maritimen Meteorologie. Anlässlich des 90 Geburtstages von Wladimir Koppen. Herausgegeben von der Deutschen Seewarte in Hamburg. Pp. viii+94+8 plates. (Berlin: E. S Mittler und Sohn.) [411

Kgl. Danske Videnskabernes Selskab. Biologiske Meddelelser, Bind 13, No 3: Den kinesiske Uldhaandskrabbe (*Eriocheir sinensis* M.-Edw) i Danmark. Af Ad. S Jensen. Pp. 24+3 plates. (København. Levin and Munksgaard.) 1.50 kr. [511

University of California Publications in American Archæology and Ethnology. Vol. 34, No. 5: Myths of the Owens Valley Paiute. By Julian H. Steward. Pp. iii+355+440. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 75 cents; 3*s* 3*d*. net. [511

University of Denver · Department of Anthropology. The Archæological Survey of the High Western Plains Eighth Report: Pictographs and Petroglyphs of the High Western Plains By E. B. Renaud. Pp. 47+25 plates. (Denver, Colo.: University of Denver) [911

Smithsonian Miscellaneous Collections. Vol. 95, No. 17: A New Race of the Song Sparrow from the Appalachian Region. By Alexander Wetmore. (Publication 3399.) Pp ii+3. (Washington, D.C. Smithsonian Institution.) [911

U.S. Department of the Interior: Geological Survey. Bulletin 860–B: Geology and Fuel Resources of the Southern Part of the San Juan Basin, New Mexico. Part 2: The Mount Taylor Coal Field. By Charles B. Hunt. Pp. vi+31–80+plates 18–38. 1 dollar. Water-Supply Paper 770: Surface Water Supply of Hawaii, July 1, 1933, to June 30, 1934. Pp. 120 20 cents. Water-Supply Paper 775: Records of Wells on the Snake River Plain, Southeastern Idaho. By Harold T. Stearns, Lynn Crandall and Willard G. Steward. Pp. 139. 20 cents Professional Paper 185–I: Geomorphology of the North Flank of the Uinta Mountains. By Wilmot H. Bradley. (Shorter Contributions to General Geology, 1934–35.) Pp. iv+163–204+iv+plates 34–45. 45 cents. (Washington, D.C.. Government Printing Office.) [911

The Hanna Star Dome. By Dorothy A. Treat. (Pocket Natural History, No 6: Astronomical Series, No. 1.) Pp. 48. 25 cents. Scientific Publications of the Cleveland Museum of Natural History. Vol. 6. The Composition and Dynamics of a Beech-Maple Climax Community. By Dr. Arthur B. Williams. Pp. 92. (Cleveland, Ohio: Cleveland Museum of Natural History.) [911

Indian Central Cotton Committee. Technological Laboratory. Technological Bulletin, Series A, No. 34 The Effect of raising the Middle Roller and some other Factors on the Yarn Strength of Sindhi Cotton. By Dr. Nazir Ahmad. Pp ii+11. (Bombay Indian Central Cotton Committee.) 8 annas [911

Indian Forest Records (New Series). Vol. 2, No. 7: Entomological Investigations on the Spike Disease of Sandal, (29) Coreidæ and and Berytidæ (Hemipt) By N. C. Chatterjee. Pp. ii+157–175. (Delhi · Manager of Publications.) 8 annas; 10*d*. [911

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 65 · A Survey of the Sheep and Wool Industry in North-Eastern Asia, with Special Reference to Manchukuo, Korea and Japan. By Dr. I. Clunies Ross. Pp. 52. (Melbourne. Government Printer.) [911

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 88. Zoological Results of the George Vanderbilt African Expedition of 1934. Part 4. Notes on Four Gorillas from the Sanga River Region. By Harold J. Coolidge, Jr. Pp. 479–501+plates 12–13. Notes on Anacondas, with Descriptions of Two New Species. By Emmett R. Dunn and Roger Conant. Pp. 503–506+plate 14. Zoological Results of the George Vanderbilt African Expedition of 1934 Part 5: Dermaptera. By James A G. Rehn. Pp. 507–526 (Philadelphia: Academy of Natural Sciences.) [911

Catalogues

Cambridge Easy to Read Thermometers. (Folder No. 25a.) Pp. 6. (London: Cambridge Instrument Co., Ltd.)

Philosophie (Antiquariats-Catalog Nr. 708.) Pp. 232. (Leipzig · Gustav Foch G.m b.H.)

Books on Astronomy and Mathematics (New Series, No. 44.) Pp 16. (London: Wheldon and Wesley, Ltd.)

A Catalogue of Books. Africa, Americana, Australasia, English History and Literature, Leaves from Manuscripts and Early Printed Books; Early Medicine and Surgery, Oriental; French, Spanish and Portuguese History and Literature; Early Science; and a Selection of Important New Books. (No. 526.) Pp 116. (London: Bernard Quaritch, Ltd)

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The Service of Unified Knowledge

JUST a century ago the library of that mighty book hunter, Richard Heber, came under the auctioneer's hammer, and two hundred and two working days were consumed in dispersing a hundred and twenty thousand volumes—a noble collection which yet did not represent more than a fragment of that portion of the world's thought heretofore collected between the covers of printed books.

What a change has come over the scene in the century that has passed! The staid astronomy over which Airy presided has expanded into a world picture wherein countless universes stream through space, and temperatures are reckoned in millions of degrees. The physical sciences are altered out of all recognition; their content has increased in an incredible ratio and, concurrently with an unprecedented increase in the technique of accurate measurement, has developed a doctrine of uncertainty which prescribes a limit to the accuracy of our knowledge. Theories of evolution have appeared on the scene, crossed the stage, and disappeared—possibly to reappear in modified form. Social systems, apparently stable, are in a state of flux; the father of sixty years since could train his son to a trade or profession with the reasonable expectation that the society in which he lived and moved would remain indefinitely stable; the father of to-day sees no such prospect. Youth is healthily critical of the fundamentals of our social system, and discourses copiously—sometimes perhaps a little superficially—concerning dialectical materialism and the Hegelian theory. And, if 'Whitaker' be a trustworthy guide—the year 1934 saw 15,436 new volumes thrown into this weltering confusion of assertion, argument and denunciation, in Great Britain alone.

What can be done about it? If there is one thing more certain than another, it is that some appreciation of the magnitude and mode of action of these forces of disintegration, of these rapidly changing aspects of political, moral and religious thought, of the social repercussions of the advances of scientific knowledge, must be the possession, not merely of an oligarchical or aristocratic governing class, but also of every man who by his vote or otherwise may influence the policy and outlook of the community of which he forms a unit.

Government to-day is much more of an art than a science, and grave questions of national policy are settled as the result of waves of mass-emotion—emotion which may or may not have its origin in a wise, altruistic and rational attitude to the problems of life. It will always be so—great movements of humanity will ever be determined by the forces directed by the emotions and passions of mankind; and it is the business of all who can help, to do so by assisting each one of us to form, so far as his limitations of capacity and opportunity will permit, that background of ordered knowledge which so much enlarges his outlook and thereby his ability to think clearly and wisely, and to direct his emotions to a worthy end. Moreover, the need presses; in more than one community where shallow draughts of psychology and philosophy have intoxicated the brain, we see a growing habit of depreciation of the actions of the intellect and of undue exaltation of emotional and intuitive processes.

We can at least provide the means towards supplying this need—we can, granted goodwill and energy, put at the disposal of every man, learned and unlearned, ordered statements of present-day knowledge in all branches of life and learning that the mind of man has traversed, and concerning which he has recorded his thoughts, his difficulties and conclusions in the pages of a book. Such a statement is an encyclopædia.

The notion of an encyclopædia is old enough, as old as the appreciation of the organic unity of knowledge—of the fact that the totality of knowledge is something more than the sum of its parts. The name is no older than 1541, the date of publication of Ringelberg's "Cyclopædia" at Basel; the notion is possibly as old as Aristotle, whose mind was essentially encyclopædic—as Pliny's was not. But the great incentive to encyclopædia-building came from the labours of Francis Bacon, whose attempt at a systematic classification of knowledge fired the imagination of Diderot and inspired the labours of D'Alembert.

Our countryman, Ephraim Chambers, had the root of the matter in him when he remarked that, in his view of an encyclopædia, one should "consider the several matters not only in themselves, but relatively, or as they respect each other; both to treat them as many wholes, and as so many parts of some greater whole". A truly admirable ideal; whether the "Cyclopædia or Universal Dictionary of the Arts and Sciences" (two volumes, folio; London, 1727) fulfilled these generous aspirations is another matter.

It cannot be too strongly emphasized that a true encyclopædia is something more than a bare summary of the knowledge of its day. Its articles may or may not be dashed off hastily—in the age of intellectual ferment that produced the great French Encyclopædia, articles were written at a white heat of enthusiasm, and it was just *because* that enthusiasm was linked with the forces of reason and of knowledge the French Encyclopædia became such a mighty weapon for the cause of progress. For that very reason it rallied, in the words of one of its great historians, "all that was then best in France round the standard of light and social hope".

So, too, the age that saw the passing of the Reform Bill saw the birth of a desire for the spread of positive knowledge that resulted in the publication of those remarkable volumes (twenty-seven of them, and two or three appendix-volumes) known as the "Penny Cyclopædia". He who has these volumes on his shelves will more willingly part with more pretentious cyclopædias. The wealth of articles contributed by Augustus de Morgan will never lose their value; and the whole encyclopædia is a noteworthy record of the aspirations and limitations of a phase in our history marked by a special enthusiasm for "the particular go" of material things.

It was also, we note in parentheses, the England of the Oxford Movement. But it was also the England of the Society for the Diffusion of Useful Knowledge—a Society the activities of which produced an inimitable passage in "Crotchet Castle"—and the "Penny Cyclopædia" faithfully reflects that aspect of its age. Calculus and chronology are there in full measure; the artistic and mystical side of life find but scanty record.

What type of encyclopædia will most fittingly serve the needs of our own age? Mr. Wells's vision sees a World Encyclopædia where all that is best of everything that need be said is gathered together in one great series of volumes—the best thoughts of the best writers—"selections, extracts, quotations, very carefully assembled with the approval of outstanding authorities in each subject, carefully collated and edited and critically presented".

It may well be so; this represents a high, though not an unattainable ideal. But though the difficulties are great and will have to be considered, we need not assume that the gain in authority of a collection and collation as nearly perfect as this imperfect world of ours will permit, will involve a loss of unity if control is entrusted to a band of learned workers informed with an enthusiasm for their task, and having a clear perception of the social needs of their age. It is, however, vitally necessary to realize such difficulties before embarking on the task of preparing an encyclopædia the influence of which may be so far-reaching.

Yet a further possibility should be considered. *Entia non multiplicanda sunt praeter necessitatem*, a dictum which is specially true of encyclopædias. But, broadly speaking, there is room and need for three types: the encyclopædia wherein the articles are written in terms of specialized knowledge; the more popular encyclopædia written with an eye to the needs of the layman; and a really critical bibliography of existing knowledge which shall discriminate between the needs of the specialist and those of the layman.

Such a critical bibliography—an almost indispensable preliminary to the greater task—would place at man's disposal a weapon of immense social value.

Topics of the Age for Everyman

The Columbia Encyclopedia
Compiled and edited at Columbia University. Clarke F. Ansley, Editor in Chief Pp. v+1949. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1936.) 63s. net.

THIS massive volume, twelve inches by nine inches in its superficial dimensions, nine and a half pounds in weight and containing, within the compass of its nineteen hundred and fifty pages, not less than four and a half million words, represents a heroic attempt on the part of editor and publisher to give to Everyman such information on the topics of the age as Everyman is likely to seek—and, moreover, to give him pointers which shall tell him where further detailed and authoritative information may be found.

This is a principal function of a modern *compact* encyclopædia. Tendencious disquisitions are not wanted here; detail should be cut down to the minimum; fine writing is anathema—"no flowers by request," said Leslie Stephen to contributors to the "Dictionary of National Biography"; the information conveyed should be both judicious and judicial; and the pointers should direct the way to the latest and fullest sources of information. Though, it must be confessed, the pointers are occasionally missing where they might well have been supplied, these necessary qualities are well shown in the "Columbia Encyclopedia", and the crucial questions now arise: What is the *content* of the volume? Over what regions of thought and of fact does it range?

These questions can be answered only by a process of sampling, and sampling processes are peculiarly liable to error. Everyman interested in theology may seek aid in the matter of the distinction between homoousian and homoiousian, or the thinkings and doings of sublapsarians, supralapsarians and semi-Pelagians, while remaining completely indifferent to the discovery of the neutron or the meaning of the Œdipus-complex; and contrariwise. (May it be said at once, and in parenthesis, that Œdipus, his complex and the neutron receive due notice, and that the Pelagian heresies and the views of the semi-Pelagians are handled in clear and scholarly fashion, but that the only entry made under the term 'supra' deals with the supra-renal gland—a pleasant, and not inapposite illustration of the trend of modern thought as interpreted in this encyclopædia.)

Still, if Everyman has a fairly inquisitive and ranging disposition the sampling process may not be devoid of significance. So far as the process has gone, it indicates, as was to be expected, that the outlook of the work is American. This is not an adverse criticism; it is a mere statement of fact, and does not imply that English interests do not receive adequate treatment. On the gazetteer side, for example, we find small American townships entered with a degree of particularity which it would be quite impossible to observe universally. But the English entries are adequate, and thoroughly up to date, as may be tested by reference to very recently formed boroughs.

The historical and political articles are remarkable for their clarity and for the completeness with which they supply essential and no more than essential information. In the articles which deal with theological topics, the omission of one or two subjects of special English interest is noteworthy. The accounts of the various Christian churches are admirably executed, the tenets of quite obscure sects being duly and briefly elucidated; but while Bishop (pop. 1159) and Bishopville (pop. 2249) are entered and described, the English Church dignitary is passed unmentioned, and he who would seek to know something of the duties of an archdeacon must remain content to think of him as one who exercises archidiaconal functions.

The scientific articles are definitely qualitative in character, in the sense that they abjure any attempt at symbolic exposition. Thus there is no entry to be found under the headings 'Differential Calculus' or 'Integral Calculus' and, under the general heading 'Calculus' a short entry of some two hundred words disposes of the whole matter. Similarly, the terms 'exponent' and 'logarithm' are simply and briefly explained, but there is no entry of the corresponding series, and these articles, again, contain no references to texts in which further information may be found. One or two references to mathematical literature are entered *s.v.* 'Mathematics'. Indeed, it is not only mathematical symbolism that is abjured, for the compilers are at pains to avoid any specialized jargon. Thus, to take a simple random example, 'Wallflower' is defined as an "ornamental perennial shrub of the mustard family" and the salient facts are given concerning its origin and cultivation, further descriptive notes on the family being found under the heading "mustard".

Although finer details are occasionally missing, the physical, chemical and astronomical articles are, in general, admirable examples of lucid compression. The articles under the headings 'variables', 'nebulæ', 'planetesimal hypothesis', 'hydrogen', 'X-rays' and 'photometry' may be cited as typical. A few of the more modern terms have been overlooked or treated very briefly in comparison with the space allotted to classical work. The policy of qualitative, or rather, of non-symbolic exposition—for there is no lack of numerical detail, where numbers are necessary—is one that has obviously been pursued of set purpose. It has everything to commend it, and the editor is to be congratulated on breaking away from the older tradition of exposition. He who can understand a symbolic expression of the binomial theorem or of a matrix is not likely to seek further information in a popular encyclopædia ; and, in the great majority of such cases, he knows where to seek his information, and is scarcely likely to need those pointers which are so useful to the reader interested in historical or literary matters.

What of the articles which are concerned with matters literary ? The lives and work of the great ones of the earth are expounded well and clearly, and most of the lesser lights find adequate mention, though Alfred Austin achieves a five-line immortality, whereas his fellow-laureate Pye ("Better to err with Pope, than shine with Pye") is left to languish in an unnamed obscurity.

It is when one comes to those very minor stars concerning whose merits and interest opinions may differ so widely that lacunæ begin to manifest themselves. Is Everyman entitled, as of right, to know something of the life of that odd figure, John Buncle, and of his equally odd creator, Thomas Amory ? Or of the author of "Valentine Vox, Ventriloquist", and his illustrator, Onwhyn ? The English reader may seek, but he will not find. On the other hand, the American, Gilbert Imlay, whose main interest to English readers lies in his relations with Mary Wollstonecraft, receives a notice of some twenty lines, and this may be taken as a fair example of the American leanings of an encyclopædia, which after all is called the "Columbia Encyclopedia".

Again, the claims of taste may be heard in the matter of the inclusion or omission of certain topics. The personal side of crime and criminology does not bulk largely in the pages of the encyclopædia, and Everyman interested in these matters may look up the story of Prof. Webster (one of our few academic murderers) only to be fobbed off with the life-history of the blameless and dull Noah Webster of dictionary fame. And why should the poisoner Thomas Griffiths Wainewright ('Janus Weathercock' and friend of Charles Lamb) be chosen, and Henry Wainwright, of the Whitechapel Road, left ? These be snobbish distinctions.

Seriously, this must not be interpreted as adverse criticism. From every point of view, the work is crammed with matter of very deep interest to the English reader. In the end, the test of such a volume, the compilers of which must necessarily pick and choose, decide to insert this and omit that, is : How often does it let one down ? The result of a fairly severe test shows that the occasions are relatively small.

Editor and publishers are to be congratulated on the completion of an arduous undertaking which fully deserves the success that doubtless awaits it.

A. F.

International Co-operation in Astronomy

Transactions of the International Astronomical Union
Vol. 5 : Fifth General Assembly held at Paris, July 10 to July 17, 1935. Edited by F. J. M. Stratton. Pp. viii+429. (Cambridge : At the University Press, 1936.) 15*s*. net.

IT is difficult to speak without admiration of this volume and of the indefatigable editorship of Prof. F. J. M. Stratton, formerly secretary of the Union, to whose almost unaided efforts we owe it. Following a brief report and financial statement from the Executive Committee, there appear the reports of the presidents of the thirty-one Commissions which form the Union. These deal with topics so diverse as notations, meridian astronomy, chromospheric phenomena, wave-lengths, nebulæ, radial velocities and stellar statistics. Amongst so much that is good, each reader, depending upon his ignorance or his knowledge, will select some reports as outstanding ; for his part, the reviewer would choose Fowler on wave-lengths and Jackson on meridian astronomy.

The remaining two fifths of the volume is concerned with accounts of the meeting of the Union as a whole, and of the meetings of the separate Commissions. While some of the Commissions, notably those on Ephemerides, Minor Planets, Wave-Lengths and Nebulæ appear to have taken advantage of the meeting in Paris to hold useful discussions, others appear to have indulged in little more than formal business.

It is in this respect that the present Astronomical Union differs so markedly from its predecessor, the International Union for Co-operation in Solar Research. In that body, if one may safely infer something of its proceedings from the published *Transactions*, informal discussion at the meetings took precedence over previously prepared formal reports, and even after an interval of twenty years, one can still recover something of the stimulation to research which those meetings must have provoked. Unquestionably there were giants in those days, and it would be difficult to imagine meetings attended by Schwarzschild, Schuster, Rydberg and Kayser which were not exciting. It is not to this, however, that the difference between the two Unions is to be ascribed; indeed, a meeting which has its Eddington, its Russell, its Shapley and its Milne can scarcely be said to be lacking in colour. Rather it would appear that, while by its own statutes the present Union puts first the facilitation of "the relations between astronomers of different countries where international co-operation is necessary or useful", the International Solar Union, in the words of its founder, put research first. Speaking at Mt. Wilson in 1910, Hale said:

> "It seems to me obvious that the most important work of the Union has been, and must continue to be, the stimulating of research. That is, it seems to me to be more important for us to come together, and talk together, than to carry on formal co-operative investigations. That has been our idea, I think, from the very beginning, and I believe that the Solar Union has accomplished it by stimulating research."

International co-operation is good, but individual research is better, and in the opinion of the reviewer the International Astronomical Union can only hope to reach the standard set by its predecessor when discussions on research problems take precedence over co-operative schemes and formal business.

H. H. P.

Mr. Fisher's History of Europe

A History of Europe
By the Rt. Hon. H A. L. Fisher. Complete edition in one volume. Pp. xv +1301. (London: Edward Arnold and Co., 1936.) 10*s*. 6*d*. net.

THE recent issue in one cheap volume of Mr. Fisher's already popular work is an event of considerable educational importance. There can be no doubt of the great vogue of this attractive reprint. It will become the most widely read book of general history for this generation of Englishmen, as Gibbon was for our forefathers of a century and a half ago, and there is a touch of Gibbon—a Liberal Gibbon—in its learning, spirit and style. It deserves, therefore, careful scrutiny and judgment, as much for its own great merits as for the sake of those whom it will influence. Moreover, the chief side on which it is open to criticism is that which comes most naturally within the scope of this journal To that alone we must confine our attention here.

Mr. Fisher's book does not purport to be merely a political history of Europe, and it contains many suggestive passages—notably those on Dante and Luther—dealing with other aspects of the life of Europe beside statecraft. On the aspect of intellectual life which specially interests us here, handsome homage is accorded in the introductory chapter. The passage deserves quotation

> "It is, moreover, to Europe-man that the world owes the incomparable gifts of modern science. To the conquest of nature through knowledge the contributions made by Asiatics have been negligible [this, of course, is far too sweeping] and by Africans (Egyptians excluded) non-existent. The printing press and the telescope, etc., etc., together with all the leading discoveries in physiology . . . are the result of researches carried out by white men of European stock. It is hardly excessive to say that the material fabric of modern civilized life is the result of the intellectual daring and tenacity of the European people."

This is a magnificent exordium, and later on at the beginning of the second volume, there is an excellent chapter on the various aspects of the Renaissance with due reference to Copernicus and Vesalius, and again, in the third volume a few pages on Darwin and Spencer. But sound in tone as these passages are, they form but a small digression in the 1,300 packed and brilliant pages which narrate the characters and actions of the heroic Vikings, the founders of dynasties and the leading statesmen and warriors who make up the traditional historical pageant of Europe. It has never been better mustered and presented in English than in these pages; but is it the most important part of the truth? One asks the question, not with any wish to disparage the value of the actual matter of which Mr. Fisher treats, or with the absurd idea that a historical work should be an encyclopædia and mention everything, but quite seriously and with a sincere desire to have his considered judgment, if he would give it. Two contrasted cases, nearly contemporary, will make the point clear. L. Cornelius Sulla, "an aristocrat of fine culture and licentious manners", whose calculated butcheries came to nothing, receives three pages. Archimedes, one of the greatest and most constructive minds who ever lived, is not mentioned at all. Nor indeed are most of the men of similar type throughout the story.

Our object here, however, is not to set up a series of such unprofitable, almost inconceivable, comparisons. There is a much more substantial question involved to which Mr. Fisher himself alludes in his preface. He there says, with modest pathos, that he is not one of those "wiser and more learned" than himself who can discern in history "a plot or rhythm", and that for him there is "only one emergency following another, and that the ground gained by one generation may be lost by the next". Surely it is just here that the growth of organized knowledge comes in to supplement, correct and give a background to the political story with its inevitable breaks and contretemps. For knowledge grows and works, no doubt with temporary lapses, but never with any permanent loss of what has been secured. Nor is organized knowledge a separate thing which can be left alone by the political historian to be treated by others. It enters intimately, continuously and with increasing dominance into the ordering of the life of the people, which we all agree is the main subject of history.

One consideration alone is sufficient to prove this in relation to the subject of Mr. Fisher's book. At the best period of the Roman Empire in Europe there was, it has been estimated, a population of some 70 million persons in the area, largely enslaved. There are now more than 400 millions, leading on the whole a peaceful and industrious life and all free—at least from legal slavery. It is the greatest and the most beneficent revolution which the world has seen and must be regarded as the goal of any history of Europe. Many causes have led the way. Better political organization is no doubt a large factor, and moral advance assisted by the Christian church and doctrine. But some of us hold that the organized knowledge of Nature, applied to industry, should have a leading place among the causes, and we look anxiously in any account offered to us for some recognition and analysis of this factor. It is not only essential to the understanding of the past, but it also gives to those disturbed by present events (among whom Mr. Fisher includes himself) a better standing towards the future. Here is the plot and the rhythm, and it is sadly to seek in this otherwise magnificent achievement. F. S. MARVIN.

Anthropology as it is

The Economics of Primitive Peoples
By Dr. Stephan Viljoen. Pp. 282. (London: P. S. King and Son, Ltd., 1936.) 12*s*. 6*d*. net.

WHEN first we set eyes on Negroes or Chinamen, their faces seem all alike. So do the minds of all non-Europeans. To the anthropologist, all men outside the trousered world are of one mental hue, called primitive. Since they are all one kind, what is true of one tribe can unhesitatingly be applied to all the rest from the North Cape to Cape Horn. If one is crassly conservative, all are (p. 30); if marriage is an extremely loose bond, say in Tahiti, it must be so in the Solomons; a place has been found where a woman's ambition is satisfied with presenting a son to her husband, so this is characteristic of all 'primitive' women.

Those who have had first-hand experience will demur at such generalizations and challenge the statements that lack of food leads to war (p. 75), that the arts and crafts are held in contempt by the men (p. 84), that primitives like to carry their most precious possessions on their person (p. 233). He is sure to know at least one tribe that does not conform, and perhaps a great number. But it would not be fair to hold the author responsible for the initial fallacy and its inevitable consequences. He has not undertaken to speak from experience, but only to mirror faithfully the views generally accepted, or at least discussed, in anthropological departments, not on economics alone, but also on a large number of subjects slenderly connected, such as couvade, human sacrifice, birth rites, metal working, etc. This is a work that is needed, especially by students.

For this task, the author is well fitted. Free from sectarian prejudice, or even from very decided opinions of his own, he can be content to record impartially the views of the recognized authorities. Sensible when critical, widely tolerant and eclectic, he has selected his materials well, put them together lucidly, and produced a very readable manual of anthropology as it is in 1936.

A. M. HOCART.

Schlacke und Vitamine:

die Schlackenkost als Behandlungsweg bei Krankheitszuständen. Von Prof. Dr. Hugo Salomon. Pp. vii+263. (Leipzig und Wien: Franz Deuticke, 1936.) 12 gold marks.

THAT anyone should be able to write some 250 pages on vitamins and roughage, in relation to the treatment of disease, is in itself surprising. When, however, we consider the author's name along with the facts that his book is published in Leipzig and Vienna and that he describes himself as of Buenos Ayres, we turn with some curiosity to see what it is all about, noting in passing that the dedication (to the author's wife) appears on a page headed by a text from Houston Stewart Chamberlain.

After all, there turns out to be nothing very exciting or subversive in the book. The author is an enthusiast for diets with a high roughage content, which also frequently means a high content of water-soluble vitamins and possibly of carotene. He seems to advocate wholemeal bread ("Schrotbrot", "Grahambrot") as an essential dietary constituent in the treatment of conditions as pathologically diverse as catarrhal icterus, hypertension, eczema, tuberculosis, diabetes (*sic*) and migraine.

Actually vitamins come in for very little mention at all; it is almost as if they had just been put into the title "to make it harder". The author's belief would seem, therefore, to be that if you take care of the roughage, the vitamins will take care of themselves. We know of little evidence for this faith, if fat-soluble vitamins are included in the creed.

This book may be of some assistance to those who have to ring changes on laxative diets with the view of achieving palatability and variety. As a contribution to nutritional or biochemical science it does not, however, seem likely to make an epoch, but its extreme colon-consciousness may give it an interest for psychologists.

A. L. B.

Jabo Proverbs from Liberia:

Maxims in the Life of a Native Tribe. By George Herzog, with the assistance of Charles G. Blooah. (Published for the International Institute of African Languages and Cultures.) Pp. xiv+272. (London: Oxford University Press, 1936.) 10*s*. 6*d*. net.

PROVERBS are mere pin-points of a mass of communal wisdom and experience. A collection of proverbs is therefore meaningless unless to each saying there is added an account of the traditions and situations that give rise to it.

However well this may be done—and our authors have done it well and thoroughly—it is beginning at the wrong end. God and eternity, for example, do not appear as concepts that permeate life and inspire many things of which proverbs are the least; they are introduced merely as footnotes to pithy sayings. Those sayings are recorded with a phonetic minuteness which is entirely laudable, but the subject of titles is scattered in allusions that are sufficient only to convince us that they play an important part in Liberian society (pp. 28, 31, 196, etc.). On the other hand, many topics often go to one proverb. Thus, No. 192 is a multiple peg for the care of teeth, matrimonial troubles, sacrifices, etc.

The reader feels as would a student of zoology who, instead of being given the whole animal to dissect, is faced with 416 carefully arranged heaps of miscellaneous tissues, which, if it were possible to piece them together, would represent only a small part of the whole.

The greater the care lavished on the preparation, the more one regrets that the labour should have been invested at so small a yield. The authors are thorough, painstaking, accurate, minute; in fact, they have the virtues one expects in research, except a sense of purpose.

A. M. H.

The Rational Quartic Curve in Space of Three and Four Dimensions:

being an Introduction to Rational Curves. By H. G. Telling. (Cambridge Tracts in Mathematics and Mathematical Physics, No. 34.) Pp. viii+78. (Cambridge: At the University Press, 1936.) 5*s*. net.

IN this tract Miss Telling has presented in compact form a great deal of information, gathered from various sources, which is not available as a whole elsewhere. The tract is divided into two chapters and a short appendix. The first chapter deals with the four-dimensional curve and its projective generation, invariants and the symbolical notation for them, fundamental polarity, trisecant planes, chords, quadratic involutions, director lines and planes, g-lines and the manifold G, the chordal J, the quartic surface K and its nodes, Segre cubic primals, and linear complexes containing the curve, or apolar to it. In the second chapter we descend to three-dimensional space, and consider quartic curves of the first and second kind, principal, quadratic, and cubic involutions; flexes, trisecants and Hessian points, the surfaces of Steiner and Veronese, and several special kinds of quartic curves. The appendix consists of a note on involutions on the four-dimensional quartic.

The style of the tract is clear and readable. The text is confined to the main line of argument without minor details, and the smaller points are summarized in the form of examples for solution by the reader.

H. T. H. P.

Mesure des températures

Par Prof. G. Ribaud. (Collection Armand Colin: Section de physique, No. 190.) Pp. 224. (Paris: Armand Colin, 1936.) 10.50 francs.

THIS handy volume on the measurement of temperature maintains the high standard we have been led to expect in the Collection Armand Colin. Prof. Ribaud has had wide experience of the subject both in Strasbourg and in Paris, and his larger volume "Traité de Pyrométrie Optique" is an authoritative account of one single branch. The amount of information contained in this smaller book is remarkable, and the presentation is admirable. The international temperature scale is adopted as standard, and the various methods of measuring high temperatures receive special attention. At the moderate price charged, the volume ought to be in the possession of all concerned in this important practical problem.

The McCoy Society's Expedition to Lady Julia Percy Island

By Prof. Frederic Wood Jones, F.R.S.

THE complete ecological survey of Lady Julia Percy Island was the first enterprise undertaken (in January 1936) by the McCoy Society for Field Investigation and Research. The McCoy Society was founded and organized by students of the University of Melbourne during 1935; and Lady Julia Percy Island lies off the coast of western Victoria (38° 24′ S., 142° E.). The island is separated from the mainland by a channel some five miles wide, and with as much as twenty fathoms of water intervening between it and the coast of Victoria to the west of Port Fairy (Fig. 1). The island is uninhabited, though various unsuccessful enterprises have at one time or another attempted to exploit it for grazing, for pig raising, or as a source of guano. It is more than 100 feet high, sheer on all sides, save for a precarious landing to the north, and is flat and exposed to all winds on its elevated plateau.

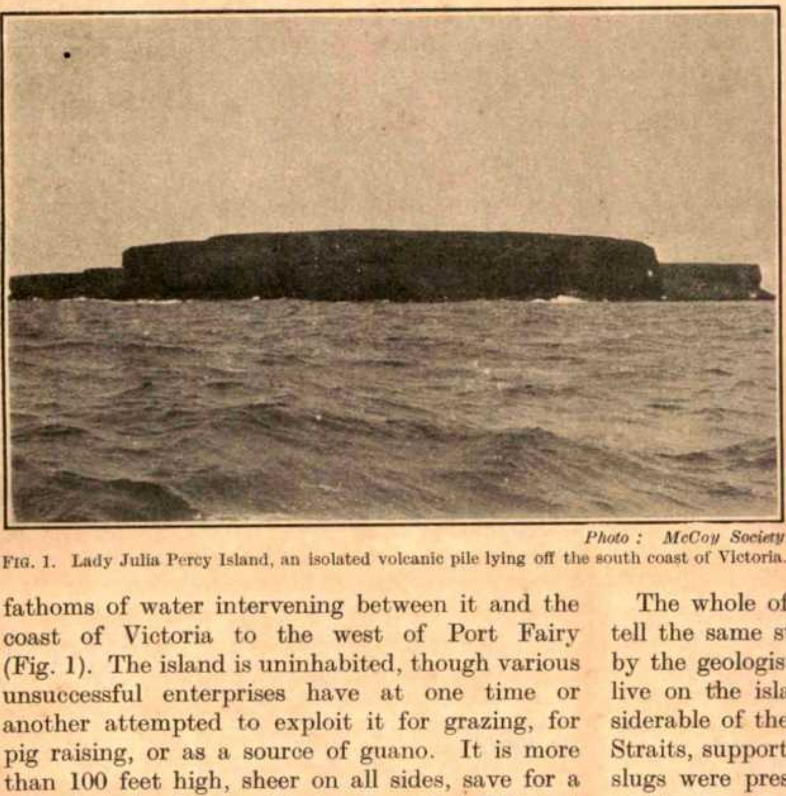

Photo: McCoy Society.

FIG. 1. Lady Julia Percy Island, an isolated volcanic pile lying off the south coast of Victoria.

The island plateau is a mile and a quarter long and three quarters of a mile wide. It was completely surveyed and mapped by the members of the expedition, and floral and faunal areas were precisely determined. A century ago it was covered with a dense, almost impenetrable, growth of the mixed bushy scrub that characterizes certain parts of the coast of the adjacent mainland. Some sixty years ago this dense scrub was still standing over the major portion of the island; but to-day the whole of the plateau is devoid of any growth more majestic than bracken fern and thistles. The whole plateau is, at present, a wind-swept area, clothed only by vegetation knee-high at the best, and at the worst, by loose volcanic soil or bare rock. This denudation of forest cover is due to human interference, for pigs were at one time turned down on the island, rabbits were liberated and are still living in their thousands, and sealers, fishermen and guano workers have cut down and burned the stunted and wind-blown trees that formerly covered the island.

Barren, inhospitable and forbidding though the island now appears, it proved to be a place of the most absorbing interest. The Bass Straits, St. Vincent's and Spencer's Gulfs, and the Great Australian Bight—the whole of the southern shores of Victoria and South Australia are dotted with islands, and I have visited more than thirty of them. But Lady Julia Percy Island, off Port Fairy, in Victoria, is different from all these. It is a pure volcanic island uprisen in the sea, and it has never formed a part of the continental mass of Australia, as have all the other offshore islands.

The whole of the flora and fauna of the island tell the same story as that which was unravelled by the geologists of the party. No land molluscs live on the island, though even the most inconsiderable of the islands of the Bight, and of Bass Straits, support a flourishing land-shell fauna. No slugs were present, and no amphibia. The only earthworm was not an Australian species, but was one introduced from Europe—an eloquent testimony to the reality of human interference in the dispersal of animal forms. There were no snakes, and the only reptile was a lizard which has an aptitude for being dispersed on every tiny fragment of land that lies off the Australian coast. No mammals live on the island plateau save the swarm of introduced rabbits, and the history of their advent is well attested. The only other mammals are the sea lions that resort to the island to breed, to raise their pups, to play, squabble and indulge in aquatic sports, and generally to have a wonderful time of fooling about that renders them the most engaging of animals for the casual observer—and the most lovable to the real student of Nature. It is a noteworthy fact that the sea lion of Lady Julia Percy Island differs profoundly, both in behaviour and in anatomical characters, from the species that inhabits the islands of the Great Australian Bight. This sea lion is a resident and local species, just as is the sea lion of the islands to the west, and it is much to be desired that local and uninformed legislation will never be directed towards the slaughter of these animals, the distribution of which is so restricted and the economy of which is, at present, so little understood.

The birds inhabiting the island are of two kinds, the land birds resident and breeding in the island, and the truly marine species that breed upon the plateau or among the rock boulders. In addition to these breeding species there are the visitors, both land and marine.

The resident and breeding species of land birds are of no especial interest. Native swallows, pipits, chats and red-capped dottrel breed in their accustomed sites upon the island, but only the pipits and the chats are numerous. The fine native swamp harrier is the dominant bird, and it breeds among the bracken ferns upon the open island plateau. On our arrival, these birds were so tame that it was possible to pick up the fully fledged young birds from their nests among the bracken; but, although they were not molested, they very soon learned all the wariness of their kind. They are the most conspicuous birds of the island and, at almost any time of the day, half a dozen or so could be seen floating above the plateau on the watch for young rabbits, penguins and mutton birds. Even the kestrels and the peregrines, which had apparently nested on the rock ledges of the cliffs, took a very minor part in policing the plateau. Introduced starlings and sparrows have reached the island, but they are inconspicuous and timid, and, for the most part, have their home in the volcanic cliffs and find their food upon the seal beaches.

Of the true sea birds, the Bass Straits mutton birds or short-tailed (or slender-billed) shearwaters (*Puffinus tenuirostris*) breed in large numbers in burrows tunnelled into the soft volcanic earth of the island plateau. The whale bird, ice bird or prion (*Prion turtur*) visits the island to lay its egg in the cavities beneath the vast basaltic boulders that strew the shore line, and the talus slopes of those parts of the island where the cliffs do not rise sheer from the water's edge. The shearwater and probably the prion are seasonal breeding visitors, but almost certainly the little diving petrel (*Pelecanoides urinatrix*) is a resident bird, breeding on the island and returning to it at dusk all the year round. The diving petrel is one of the most attractive of sea birds, a sturdy, manly, independent little fellow, with the most beautiful turquoise blue legs and feet and shining black and white plumage. He comes to the island only when the evening dusk has settled down, and as he comes he makes a little noise like a new-born puppy seeking its mother. From beneath some great boulder there comes the same little sound in answer, and soon, after flitting around like a bat in the dusk, he creeps into some chink, and a duet of little puppy-like love notes comes forth.

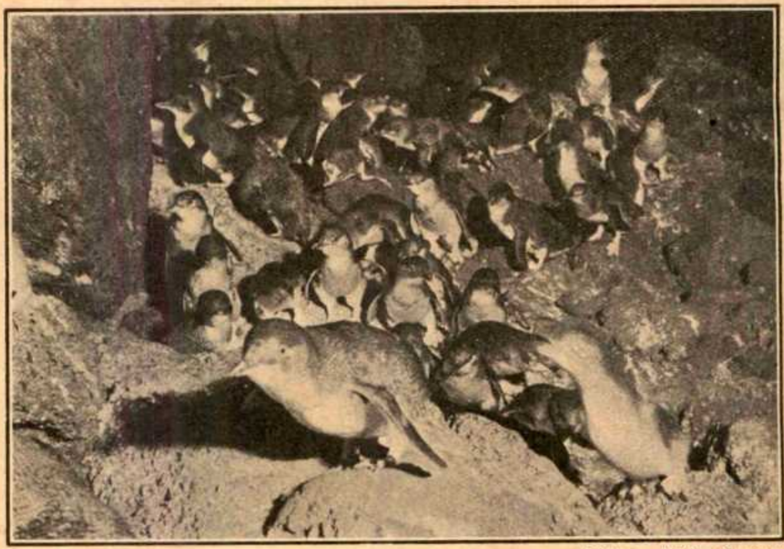

Photo: McCoy Society.

FIG. 2. The evening arrival of the penguins. The start of the long climb from the sea to the top of the island, taken by flashlight.

The prion is a ghost. A fluttering thing of pale grey-blue and white, a delicate wraith of a bird that comes moth-like into the beam of an electric torch and falls confused among the boulders—as it does at every lighthouse on the islands around the coasts of Victoria and Tasmania.

The Bass Straits shearwaters are birds of mystery. Anyone who has watched their evening arrival at a breeding island, seen their wheeling, watched them, as myriads of boomerangs, hurtling in the air, and followed their flutterings as they quarter the ground seeking their breeding burrows, has witnessed one of the most remarkable perfections of avian flight.

Then everywhere on the island are the penguins (*Eudyptula minor*). These little blue and white birds are among the most engaging of all the penguins, despite the fact that all their island activities are nocturnal. In solemn thousands they come ashore from the surf, and always at the same place, and in a sudden rush, every evening.

Every evening the whole company marches and hops up the same well-marked pathway to the island plateau and, at the plateau, disperses along numerous tracks to the breeding burrows. Every step of the way, every jump, every turn, is performed by every individual in the whole great army in exactly the same manner, and with the utmost solemnity. Every bird that, after the whole long journey, arrives at its home, finds two fluffy chicks awaiting it at the mouth of the burrow and regarding it with solemn expectancy. The little blue penguin is attractive beyond all birds in its serious and ordered ways of life, and in its queer sturdy independence that is combined with a most remarkable communal spirit. It is a strange thing that all these birds coming to the island at nightfall should forgather in the surf until their numbers are complete, and then, making a concerted rush through the breakers to the landing rock, start their long climb together (Fig. 2). For this coming and going is their time of peril, and a visit to any island upon which penguins breed tells its own tale. Penguin carcases, killed by harriers, peregrines and seals, strew the pathway from the surf to the breeding places; and around the rock holes or the burrows in which they breed are downy chicks ripped open by hawks or gulls. On Lady Julia Percy Island they did not have to run the gauntlet of gulls, for, strangely enough, these birds were not present on the island; but despite this, their mortality was very high.

During the hours of daylight, the island was a comparatively quiet place. Always there were the farmyard noises of the sea lions, for every sound, from the bleating of the lamb to the snarling of dogs and the lowing of oxen, came perpetually from the seal beaches. But when dusk came on there were added the indescribable groaning, mewing and caterwauling tumult from the mutton birds; the noise, rising from human snoring almost to donkey braying, of the penguins, and the newborn puppy sounds from the diving petrels and the prions. But despite all this, and the scarcity of fresh water, the members of the McCoy Society spent six happy weeks camped upon this volcanic island. They examined and collected everything, from soil bacteria to sea lions, and endeavoured to link the whole together in one complete ecological survey.

Terminology in Physics

By Prof. C. G. Darwin, F.R.S.

THERE has for some time existed an international committee, the 'S.U.N.', charged with the duty among other subjects of standardizing the nomenclature of physical quantities. So far as concerns such things as the names of units and their symbols it has proved effective. There has perhaps been a tendency for some of the members to point out that the majority were marching out of step; but in view of the very different approaches of different schools of thought, a certain latitude is perhaps permissible in the meaning and symbol of such a thing as *free energy*. This side of the question of nomenclature is adequately cared for, and is not the subject of the present article. Here it is proposed to consider certain obvious deficiencies and nonconformities in descriptive technical terms as they have arisen during the last decade or so in both English and American writings on atomic physics. It is not to be expected, perhaps not even to be desired, that any exact uniformity should be reached, but there are a number of cases where there is complete anarchy, and it is the aim of the present review to examine what principles should guide us in giving names to things, and possibly in a few examples to suggest appropriate solutions which may appeal to some of those who have not a conscientious preference for anarchy.

One of the greatest difficulties in the naming of physical ideas lies in the difficulty of translating a name out of one language into another. Consider, for example, the energy that remains in a body at the absolute zero of temperature. This idea was chiefly developed in German writings, and the quantity, following the polysynthetic spirit of the language, was called *Nullpunktsenergie*—name and definition in a single mouthful. Unfortunately, those who are charged with the literary side of education in England seem to hold that the best way to teach the writing of English is by drill in the very different rules of Latin grammar, and that nothing further is needed. The consequence of this curious opinion is that those, who will later have to invent new English terms, have been given no literary principles whatever to guide them in doing so, and therefore, since the idea was acquired in German, they can do no better than a literal translation, *zero-point-energy*, or even *zeropointenergy*. Now this is quite a different kind of name from any given when the original idea was invented by an English-speaking physicist; for example, if the α-particle had first been studied in Germany, we should, on this principle, be now calling its *range* its *reach-width*. Moreover, the translation of *Nullpunktsenergie* is a poor one, because we do not translate *Nullpunkt* as *zero-point*, but simply use the English term *zero*. It must rest with individuals to judge whether the expressions *zero-point energy*, *zero-point displacement* and so on (anyhow with only one hyphen) are so well established that their ugliness must be accepted, but it does seem a pity not to create an English technical term and speak of *residual energy*, etc., which could be done without ambiguity.

The expression *zero-point energy* is merely clumsy and ugly; but our next example is rank bad grammar. One of the great advantages of English is the latitude allowed in grammatical construction, but even this has its limits. Contrary to the rules of most European languages, it is admissible to use a noun as an adjective qualifying another noun, and this makes it unnecessary to coin many adjectival forms that would otherwise be needed, but it is not allowable to use a noun to qualify an adjective. One may not infrequently see in learned journals such a phrase as "This may be proved by *quantum theoretical* methods". What part of speech is *quantum* here? Some writers, perhaps conscious of offence, run the two words into one—a pure Germanism. Others hyphenate them, and if the expression must be used at all this is the least intolerable form. The proper English form would be *quantum theory methods*, though even that is very clumsy, and *quantum methods* is quite good enough. However, for such a fundamentally important idea there is need for a real adjective, if only to make the contrast with *classical*. Moreover, there is absolutely no need to have the word *theory* (or the word *mechanics*) in the name, and so the right procedure is to coin the adjective *quantal*. To justify its adequacy it is only necessary to notice the impossibility of finding anything that would be *quantally* right, but *quantum-mechanically* wrong.

The general difficulty about the translation of technical terms is that when an idea is first invented one is not sure if it will be worth translating at all, and later, when its utility is established, one is so accustomed to the awkward literal translation that one is like the cricketer who was asked the origin of the 'yorker' and replied, "I don't see what else you could call it". In the choice of a name for a new idea there are several alternative methods. First it is easy to overrate the danger of taking an ordinary word and giving it a technical meaning: witness such words as *force*, *strain*, *susceptibility*. In spite of the double meanings, these are good names, but not all such words have been so well chosen; the word must be recognizably a technical term, which means that there must be no likelihood of its ordinary use being needed in the same context as its technical use. The difficulty of this method of choosing a name is that the word will always have a whole set of mental associations different from the new intention, so that the inventor is conscious of objections against any choice; for this reason it is inadvisable to stretch the meaning of a common word very far.

Another method of nomenclature gives up the problem altogether by simply taking the name of the inventor. This is often a good method, but it must not be carried too far or the reader will have to construct a special dictionary in order to remember the meanings of the various names. Another confusion arises when two things, cognate but different, are named after the same author. For example, there are a *function* and *equations* and a *principle*, all named after *Hamilton*. The first two belong together and are habitually called after him, but the *Hamiltonian principle* is something rather different, and is better called, by a slight misdescription, the *principle of least action*. Another thing to avoid with this method is what appears to be a growing fashion, the stringing together of a sequence of the names of all those who have worked at a subject. There is a most useful process in quantum theory often called the *Wentzel-Kramers-Brillouin method*, and it is no disparagement of the brilliant work of these writers to say that this is a very inconvenient name. If no better technical name can be found, then physics should borrow a rule established in taxonomic biology and take the name of the author who had the strict priority of publication; in the present case it happens that it would be none of the three names above, for the method has been discovered no less than four times independently, and *Jeffreys* has the priority.

Another way of making a name is to construct it from parts out of the classical languages, and this method has the great advantage that the word, being a new one, is immediately recognized as being a technical term. A thing like *entropy* has to be given some sort of name, though the idea is really incapable of any short description, and we feel that this is a better kind of name than the artificial *gas*, even though Aristotle would have been equally unable to make anything of either. There are, however, many words which do aim at explaining themselves, so that the classical scholar, perhaps repressing a shudder at faults of synthesis, would have some idea what they meant, and the guiding principle for these ought to be that their composing parts should be fairly well-known words in the original language; for this reason, Latin is perhaps more suitable than Greek. Following this line, and without suggesting that established practice should be changed, it seems a pity that one must use the word *hœmatopoietic*, instead of *sanguinific*, always supposing that there are objections to the honest and simple *blood-making*.

Yet another method is to take a word straight out of some foreign language and use that. This is a method that needs much caution; for the borrowed word must be such as will fit into a spoken English sentence. Consider Gibbs's *ensemble*. It is a most embarrassing word to have to speak in a lecture, since all the letters have different values from those in the accompanying words. Even the skilled bilinguist has to 'change gear' in the middle of his sentence, and the less accomplished can scarcely fail to exhibit the deficiencies of his international culture. When such a word has been adopted, the proper course is boldly to give every letter its English value[*]. This word also exhibits the general difficulty of nomenclature. In French it does not really describe the idea at all well, since a *together* does not convey the idea of the simultaneous consideration of a set of quite separate motions of an assembly of atoms. Indeed, one would naïvely suppose that it meant the assembly itself, and such a word as *collection* seems to describe the idea better in English than does *ensemble* in French. As it turns out, the French word, used in English and anglicized, is best of all, but this may be partly because the inventor had the field entirely to himself for many years, so that his word has been accepted without having to prove its superiority over possible rivals. German words on the whole fit the English mouth better than French, but their uncongenial length gives them an alien character much more marked than that of an anglicized French word; we may accept *eigen*-functions, etc. (though the more usual prefix would have been *auto*-) but most others are unsuitable.

There is quite a different matter in which our present terminology is bad; unfortunately, sometimes in well-established practice. This is when two words which express opposite ideas sound nearly the same. To make a contrast between *intra-molecular* forces and *inter-molecular* forces confuses listener, reader, printer and sometimes even speaker as well. Here the right course is undoubtedly to make names which, even if less exactly suitable, sound quite different; the proper contrast to *intra* is *extra*. A worse example is *microscopic* and *macroscopic* when used in physics. To the inventor, this contrast may have had a pleasing epigrammatic flavour, but when the freshness has gone it becomes fantastic. We have two diametrically opposite ideas described by eleven letters with only one of them different, and they are such that the pronunciation of either in some of the English dialects would give the impression that the other was meant[*]. Both words are objectionable. *Microscopic* in this contrast habitually refers to things far too small to be seen in any microscope; it might just do in the popular sense of 'awfully small', but if a change is to be made we might as well get it right. *Macroscopic* is worse, because μάκρος is not one of the words otherwise used for derivatives, so that it will not convey its meaning to any but a scholar, and to be understood by others the word ought to have been *megascopic*. We want a word which the dictionary would describe as 'of, or pertaining to, bulk', and the best seems to be *molar*. It is true that this word has other meanings both in physical chemistry and in dentistry, but there is little danger of confusion. The contrasted word would be *atomic* (better than *molecular* because so much less like *molar*), since this describes the actual scale of magnitude which has hitherto been misdescribed as *microscopic*.

Finally we may refer to a less important matter, but one which makes an inconvenient gap in our language; this is the non-existence of an ordinal number corresponding to the cardinal number *zero*. In the literature one can find the expressions, "Bessel function of *zero* order", "*null* approximation", "*zeroth* law of thermodynamics", where in each case the next of the sequence would be called *first*, not *one* The word *zeroth* is a terrible hybrid, but the mere fact that it has been tried shows that the need of a distinction between ordinal and cardinal is really felt. On the whole, this seems to be a case for the technical use of an ordinary word, and the word *null* might be adopted. It may be objected that it does not quite mean what is wanted; of course, it has not meant it hitherto, for if it had the question would not arise, and this paragraph would not have been written. But it is a true adjectival form connected with the number *zero*, and so seems to fill the bill with less strain than any other word.

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[*] In the same way *spin* has recently been adopted abroad, and it is to be hoped that it is called *shpin* in Germany, and nasalized in France.

[*] There is less danger in other languages when spoken, but a careless printer might give just as much trouble

There are no doubt other examples where improvements are needed, but the above are among the most glaring. The present article does not aim at inducing any exact conformity to its suggestions, but rather at directing attention to the real difficulty in the invention of suitable names for new things, and to the importance of doing it carefully. It may also be hoped that the actual suggestions may be of service, so that those future writers who have not yet firmly established their own usages may be induced to accept at least some of them.

Control of the Prickly-pear in Australia

THE control of the prickly-pears, *Opuntia inermis* and *O. stricta*, in Australia affords one of the most outstanding examples of the application of biological knowledge to economic purpose. It needs to be recollected that in 1925, about sixty million acres of grazing and farming land were known to be under infestation by prickly-pear in Queensland and New South Wales: the rate of spread of this scourge was stated to be reliably figured at almost one million acres a year. About fifty per cent of the infested territory was under dense prickly-pear, 3–5 ft. high, while the remaining area was affected by scattered infestations of varying intensity. To-day, the enormous rate of increase has been arrested, and less than ten per cent of the former great body of infestation survives: the whole of the primary pear in Queensland and much in New South Wales has broken down and collapsed. Approximately, twenty-five million acres of good land are now cleared and are being developed and brought under production.

The history of the campaign of control and eradication of prickly-pear has recently been briefly discussed by Mr. Allan P. Dodd, officer-in-charge of prickly-pear investigations, Brisbane. All interested in the subject should read his important paper in the September issue of the *Bulletin of Entomological Research* (27; 1936); a comprehensive history of the whole subject is promised in book form within two years time.

At the outset, the problem was how to eradicate a plant pest which had overrun, and rendered valueless, vast areas of territory. A pest, in fact, which could not be controlled by cultural, mechanical or chemical means, since the cost of widespread treatment by any of these methods rendered their application out of the question. The first steps towards applying biological methods of control were taken in 1912, and in 1920 the Commonwealth Prickly-pear Board came into being. This Board was charged with the study of prickly-pear in its natural home in America and the introduction, if possible, of insect or other enemies into Australia.

Since 1921, officers of the Board have visited most of the known prickly-pear regions of North and South America. Their investigations resulted in the discovery of about 145 species of insects which appear to be confined, in feeding habits, to prickly-pears and other Cactaceæ. Fungal and bacterial diseases also came in for investigation, but it was revealed that they did not afford much promise of direct utility, since many of these diseases were already established in Australia.

The Board's policy was based upon the conception that biological control offered best chance of success if a carefully selected group of species, working more or less in association, was established. A variety of promising species readily became adapted to Australian conditions and it was anticipated that their combined activities would, in course of time, result in gradual thinning out of the prickly-pear, in reduction of fruiting and consequently restriction of the spread of the pest.

It was quite unforeseen that the outstanding success evident to-day would have been effected by the agency of a single species of insect in the space of a few years. Nevertheless, this is what actually has happened, and the insect in question is the phycitid moth, *Cactoblastis cactorum* Berg. The fact is all the more remarkable for the reason that only 2,750 eggs (from the Argentine) of the insect were introduced into Australia, yet between 1926–30, about three thousand million eggs, laid by descendants of insects issuing from the original batch, have been distributed in the great prickly-pear areas. The eggs are laid by the moth in 'sticks', averaging seventy-five eggs in each: these 'sticks' are readily collected and artificially attached to the cladodes of the host plant. The resulting larvæ are gregarious, internal feeders which tunnel in companies through the tissues of the plant, thus also providing for the ingress of disease organisms. In this way the prickly-pear ultimately becomes so completely destroyed that it is reduced to a rotting mass of pulp. The various insects, established prior to the *Cactoblastis*, have either been largely suppressed or their activities nullified owing to competition with its larvæ. It is only locally, and in relation to a few species of *Opuntia* of lesser importance, that the *Cactoblastis* has proved more or less ineffective. Such problems, however, are being dealt with effectively through the operations of other phytophagous insects including cochineal (*Dactylopius*) and cerambycid beetles.

In any campaign involving the repression of pest plants through the medium of introduced species of insects, the potential danger that such insects, in a new environment, may transfer their activities to other host plants cannot be neglected. In the case of prickly-pear control, elaborate biological tests as to the host plant range and preferences of such insects have been a feature of inestimable value. Doubtful species have been excluded and none so far introduced has betrayed any tendency, other than of a sporadic nature, to resort to hosts outside the species of *Opuntia*.

We hope to refer to prickly-pear control again at a later date when the promised book, recounting full details, becomes available.

A. D. IMMS.

Obituary

Prof. T. M. Lowry, C.B.E., F.R.S.

THOMAS MARTIN LOWRY, who died at Cambridge on November 2, came of an old Cornish family which had been long connected with the Methodist Church; he was born at Low Moor, Bradford, Yorks, on October 26, 1874, the second son of the Rev. E. P. Lowry, senior Wesleyan chaplain and staff officer at Aldershot. He was educated at Kingswood School, Bath, and thence passed to the Central Technical College, South Kensington, in 1893, with a Clothworkers' scholarship, and was ultimately awarded the fellowship of the City and Guilds of London Institute. From 1896 until 1913 he was an assistant to Prof. H. E. Armstrong; in 1904–13, was lecturer in chemistry, Westminster Training College, and from 1913 until 1920 head of the chemical department in Guy's Hospital Medical School; in 1920 he was appointed to the newly created chair of physical chemistry in the University of Cambridge, a position which he held at his death. He married a daughter of the late Rev. C. Wood in 1904 and leaves two sons and a daughter.

During his long service with Prof. Armstrong, Lowry gained recognition for his delicate work in organic chemistry. The proficiency which he then acquired as a crystallographer expressed itself later in the aptitude which he displayed in applying exact physical methods of measurement to the solution of chemical problems; he developed a rare instinct for grasping the essentials of any subject which he attacked and for ensuring that the quantitative methods used were devoted to the measurement of something which was clearly defined. The vast mass of quantitative physical data collected by Lowry is thus not of merely ephemeral interest but will also provide useful working material for future generations of physical chemists.

During Lowry's first research work, he noted that the optical rotatory power of nitro-*d*-camphor solutions changes with lapse of time, and he early realized that this effect, which he termed mutarotation, arises from the tautomeric change of substances such as derivatives of camphor and of sugars. Mutarotation is dependent on the nature of the solvent, and the mutarotation of *d*-glucose can be arrested in such a hydroxylic solvent as cresol, or a basic one like pyridine, but proceeds almost too rapidly for measurement in a mixture of these solvents. Lowry thus showed that an amphoteric solvent is necessary as a catalyst for the mutarotation process, and built up his now well-known theory of prototropic change; it is largely on this work that the conception of dynamic isomerism advanced by van Laar became generally accepted.

Concurrently with his purely chemical work on mutarotation, Lowry studied the variation of rotatory power with wave-length, a subject which had been much neglected since the death of Biot in 1862. He demonstrated the validity of Drude's equation for simple substances and expanded the equation so that it covered the anomalous rotatory dispersion of *d*-tartaric acid and the tartrates; this formed the subject of the Bakerian Lecture before the Royal Society by Lowry and Austin in 1921. Lowry's later determinations of the rotatory power of quartz, made on a column nearly half a metre in length, both in the visible and ultra-violet, furnished data of the highest precision by which again the validity of the Drude equation was established. He turned next from the optical rotatory power of transparent media to that of absorbent media and studied the Cotton effect; here he was able to develop equations which adequately express the dispersion throughout the absorption band. Whilst Lowry's main work in this field bore on optical rotatory power, he also studied other optical phenomena, and during recent years had initiated a series of investigations concerned with the refractive dispersion of organic compounds.

During the Great War, Lowry devoted himself to problems connected with high explosives and acted as director of shell-filling from 1917 until 1919; he did valuable service on the Trench Warfare Committee and the Chemical Warfare Committee and was an associate member of the Ordnance Committee at the time of his death. His war services gained him the C.B.E. and the Order of St. Maurice and St. Lazarus. He took the D.Sc. (London) in 1899 and held the honorary degree of M.A. (Cambridge) and doctorates of science of Dublin and Brussels; he became a fellow of the Royal Society in 1914.

In addition to some hundreds of important papers published with numerous collaborators, Lowry wrote several useful books; the last of these, on "Optical Rotatory Power", was issued last year and will long remain a standard work on the subject. The immense amount of accurate experimental work which Lowry has left on record secures him a permanent place in the history of the science to which he was devoted. His old colleagues and students in the laboratory of physical chemistry which he built up at Cambridge will remember him as a staunch friend, an inspiring teacher and an indefatigable worker who has passed too soon from their ranks.

WM. J. POPE.

Prof. H. R. Briton-Jones

PROF. HARRY RICHARD BRITON-JONES whose untimely death occurred in Trinidad on November 3, following an operation for appendicitis, will be mourned by a wide circle of friends, scientific colleagues and past and present students of the Imperial College of Tropical Agriculture. He was born in 1893 and educated at Llandovery College, of which he was a scholar. He entered King's College, London, in 1912, proceeding to the Royal College of Science in 1913, where he took the associateship and, later, the diploma of the Imperial College. In 1915 he was commissioned in the R.G.A. and he gained the M.C. on active service, being eventually invalided from shell-shock, with the rank of captain. Attracted to the study of plant diseases, he re-entered the Royal College of Science to equip himself for phytopathological research; a short period was also spent at the Royal Botanic Gardens, Kew, in systematic study of the fungi parasitic on plants.

At the end of 1919, Briton-Jones was appointed mycologist in the Egyptian Department of Agriculture, but he left in 1923 to become mycologist at the Horticultural Research Station of the University of Bristol at Long Ashton. He was appointed professor of mycology and bacteriology at the Imperial College of Tropical Agriculture, Trinidad, in 1926 and dean of the College in the following year; he acted as principal on several occasions.

In Egypt, Briton-Jones devoted himself largely to the study of cotton and cereal diseases, publishing in 1925 the main results in a memoir entitled "Mycological Work in Egypt during the Period 1920–1922". At Long Ashton he was led to consider the influence of the nutrition and cultural management of the host plant on its susceptibility to parasitic disease, a subject which afterwards became increasingly predominant in his mind. While there, he published work on the cause of die-back of fruit trees, a problem not yet fully elucidated but in which the factors of nutritional and soil-moisture unbalance which he emphasized probably play a considerable part. On proceeding to Trinidad, he applied the same considerations to the diseases of permanent tropical crops, especially cacao and coco-nuts. His book on "The Diseases and Curing of Cacao" (Macmillan and Co., Ltd., London, 1934) was followed by a similar work on coco-nut diseases, but he did not live to see it published.

Briton-Jones's outstanding virtue as a mycologist was his very practical outlook. His opposition to academic views was sometimes carried to extremes, but he was intensely in earnest, and his enthusiasm in combating theory by practical experience often supplied a useful corrective. He helped to place plant pathology on a wider basis than that of parasitology, and in this his influence has been spread by his students to many parts of the Empire. As a teacher, he was the right man in the right place; to his students he was a friend, and he shared in their college life—he was a keen Rugger player—and gained their affection to an unusual degree.

E. J. B.

Lieut.-Colonel R. H. Elliot

LIEUT.-COLONEL ROBERT HENRY ELLIOT, whose death on November 9 we regret to record, had a distinguished career in ophthalmology as well as in other walks of life. The son of a colonel in the Army, he was educated at Bedford School and St. Bartholomew's Hospital, where he was a prizeman of the medical school. He had a brilliant career as a student and qualified M.B., B.S. (London) with honours in three subjects. He took his fellowship of the Royal College of Surgeons of England in 1892 and in the same year took the D.P.H. Cambridge and entered the Indian Medical Service. At Netley he was Montefiore scholar and medallist and Maclean prizeman in military surgery.

Soon after arrival in India, Elliot joined the Southern Presidency. His work there naturally led to an extended experience in ophthalmology, and he was superintendent of the Government Ophthalmic Hospital, Madras, and professor of ophthalmology in the Medical College from 1904 until 1914. While on leave in 1904, he completed his qualifications by obtaining the Sc.D. (Edin.) and the M.D. (Lond.).

Elliot's name will always be remembered for the work he did on sclero-corneal trephining in cases of glaucoma. The operation is known by his name all over the world, and was a notable advance in the surgical treatment of a disease the origin of which is in many cases obscure, and which has in the past led to a great deal of blindness.

Elliot's literary output was considerable. His chief works were handbooks on glaucoma and an account of sclero-corneal trephining, each of which went to a second edition. Besides this, he wrote an excellent text-book on tropical ophthalmology, which has been translated into a number of foreign languages, as well as smaller works. His work brought him many distinctions at home and abroad. Returning home in 1915, Elliot settled in London and quickly acquired a very large practice. For a number of years he was ophthalmic surgeon to the Prince of Wales General Hospital, Tottenham; and he was Consulting Ophthalmic Surgeon to the Hospital for Tropical Diseases.

Apart from his work as an ophthalmic surgeon, Elliot was an authority on snakes and a first-class amateur conjurer. His last book was published two years ago with the title "The Myth of the Mystic East". In it he discussed Indian magic and miraculous cures. He insisted that there was little if anything in Indian medicine that was unknown to European medicine; and he was equally sceptical as to the Indian rope trick, as may be seen from an article on "Indian Conjuring" contributed by him to NATURE of September 12 last.

Of late years, Col. Elliot had taken a prominent part in the management of the British Health Resorts Association, and until his health broke down he made his driving force felt in whatever he undertook. His wife died some years ago; much sympathy will be extended to his three sons.

We regret to announce the following deaths:

Captain H. J. Coningham, an authority on the geography of Asia Minor and the Caucasus, aged sixty-nine years.

Prof. Edwin O. Jordan, professor of bacteriology in the University of Chicago, known for his work on public health, on September 2, aged seventy years.

Prof. Oskar Klotz, professor of pathology and bacteriology in the University of Toronto, an authority on diseases of the arteries and the liver, on November 3, aged fifty-eight years.

Dr. Alfred Nippold, director of the Magnetic Observatory, Berlin, on October 4, aged sixty-two years.

News and Views

Rev. Wm. Tuckwell: a Pioneer of School Science

IN the first number of NATURE appeared an article by one of Huxley's friends, the Rev. Wm. Tuckwell, on "Science Teaching in Schools". Tuckwell was a pioneer in this work, and it was he who really first introduced a regular course of instruction amounting to no less than three hours per week per boy. The story of his career as headmaster of Taunton College School, now King's College, Taunton, is a long and interesting one. At first he met with extraordinary success, numbers of scholarships were won, and with the help of Henry Labouchere, Lord Taunton, and other influential friends the ancient school was moved to new quarters outside the town at a cost of £25,000. Then trouble arose owing to local clerical and conservative suspicion as to Tuckwell's orthodoxy; and after a furious controversy resignation was forced on him in 1877.

TUCKWELL was a man of wide culture, a good classical scholar, with a deep knowledge of English literature, and, although his work was apparently a failure, his methods were copied in schools all over the country. The school almost broke up when he left, but was later acquired by the Woodard Corporation and has since gradually risen in numbers to two hundred boarders. The pendulum has swung back again, and in 1934, Dr. R. D. Reid, a science graduate and the first layman for three hundred years, was appointed headmaster. He, wishing to recognize the work of his pioneering predecessor, sought out Mr. Tuckwell's surviving daughters, Lady Welsh, and Miss Gertrude Tuckwell, C.H. They have presented many of their father's books and MSS. to the school library, including a much treasured first copy of NATURE. They also have erected a memorial to him in the school chapel, and this will be dedicated by the Chaplain, Bishop O'Rorke, on November 29, at 6 p.m., at which service any friends would be welcomed. King's College possesses what is believed the first school laboratory, erected by Tuckwell in 1868. It is still in use, but is shortly to be demolished.

Wilhelm Ebstein

NOVEMBER 27 marks the hundredth anniversary of the birth of the eminent German physician Prof. Wilhelm Ebstein. He was born at Jauer, in Silesia, and studied medicine in Breslau and Berlin, where he was the pupil of Frerichs, Virchow and Romberg. After qualifying in 1859, he became physician to the All Saints Hospital at Breslau, where he did valuable work on gastric secretion and dermatology, a subject in which he always took a keen interest. He served as a medical officer in the Franco-Prussian War of 1870–71, and in 1874 was appointed professor of medicine and director of the Polyclinic at Göttingen, where he proved himself to be an indefatigable teacher, investigator and organizer, and created a model clinic well equipped with laboratories for scientific research. He was a remarkably prolific writer, as will be seen by the list of his works compiled by his son, the late medical historian Dr. Erich Ebstein (*Deut. Arch. Klin. Med.*, 89, 367; 1907), but he is best known for his studies on obesity, gout and diabetes. His book on diabetes and its treatment was translated into French, Danish, Swedish and Russian, and one on the nature and treatment of gout into English and French. His historical contributions included articles on the Plague of Thucydides, the English Sweat, medicine in the Bible, Linnæus as physician, and the history of chicken-pox. He retired from his chair in 1906 at the age of seventy years, but remained in active consulting practice until a few days before his death from apoplexy on October 12, 1912.

Relation of Science to War and Defence

AT a public meeting organized by the Association of Scientific Workers, held at the Royal College of Science, London, on November 19, questions relating to "Defence and the Responsibilities of the Scientist" were discussed by a representative gathering of scientific workers. Prof. J. B. S. Haldane presided, and Prof. S. Chapman and Air Commodore L. E. O. Charlton opened the discussion. Prof. Chapman denied the accusation that science is responsible for the horrors of war; dismissed the proposal that scientific workers should refuse to do war work as impracticable; urged them to join with the general public in order to take the necessary political action to stop the use of science for purposes of destruction, and suggested finally that the most suitable form of action would be the setting up of an international police force under the auspices of the League of Nations. Air Commodore Charlton showed how one of the principal technical achievements of our age, the aeroplane, has brought war to our doorstep, and has made the world population centres, such as London, the principal military objective in a future war. He presented quantitative evidence of the inadequacy of all known methods of defence, and urged scientific workers to devise something that would render the use of bombers impossible. In the subsequent discussion, attention was directed to the alternative policies advocated for avoiding war. The general consensus of opinion seemed to be in favour of some system of genuine collective security, and rejected both the isolationist and the pacifist solutions. J. D. Bernal reported the principal recommendations of the Science Section of the International Peace Conference held in Brussels last September. These included the proposal that scientific workers should apply scientific method to the study of war in all its aspects, to investigate the causes of war from the point of view of social and biological science, and to expose pseudo-scientific theories justifying war and racial superiority. It was finally proposed that a national commission representing all branches of science be set up to co-ordinate this work. These recommendations met with the warm support of the meeting.

Social Mission of Science

THE "Social Mission of Science", which formed the subject of a leading article in NATURE of October 24, has no more important objective, according to Prof. John Dewey, the veteran philosopher of Columbia University, than to elucidate the relation between authority and freedom. In his address at the Harvard Tercentenary Conference of Arts and Sciences on September 4 on "Authority and Resistance to Social Change" (*School and Society*, October 10), he exposed two fallacies underlying much of the philosophy that has gone by the name of liberalism, namely, that authority and freedom have separate and independent spheres of activity and no form of authority is justifiable that is not the product of, and sanctioned by, the conscious wants, efforts and satisfactions of individuals in their private capacity. While decrying the principle of authority, this philosophy, in fact, erected the wants and endeavours of private individuals seeking personal gain to the place of supreme authority in social life. Its failure to produce the conditions of a generally shared individual freedom is largely responsible for the recrudescence of the principle of authority in its most extreme and primitive form—the rise of dictatorships.

No collective planned economy, Prof. Dewey said, will succeed without some hitherto untried means for bringing into life an organic co-ordination of authority and freedom. It is here that science may help. It is suggested that the working of co-operative intelligence as displayed in science may serve as a working model of the union of freedom and authority. Here is seen individual freedom that is both supported by collective organized authority and, in turn, changes and is encouraged to change and develop by its own operation the authority upon which it depends. The extension to the wider field of human relations of the method of control by organized intelligence operating through the release of individual powers and capabilities presents enormous difficulties, but it is, Dewey holds, the only means whereby humanity can be rescued from "that futile and destructive oscillation between authoritative power and unregulated individual freedom to which we may justly attribute most of the sorrows and defeats of the past".

The Permanent International Studies Conference

THE report on the work of the Intellectual Co-operation Organisation, submitted by the Sixth Committee to the Assembly of the League of Nations, refers to the expansion of the Permanent International Studies Conference, which is now engaged in an objective and scientific study of foreign policy. This is an autonomous body which is able to pursue its work in the complete independence proper to scientific research. The most recent subjects dealt with by the Conference are State intervention in economic life, the possibility and conditions of an organization of collective security, and peaceful methods of change as applied to particular problems. For 1936 and 1937, the subjects chosen include the procedures for the peaceful settlement of disputes which have been applied in particular cases, over-population, colonies, migration and distribution of raw materials. In the field of education, an important result of the year's work of the Committee has been the publication by the Paris Institute of a first volume dealing with the organization of higher education and research in several European and American countries, while the Committee's efforts in the teaching of history are bearing fruit in the revision of text-books.

SPECIAL interest is attached to the attention which the International Committee is now giving to the question of unemployment among intellectual workers. While this question cannot be separated from the problem of unemployment as a whole, and the remedies to be recommended are chiefly national in character, international action may be of great value, particularly in the nature of co-operation between university information bureaux. Closer relations are being established between the Intellectual Co-operation Organisation and the International Council of Scientific Unions, and a permanent scientific committee is being set up as a result of the meeting of an expert committee to develop the Organisation's work in this field, and conversations on scientific subjects contemplated include the future of scientific research and of science in modern societies. In this field also the Institute of Intellectual Co-operation and the International Labour Office have undertaken an inquiry into the social consequences of progress in mechanization, and its effects on man and the circumstances in which he lives. Discussions on the main international systems governing authors' rights have led the Committee to conclude that amalgamation of the Berne Convention and the Pan-American Convention of Havana is not possible, and a new convention is being prepared with the object of reconciling the principles common to these Conventions and capable of forming the basis of a universal system of authors' rights.

Indian Science Abstracts

THE immense volume of original work now published necessitates a very complete system of abstracts, and the requirements of the individual sciences are now well served in this respect. Rarely, however, is an attempt made to abstract separately the scientific publications of any country, so that it is not possible to estimate its direct contributions to knowledge. Prior to the Great War, the now defunct Board of Scientific Advice published annually a résumé of the principal Indian scientific memoirs, and now, after the lapse of many years, the National Institute of Sciences in India has undertaken the much more difficult task of compiling an annual bibliography of science in India. This comprises not only the titles of all papers published by authors resident in India and of Indians working abroad, but also of papers dealing with problems specifically related to India. In the majority of cases, not only is the title of the paper given, but it is also followed by a brief, but adequate, abstract. To those who look upon India as a backward country this publication will come as a revelation, not merely from the volume of the work produced but also by the high standard to which much of it attains. In a country so predominantly agricultural it is gratifying to find that so much attention is being paid to biological subjects ; nearly one half of the abstracts come under the heads of botany, zoology and physiology, the latter including veterinary and medical subjects. As the general editor points out in his introduction, the present division of subjects, which is under nine main heads, is purely tentative and may require revision in the light of experience.

FUTURE historians of science are sure to find this publication invaluable, but we would suggest that the addition of an author index would facilitate reference. To the general editor, Dr. Baini Prashad, and to his associate editors, we would offer our congratulations, and we trust that the favourable reception which is sure to be accorded to these abstracts will encourage them to continue the issue of the bibliography. Further evidence of the great attention now being devoted to research in India is found also in the publication by the Inter-University Board, India, of a bibliography of the theses accepted for higher degrees in arts and science by the universities during the years 1930–35. By their system of external examiners, the Indian universities ensure that their higher degrees shall equal those of the Western universities, and this bibliography shows how active these young universities are as centres for the advancement of knowledge. It will go far to dispel the idea that they are merely examining bodies.

Post Office Tests of Inoculation against Colds

THE common catarrhal cold is responsible for much sickness disability, and preventive vaccines containing a mixture of the predominant microbes present in the secretions have been employed, the microbes being bacteria such as *M. catarrhalis*, *B. hofmanni*, Friedlander's bacillus, *Pneumococcus*, *Staphylococcus* and *Streptococcus*. Trials of such a vaccine in the past, some of them on a large scale, have been disappointing, occasionally seeming to be useful in individual cases, but not significantly so in any large groups. A further test by the Chief Medical Officer of the Post Office during the last three years upon a large scale has, it is announced, similarly been disappointing. Volunteers were invited from large towns, and some hundreds of them were inoculated in the autumn of the three years 1933–35, and their sickness rates over periods antedating the inoculations and during the treatment were compared. Comparisons were also made with large control groups in each place of uninoculated workers. About ten per cent of the volunteers—less than half the original number—who persisted throughout the three years of the experiment showed some improvement, but taken as a whole the results were not encouraging, for there was little reduction of sickness among the whole group compared with the control groups or with their previous record. The use of anti-catarrhal vaccine as a large-scale routine measure in the future is, therefore, not considered justifiable. The negative character of the results of this experiment is not unexpected, as the common cold is now regarded as being a virus disease, the bacterial organisms associated with it being of the nature of secondary invaders.

Civilization since James Watt

AT a dinner given by the Franklin Institute on January 21, 1936, to celebrate the two hundredth anniversary of the birth of James Watt, J. P. Boyd gave a thoughtful address, a résumé of which appears in the *Journal of the Franklin Institute* for September. He pointed out that while James Watt was still an infant, Saint-Pièrre had suggested that the attainment of knowledge and the subjugation of the material world to the requirements of human welfare would lead to a continual improvement in the lot of mankind. But the logic of academicians and the pamphleteering of philosophers could not compare in effectiveness with the work initiated by James Watt. The steam engine meant freedom from the limitations of time and space. England in 1750 contained seven million inhabitants, and was over-

(*Continued on p.* 925.)

NATURE

SUPPLEMENT

No. 3500 SATURDAY, NOVEMBER 28, 1936 Vol. 138

The Idea of a World Encyclopædia*

By H. G. Wells

MOST of the lectures that are given in this place to this audience are delivered by men of very special knowledge. They come here to tell you something you did not know before. But to-night I doubt if I shall tell you anything that is not already quite familiar to you. I am here not to impart facts but to make certain suggestions; and there is no other audience in the world to which I would make these suggestions more willingly and more hopefully than I do to you.

My particular line of country has always been generalization and synthesis. I dislike isolated events and disconnected details. I really hate statements, views, prejudices and beliefs that jump at you suddenly out of mid-air. I like my world as coherent and consistent as possible. So far at any rate my temperament is that of a scientific man. That is why I have spent a few score thousand hours of my particular allotment of vitality in making outlines of history, short histories of the world, general accounts of the science of life, attempts to bring economic, financial and social life into one conspectus and even, still more desperate, struggles to estimate the possible consequences of this or that set of operating causes upon the future of mankind.

All these attempts had profound and conspicuous faults and weaknesses; even my friends are apt to mention them with an apologetic smile. Presumptuous and preposterous they were, I admit, but I look back upon them, completely unabashed. Somebody had to break the ice. Somebody had to try out such summaries on the general mind. My reply to the superior critic has always been—forgive me—"Damn you, do it better".

The least satisfactory thing about these experiments of mine, so far as I am concerned, is that they did not at once provoke the learned and competent to produce superior substitutes. And in view of the number of able and distinguished people we have in the world professing and teaching economic, sociological, financial science, and the admittedly unsatisfactory nature of the world's financial, economic and political affairs, it is to me an immensely disconcerting fact that the "Work, Wealth and Happiness of Mankind" which was first published in 1932 remains—practically uncriticized, unstudied and largely unread—the only attempt to bring human ecology into one correlated survey.

Well; I mention this experimental work now in order that you should not think I am just throwing casually formed ideas before you to-night. I am bringing you my very best. The thoughts I am setting out here have troubled my mind, for years, and my ideas have been slowly gathering definition throughout these experiments and experiences. They have interwoven more and more intimately with other solicitudes of a more general nature in which I feel fairly certain of meeting your understanding and sympathy.

I doubt if there is anybody here to-night who has not given a certain amount of anxious thought to the conspicuous ineffectiveness of modern knowledge and—how shall I call it?—trained and studied thought in contemporary affairs. I think that it is mainly in the troubled years since 1914 that the world of cultivated, learned and scientific people, of which you are so representative, has become conscious of this ineffectiveness. Before that time, or to be more precise before 1909 or 1910, the world, our world as we older ones recall it, was living in a state of confidence, of established values, of assured security, which is already becoming now almost incredible. We had no suspicion then how much that apparent security had been undermined by science, invention and sceptical inquiry. Most of us carried on into the War and even right through the War under the inertia of the accepted beliefs to which we had been born. We felt that the sort of history we were used to was still going on, and we did not realize at all that the War was a new sort of thing, not like the old wars, that the old traditions of strategy were disastrously out of date and that the old pattern of settling up after a war could only lead to such a thickening tangle of evil consequences as we contemplate to-day.

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* Friday Evening Discourse delivered at the Royal Institution on November 20.

We know better now. Wiser after the events as we all are, few of us now fail to appreciate the stupendous ignorance, the almost total lack of grasp of social and economic realities, the short views, the shallowness of mind, that characterized the treaty-making of 1919 and 1920. I suppose Mr. Maynard Keynes was one of the first to open our eyes to this world-wide intellectual insufficiency. What his book, "The Economic Consequences of the Peace", practically said to the world was this: These people, these politicians, these statesmen, these directive people who are in authority over us, know scarcely anything about the business they have in hand. Nobody knows very much, but the important thing to realize is that they do not even know what is to be known. They arrange so and so, and so and so must ensue and they cannot or will not see that so and so must ensue. They are so unaccustomed to competent thought, so ignorant that there is knowledge and of what knowledge is, that they do not understand that it matters.

The same terrifying sense of insufficient mental equipment was dawning upon some of us who watched the birth of the League of Nations. Reluctantly and with something like horror, we realized that these people who were, they imagined, turning over a new page and beginning a fresh chapter in human history, knew collectively scarcely anything about the formative forces of history. Collectively, I say. Altogether they had a very considerable amount of knowledge, unco-ordinated bits of quite good knowledge, some about this period and some about that, but they had no common understanding whatever of the processes in which they were obliged to mingle and interfere. Possibly all the knowledge and all the directive ideas needed to establish a wise and stable settlement of the world's affairs in 1919 existed in bits and fragments, here and there, but practically nothing had been assembled, practically nothing had been thought out, nothing practically had been done to draw that knowledge and these ideas together into a comprehensive conception of the world. I put it to you that the Peace Conference at Versailles did not use anything but a very small fraction of the political and economic wisdom that already existed in human brains at that time; and I put it to you as rational creatures that if usage had not dulled our apprehension to this state of affairs, we should regard this as fantastically absurd.

If I might attempt a sweeping generalization about the general course of human history in the eighteen years that have followed the War, I believe I should have you with me if I described it as a series of flounderings, violent ill-directed mass-movements, slack drifting here and convulsive action there. We talk about the dignity of history. It is a bookish phrase for which I have the extremist disrespect. There is no dignity yet in human history. It would be pure comedy, if it were not so often tragic, so frequently dismal, generally dishonourable and occasionally quite horrible; and it is so largely tragic because the human animal really is intelligent, can feel finely and acutely, expresses itself poignantly in art, music and literature, and—this is what I am driving at—impotently knows better.

Consider only the case of America during this recent period. America, when all is said and done, is one of the most intelligently *aware* communities in the world. Quite a number of people over there seem almost to know what is happening to them. Remember first the phase of fatuous self-sufficiency, the period of unprecedented prosperity, the boom, the crisis, the slump and the dismay. And then appeared the new President, Franklin Roosevelt, and from the point of view of the present discussion he is one of the most interesting figures in all history. Because he really did make an appeal for such knowledge and understanding as existed to come to his aid. America in an astounding state of meekness was ready to be told and shown. There were the universities, great schools, galaxies of authorities, learned men, experts, teachers, doctors, professors, gowned, adorned and splendid. Out of this knowledge mass there has since come many very trenchant criticisms of the President's mistakes. But at the time this—what shall I call it—this higher brain, this cerebrum, this grey matter of America was so entirely unco-ordinated that it had nothing really comprehensive, searching, thought-out and trustworthy for him to go upon. The President had to experiment and attempt this and that, he turned from one promising adviser to another, because there was nothing ready for him. He did not pretend to be a divinity. He was a politician—of exceptional good-will. He was none of your dictator gods. He showed himself extremely open and receptive for the organized information and guidance . . . *that wasn't there.* And it isn't there now.

Some years ago there was a considerable fuss in the world about preparedness and unpreparedness. Most of that clamour concerned the possibility of war. But here was a case of most fantastic unpreparedness on the part of hundreds of eminent men, who were supposed to have studied them, for the normal development of a community in times of peace. There had been no attempt to assemble that mechanism of knowledge of which America stood in need.

I repeat that if usage had not dulled us into a habit of acquiescence with this sort of thing we should think our species collectively insane to go about its business in this haphazard, planless, negligent fashion.

I think I have said enough to recall to anyone here who may have lapsed from the keen apprehension of his first realization, of this wide gap between what I may call the at present unassembled and unexploited best thought and knowledge in the world and the ideas and acts not simply of the masses of common people, but of those who direct public affairs, the dictators, the leaders, the politicians, the newspaper directors, and our spiritual guides and teachers. We live in a world of unused and misapplied knowledge and skill. That is my case. Knowledge and thought are ineffective. The human species regarded as a whole is extraordinarily like a man of the highest order of brain, who through some lesions or defects or insufficiencies of his lower centres, suffers from the wildest uncoordinations, St. Vitus's dance, agraphia, aphonia, and suffers dreadfully (knowing better all the time) from the silly and disastrous gestures he makes and the foolish things he says and does.

I don't think this has ever been so evident as it is now. I doubt if in the past the gap was so wide as it is now between the occasions that confront us, and the knowledge we have assembled to meet them. But because of a certain run of luck in the late nineteenth century, the existence of that widening gap and the menace of that widening gap were not thrust upon our attention as they have been since the War.

At first that realization of the ineffectiveness of our best thought and knowledge struck only a few people, Mr. Maynard Keynes for example, who were in what I may call salient positions, but gradually I have noted the realization spreading and growing. It takes various forms. Prominent men of science speak more and more frequently of the responsibility of science for the disorder of the world. And if you are familiar with that most admirable of all newspapers, NATURE, and if you care to turn over the files of that very representative weekly for the past quarter of a century or so and sample the articles, you will observe a very remarkable change of note and scope in what it has to say to its readers. Time was when NATURE was almost pedantically special and scientific. Its detachment from politics and general affairs was complete. But latterly the concussions of the social earthquake and the vibration of the guns have become increasingly perceptible in the laboratories. NATURE from being specialist has become world-conscious, so that now it is almost haunted week by week by the question: "What are we to do before it is too late, to make what we know and our way of thinking effective in world affairs?"

In that I think it is expressing a change which is happening in the minds of—if I may presume to class myself with you—nearly all people of the sort which fills this theatre to-night.

And consider again the topics that have been dealt with at the latest gathering of the British Association. The very title of the presidential address: "The Impact of Science upon Society"! Sir Josiah Stamp, as you will remember, stressed the need of extending endowment and multiplying workers in the social sciences. Professor Philip dealt with "The Training of the Chemist for the Service of the Community". Professor Cramp talked of "The Engineer and the Nation", and there was an important discussion of "The Cultural and Social Values of Science" in which Sir Richard Gregory, Professor Hogben and Sir Daniel Hall said some memorable things. There can be no doubt of the reality of this awakening of the scientific worker to the necessity of his becoming a definitely *organized* factor in the social scheme of the years before us.

Well, so far I have been merely opening up my subject and stating the problem for consideration. We want the intellectual worker to become a more definitely organized factor in the human scheme. How is that factor to be organized? Is there any way of implementing knowledge for ready and universal effect? I ask you to examine the question whether this great and growing gap between special knowledge and thought and the common ideas and motives of mankind can be bridged, and if so how it can be bridged.

Can scientific knowledge and specialized thought be brought into more effective relation to general affairs? Let us consider first what is actually going on. I find among my scientific and specialist friends a certain disposition—and I think it is a mistaken disposition—for direct political action and special political representation. The scientific and literary workers of the days when I was a young man were either indifferent or conservative in politics; nowadays quite a large proportion of them are inclined to active participation in extremist movements; many are leftish and revolutionary, some accept the strange pseudo-scientific dogmas of the communist party though that does no credit to their critical training, and even those who are not out on the left are restless for some way of intervening, definitely as a class, in the general happenings of the community. Their ideas of possible action vary from important-looking signed pronouncements and protests to a sort of strike against war, the withholding of services and the refusal to assist in technical developments that may be misapplied. Some favour the idea of a gradual supersession of the political forms and methods of mass democracy by government through some sort of *élite* in which the man of science and the technician will play a dominating part. There are very large vague patches upon this idea but the general projection is in the form of a sort of modern priesthood, an oligarchy of professors and exceptionally competent people. Like Plato they would make the philosopher king. This project involves certain assumptions about the general quality and superiority of the intellectual worker that I am afraid will not stand scrutiny.

I submit that sort of thing—political activities, party intervention and dreams of an authoritative *élite*—is not the way in which specialists, artists and specialized thinkers and workers who constitute the vital feeling and understanding of the body politic can be brought into a conscious, effective, guiding and directive relationship to the control of human affairs. Because—I hope you will acquit me of any disrespect for science and philosophy when I say this—we have to face the fact that from the point of view of general living, men of science, artists, philosophers, specialized intelligences of any sort, do not constitute an *élite* that can be mobilized for collective action. They are an extraordinarily miscellaneous assembly, and their most remarkable common quality is the quality of concentration in comparative retirement —each along his own line. They have none of the solidarity, the customary *savoir faire*, the habits arising out of practices, activities and interests in common, that lawyers, doctors or any of the really socially organized professions for example display. A professor-ridden world might prove as unsatisfactory under the stress of modern life and fluctuating conditions as a theologian-ridden world.

A distinguished specialist is precious because of his cultivated gift. It does not follow at all that by the standards of all-round necessity he is a superior person. Indeed by the very fact of his specialization he may be less practised and competent than the average man. He probably does not read his newspaper so earnestly, he finds much of the common round a bother and a distraction and he puts it out of his mind. I think we should get the very gist of this problem if we could compare twelve miscellaneous men of science and special skill, with twelve unspecialized men taken —let us say—from the head clerk's morning train to the city. We should probably find that for commonplace teamwork and the ordinary demands and sudden urgencies of life, the second dozen was individually quite as good as if not better than the first dozen. In a burning hotel or cast away on a desert island they would probably do quite as well. Yet collectively they would be ill-informed and limited men ; the whole dozen of them would have nothing much more to tell you than any one of them. On the other hand, our dozen specialists would each have something distinctive to tell you. The former group would be almost as uniform in their knowledge and ability as tiles on a roof, the latter would be like pieces from a complicated jig-saw puzzle. The more you got them together the more they would signify. Twelve clerks or a hundred clerks ; it wouldn't matter ; you would get nothing but dull repetitions, and a flat acquiescent suggestible outlook upon life. But every specialized man we added would be adding something to the directive pattern of life. I think that consideration takes us a step further in defining our problem to-night.

It is *science* and not *men of science* that we want to enlighten and animate our politics and rule the world.

Now I will take rather a stride forward in my argument. I will introduce a phrase, *New Encyclopædism*, which I shall spend most of the rest of my time defining. I want to suggest that something—a new social organ, a new institution, which for a time I shall call *World Encyclopædia* is the means whereby we can solve the problem of that jig-saw puzzle and bring all the scattered and ineffective mental wealth of our world into something like a common understanding and into effective reaction upon our vulgar everyday political, social and economic life. I warn you that I am flinging moderation to the winds in the suggestions I am about to put before you. They are immense suggestions. I am sketching what is really a scheme for the reorganization and reorientation of education and information throughout the world. No less. We are so accustomed to the existing schools, colleges, universities, research organizations of the world ; they have so moulded and made us and trained us from our earliest years to respect and believe in them ; that it is with a real feeling of temerity, of alma-matricidal impiety, so to speak, that I have allowed my mind to explore their merits and question whether they were not now altogether an extraordinarily loose, weak and out-of-date miscellany. Yet I do not see how we can admit, and I am disposed to think you have admitted with me, the existence of this terrifying gap between available knowledge and current social and political events, and not go on to something like an indictment of this whole great world of academic erudition, training and instruction from China to Peru—an indictment for, at least, inadequacy and inco-ordination if not for actual negligence. It may be only a temporary inadequacy, a pause in development before renascence, but inadequate altogether they are. Universities have multiplied greatly, yes, but they have failed to participate in the general advance in power, scope and efficiency that has occurred in the past century. In transport we have progressed from coaches and horses by way of trains to electric traction, motor-cars and aeroplanes. In mental organization we have, so to speak, simply multiplied our coaches and horses and livery stables.

Let me now try to picture for you this missing element in the modern human social mechanism, this needed connexion between the percipient and informative parts and the power organization for which I am using this phrase, World Encyclopædia. And I will take it first from the point of view of the ordinary educated citizen—for in a completely modernized state every ordinary citizen will be an educated citizen. I will ask you to imagine how this World Encyclopædic organization would enter into his life and how it would affect him. From his point of view the World Encyclopædia would be a row of volumes in his own home or in some neighbouring house or in a convenient public library or in any school or college, and in this row of volumes he would, without any great toil or difficulty, find in clear understandable language, and kept up to date, the ruling concepts of our social order, the outlines and main particulars in all fields of knowledge, an exact and reasonably detailed picture of our universe, a general history of the world, and if by any chance he wanted to pursue a question into its ultimate detail, a trustworthy and complete system of reference to primary sources of knowledge In fields where wide varieties of method and opinion existed, he would find, not casual summaries of opinions, but very carefully chosen and correlated statements and arguments. I do not image the major subjects as being dealt with in special articles rather hastily written, such as has been the tradition of encyclopædias since the days of Diderot's heroic effort. Our present circumstances are altogether different from his. Nowadays there is an immense literature of statement and explanation scattered through tens of thousands of books, pamphlets and papers, and it is not necessary, it is undesirable, to trust to such hurried summaries as the old tradition was obliged to make for its use. The day when an energetic journalist could gather together a few star contributors and a miscellany of compilers of very uneven quality to scribble special articles for him, articles often tainted with propaganda and advertisement, and call it an encyclopædia, is past. The modern World Encyclopædia should consist of selections, extracts, quotations, very carefully assembled with the approval of outstanding authorities in each subject, carefully collated and edited and critically presented. It would be not a miscellany, but a concentration, a clarification and a synthesis.

This World Encyclopædia should be the mental background of every intelligent man in the world. It should be alive and growing and changing continually under revision, extension and replacement from the original thinkers in the world everywhere. Every university and research institution should be feeding it. Every fresh mind should be brought into contact with its standing editorial organization. On the other hand its contents would be the standard source of material for the instructional side of school and college work, for the verification of facts and the testing of statements—everywhere in the world. Even journalists would deign to use it; even newspaper proprietors might be made to respect it. Such an encyclopædia would play the role of an undogmatic Bible to a world culture. It would do just what our scattered and disoriented intellectual organizations of to-day fall short of doing. It would hold the world together mentally.

It may be objected that this is a Utopian dream. This is something too great to achieve, too good to be true. I won't deal with that for a few minutes. Flying was a Utopian dream, a third of a century ago. What I am putting before you is a perfectly sane, sound and practical proposal. But first I will notice briefly two objections—obstructions rather than objections—that one will certainly encounter at this point.

One of these is not likely to appear in any great force in this gathering. You have all heard and you have all probably been irritated or bored by the assertion that no two people think alike "*quot homines, tot sententiæ*", that science is always contradicting itself, that economists like theologians can never agree. It is largely mental laziness on the defensive that makes people say this kind of thing. They don't want their intimate convictions turned over and examined, and it is unfortunate that the emphasis put upon minor differences by men of science, and belief in their strenuous search for the completest truth and the exactest expression sometimes give colour to this sort of misunderstanding. But I am inclined to think that most people overrate the apparent differences in the world of opinion to-day. Even in theology a psychological analysis reduces many flat contradictions to differences in terminology. My impression is that human brains are very much of a pattern, that under the same conditions they react in the same way, and that were it not for tradition, upbringing, accidents of circumstance and particularly of accidental individual obsessions, we should find ourselves—since we all face the same universe—much more in agreement than is superficially apparent. We speak different languages and dialects of thought and can even at times catch ourselves flatly contradicting each other in words while we are doing our utmost to express the same idea. And self love and personal vanity are not excluded from the intellectual life. How often do we see men misrepresenting each other in order to exaggerate a difference and secure the gratification of an argumentive victory! A World Encyclopædia as I conceive it would bring together into close juxtaposition and under critical scrutiny many apparently conflicting systems of statement. It might act not merely as an assembly of fact and statement, but as an organ of adjustment and adjudication, a clearing house of misunderstandings; it would be deliberately a synthesis, and so act as a flux and a filter for a very great quantity of human misapprehension. It would *compel* men to come to terms with one another. I think it would relegate "*quot homines, tot sententiæ*" back to the Latin comedy from which it emerged.

The second type of obstruction that this idea of a World Encyclopædia will encounter is even less likely to find many representatives in the present gathering and I will give it only the briefest of attention. (You know that kind of neuralgic expression, the high protesting voice, the fluttering gesture of the hands.) "But you want to *stereotype* people. What a dreadful, dreadful world it will be when everybody thinks alike"—and so they go on. Most of these elegant people who want the world picturesquely at sixes and sevens are hopeless cases, but for the milder instances it may be worth while remarking that it really does not enhance the natural variety and beauty of life to have all the clocks in a town keeping individual times of their own, no charts of the sea, no time-tables, but trains starting secretly to unspecified destinations, infectious diseases without notification and postmen calling occasionally when they can get by the picturesque footpads at the corner. I like order in the place of vermin, I prefer a garden to a swamp and the whole various world to a hole-and-corner life in some obscure community, and to-night I like to imagine I am making my appeal to hearers of a kindred disposition to my own.

Next let us take this World Encyclopædia from the point of view of the specialist and the super-intellectual. To him even more than to the common intelligent man World Encyclopædia is going to be of value because it is going to afford him an intelligible statement of what is being done by workers parallel with himself. Further, it will be giving him the general statement of his own subject that is being made to the world at large. He can watch that closely. On the assumption that the World Encyclopædia is based on a world-wide organization he will be—if he is a worker of any standing—a corresponding associate of the Encyclopædia organization. He will be able to criticize the presentation of his subject, to suggest amendments and restatements. For a World Encyclopædia that was kept alive and up to date by the frequent re-issue of its volumes, could be made the basis of much fundamental discussion and controversy. It might breed swarms of pamphlets, and very wholesome swarms. It would give the specialist just that contact with the world at large which at present is merely caricatured by his more or less elementary class-teaching, amateurish examination work and college administration. In my dream of a World Encyclopædia I have a feeling that part of the scheme would be the replacement of the latter group of professorial activities, the college business, tutoring, normal lecturing work and so on, by a new set of activities, the encyclopædic work, the watching brief to prevent the corruption of the popular mind. In enlightening the general mind the specialist will broaden himself. He will be redeemed from oddity, from shy preciousness and practical futility.

Well, you begin to see the shape of this project; and you will realize that, except in so far as the nature of its reaction upon the world's affairs is concerned, it is far away from anything like the valiant enterprise of Denis Diderot and his associates a century and a half ago. That extraordinary adventure in intellectual synthesis makes this dream credible. That is our chief connexion with it.

And here I have to make an incidental disavowal. I want to make it clear how little I have to do with what I am discussing. In order to get some talk going upon this idea of an Encyclopædia, I have been circulating a short memorandum upon the subject among a number of friends. I did not think to mark it *Private*, and unhappily one copy seems to have fallen into the hands of one of those minor pests of our time, a personal journalist, who at once rushed into print with the announcement that I was proposing to *write* a brand new Encyclopædia, all with my own little hand out of my own little head. At the age of seventy! Once a thing of this sort is started there is no stopping it—and I admit that announcement enables you to put me in my place in a pleasantly ridiculous light. But I think after what I have put before you now that you will acquit me of any such colossal ambition. I implore you not to let that touch of personal absurdity so difficult to avoid altogether belittle the greatness and urgency of the cause I am pleading. This Encyclopædia I am thinking of is something in which manifestly I have neither the equipment nor the quality to play any but an infinitesimal part. I am asking for it in the role of a common intelligent man who needs it and understands the need for it, both for himself and his world. After that you can leave me out of it. It is just because in the past I *have* had some experience in the assembling of outlines of knowledge for popular use, that I realize, perhaps better than most people, the ineffectiveness of this sort of effort on the part of individuals or small groups. It is something that must be taken up—and taken up very widely and seriously—by the universities, the learned societies, the responsible educational organizations if it is to be brought into effective being. It is a super university I am thinking of, a world brain; no less. It is nothing in the nature of a supplementary enterprise. It is a completion necessary to modernize the university idea.

That brings me to the last part of this speculation. Can such an Encyclopædia as I have been suggesting to you, be a possible thing? How can it be set going? How can it be organized and paid for? I agree I have now to show it as a possible thing. For I am going to make the large assumption that you think that *if it is a possible thing* it is a desirable thing. How are we to set about it?

I think something in this way: To begin with we want a promotion organization. We want, shall I call it, an Encyclopædia Society to ask for an Encyclopædia and to get as many people as possible asking for an Encyclopædia. Directly that society asks for an Encyclopædia it will probably have to resort to precautionary measures against any enterprising publisher who may see in that demand a chance for selling some sort of vamped-up miscellany as the thing required, and who may even trust to the unworldliness of conspicuous learned men for some sort of countenance for his raid.

Next this society of promoters will have to survey the available material. For most of the material for a modern Encyclopædia exists already—though in a state of impotent diffusion. In all the various departments with which an Encyclopædia should deal, groups of authoritative men might be induced to prepare a comprehensive list of primary and leading books, articles, statements which taken together would give the best, clearest and most quintessential renderings of what is known and thought within their departments. This would make a sort of key bibliography to the thought and knowledge of the world. My friend Sir Richard Gregory has suggested that such a key bibliography for a World Encyclopædia would in itself be a very worthwhile thing to evoke. I agree with him. I haven't an idea what we should get. I imagine something on the scale of ten or twenty thousand items. I don't know.

Possibly our Encyclopædia Society would find that such a key bibliography was in itself a not unprofitable undertaking, but that is a comment by the way.

The next step on from this key bibliography would be the organization of a general editorial board and of departmental boards dealing with separate fields of interest. These boards would be permanent bodies—for a World Encyclopædia must have a perennial life. We should have to secure premises, engage a literary staff and, with the constant co-operation of the departmental groups, set about the task of making our great synthesis and abstract. I must repeat that for the purposes of a World Encyclopædia probably we would not want much original writing. If a thing has been stated clearly and compactly once for all, why paraphrase it or ask some inferior hand to restate it? Our job may be rather to secure the use of copyrights and induce leading exponents of this or that field of science or criticism to co-operate in the selection, condensation, expansion or simplification of what they have already said so well.

Now I will ask you to take another step forward and imagine our World Encyclopædia has been assembled and digested and that the first edition is through the press. So far we shall have been spending money upon this great enterprise and receiving nothing; we shall have been spending capital, for which I have at present not accounted. I will merely say that I see no reason why the capital needed for these promotion activities should not be forthcoming. This is no gainful enterprise, but you have to remember that the values we should create would be far more stable than the ephemeral encyclopædias representing sums round about a million pounds or so which have hitherto been the high-water mark of encyclopædic enterprise. These were essentially book-selling enterprises made to exploit a demand. But this World Encyclopædia as I conceive it, if only because it will have roped in the larger part of the original sources of exposition, discussion and information, will be in effect a world monopoly, and it will be able to levy and distribute direct and indirect revenue, on a scale quite beyond the resources of any private publishing enterprise. I do not see that the financial aspects of this huge enterprise, big though the sums involved may be, present any insurmountable difficulties in the way of its realization. The major difficulty will be to persuade the extremely various preoccupied, impatient and individualistic scholars, thinkers, scientific workers and merely distinguished but unavoidable men on whose participation its success depends, of its practicability, convenience and desirability.

So far as the promotion of it goes I am reasonably hopeful. Quite a few convinced, energetic and resourceful people could set this ball rolling towards realization. To begin with, it is not necessary to convert the whole world of learning, research and teaching. I see no reason why at any stage it should encounter much positive opposition. Negative opposition—the refusal to have anything to do with it and so forth—can be worn down by persistence and the gathering promise of success. A World Encyclopædia has not to fight adversaries or win majorities before it gets going; and once this ball is fairly set rolling it will be very hard to stop. A great danger, as I have already suggested, will come from attempts at the private mercenary exploitation of this world-wide need—the raids of popular publishers and heavily financed salesmen, and in particular attempts to create copyright difficulties and so to corner the services and prestige of this or that unwary eminent person by anticipatory agreements. *Vis-à-vis* with salesmanship the man of science, the man of the intellectual *élite*, is apt to show himself a very Simple Simon indeed. And of course from the very start, various opinionated cults and propagandas will be doing their best to capture or buy the movement. Well, it mustn't be captured or bought, and in particular its silence must not be bought or captured. That danger may in the end prove to be a stimulus. It may be possible in some cases to digest and assimilate special cults to their own and the general advantage.

There will also be a constant danger that some of the early promoters may feel and attempt to realize a sort of proprietorship in the organization, to make a group or a gang of it. But to recognize that danger is half way to averting it.

I have said nothing so far about the language in which the Encyclopædia should appear. It is a question I have not worked out. But I think that the main text should be in one single language, from which translations in whole or part could be made. Catholic Christianity during the years of its greatest influence was held together by Latin, and I do not think that I am giving way to any patriotic bias when I suggest that unless we contemplate a polyglot publication—and never yet have I heard of a successful polyglot publication —*English*, because it has a wider range than German, a greater abundance and greater subtlety of expression than French and more precision than Russian, is the language in which the original text of a World Encyclopædia ought to stand. Moreover, it is in the English-speaking communities that such an enterprise as this is likely to find the broadest basis for operations, the frankest criticism and the greatest freedom from official interference and government propaganda. But that must not hinder us from drawing help and contributions from and contemplating a use in every community in the world.

So far I have laid no stress upon the immense advantage this enterprise would have in its detachment from immediate politics. Ultimately if our dream is realized it must exert a very great influence upon everyone who controls administrations, makes wars, directs mass behaviour, feeds, moves, starves and kills populations. But it does not immediately challenge these active people It is not the sort of thing to which they would be directly antagonist. It is not ostensibly anti-*them*. They would not easily realize its significance for all that they do and are. The prowling beast will fight savagely if it is pursued and challenged upon the jungle path in the darkness, but it goes home automatically as the day breaks.

You see how such an Encyclopædic organization could spread like a nervous network, a system of mental control about the globe, knitting all the intellectual workers of the world through a common interest and a common medium of expression into a more and more conscious co-operating unity with a growing sense of their own dignity and responsibility, informing without pressure or propaganda, directing without tyranny. It could be developed wherever conditions were favourable ; it could make inessential concessions and bide its time in regions of exceptional violence, grow vigorously again with every return to liberalism and reason.

So I sketch my suggestion for a rehabitation of thought and learning that ultimately may release a new form of power in the world, recalling indeed the power and influence of the Churches and religions of the past but with a progressive, adaptable and recuperative quality that none of these possessed. I believe that in some such way as I have sketched, the mental forces now largely and regrettably scattered and immobilized in the universities, the learned societies, research institutions and technical workers of the world, could be drawn together into a real directive world intelligence, and by the mere linking and implementing of what is known, human life as a whole could be made much surer, stronger, bolder and happier than it has ever been up to the present time. Until something of this sort is done, I do not see how the common life can ever be raised except occasionally, locally and by a conspiracy of happy chances, above its present level of impulsiveness, insincerity, insecurity, general under-vitality, under-nourishment and aimlessness. For that reason I think the promotion of an organization for a World Encyclopædia may prove in the long run to be a better investment for the time and energy of intelligent men and women than any definite revolutionary movement, Socialism, Communism, Fascism, Imperialism, Pacificism or any other of the current *isms* into which we pour ourselves and our resources so freely. None of these movements has anything like the intellectual comprehensiveness needed to construct the world anew.

Let me be very clear upon one point. I am not saying that a World Encyclopædia will in itself solve any single one of the vast problems that must be solved if man is to escape from his present dangers and distresses and enter upon a more hopeful phase of history ; what I am saying—and saying with the utmost conviction—is this, that without a World Encyclopædia to hold men's minds together in something like a common interpretation of reality, there is no hope whatever of anything but an accidental and transitory alleviation to any of our world troubles. As mankind is, so it will remain, until it pulls its mind together. And if it does not pull its mind together then I do not see how it can help but decline. Never was a living species more perilously poised than ours at the present time. If it does not take thought to end its present mental indecisiveness catastrophe lies ahead. Our species may yet end its strange eventful history as just the last, the cleverest, of the great apes. The great ape that was clever—but not clever enough. It could escape from most things but not from its own mental confusion and the destruction that is the inevitable consequence of incurable mental confusion.

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crowded. Now great masses of people can concentrate in towns secure in the promise of food, shelter and clothing. In 1936 the population of London is as great as that of all England a hundred years ago. The materials required for human life in crowded centres are obtained by the steam engine. Science and engineering accelerated the growth of the 'empire of the machine'. Men everywhere, although freed from the soil, feel themselves enslaved to the machine. To-day, four of the largest modern turbines have an energy capacity greater than that of the entire adult working population of the United States.

MANKIND now appears to be on the eve of a third industrial revolution. We have machines watched and directed by other machines. As an example, consider the photo-electric cell, which never makes a mistake and never knows fatigue. It is used for many and varied purposes. It sorts vegetables, fruit and eggs, it measures illumination, appraises colours, classifies minerals, counts bills and throws out counterfeits. It times races, counts people and vehicles, records smoke in tunnels, directs traffic automatically and substitutes a new process for photo-engraving. Automatically controlled machinery for making lamp bulbs at Corning, New York, produces 650 thousand bulbs per machine per day, which is ten thousand times more than that produced by the methods previously employed. Remarkable progress in material culture has been witnessed during the last hundred years; but institutions, social customs and thought patterns have, as always, lagged behind. Saint Pièrre's idea of progress is beginning to be challenged; some social pessimists are substituting the notion of change for that of progress. To establish control over the gigantic material gains and to cope with the resultant problems are the challenges facing mankind to-day. Many years may be required to solve them, but surely that intelligence which has performed such marvellous feats in material matters will find an avenue for social progress.

The Newcomen Society

AT a meeting of the Newcomen Society held at the Iron and Steel Institute on November 18, the report of the Council for the session 1935–36 was presented. This showed that the activities of the Society have been well maintained and that the total membership is now 424 as compared with 343 a year ago. There has been a considerable increase in the membership in America. Fourteen papers were read during the session and the Society has published as an extra publication the "Collected Papers" of Mr. Rhys Jenkins, one of the founders of the Society. Mr. W. J. Tennant was elected president for the ensuing year. After the passing of the report and accounts, a paper was read by Dr J. Thomas on "Josiah Wedgwood as a Pioneer of Steam Power in the Pottery Industry". By searching the Boulton and Watt papers at the Public Library and the Assay Office at Birmingham, Dr. Thomas has brought to light new material relating to the introduction of the Watt rotative steam engine into industry in the Midlands, and he has come to the conclusion that the earliest of such engines installed in a factory was that supplied to Wedgwood and erected at Etruria in 1782. Wedgwood's faith in the steam engine was shown by the financial assistance he gave to Boulton at a critical time. Like Priestley, Erasmus Darwin, Keir, Boulton, Watt and others, Wedgwood was a member of the famous Lunar Society, and his scientific leanings were shown in many ways. Towards the close of his paper, Dr. Thomas was able to show by a series of lantern slides how Watt used the medallions and casts of Wedgwood when in his retirement he devoted his time to the construction of the two statuary reproducing machines now preserved in Watt's garret workshop at the Science Museum. There can be little doubt that Watt's work in this direction was largely due to his friendship with Wedgwood.

New Tube Trains in London

EXPERIMENTS have recently been made on the first of four six-car tube trains manufactured by the Metropolitan–Cammell Carriage and Wagon Co., Ltd. for the London Passenger Transport Board. The train is composed of three two-car units, each car having the whole of the electric equipment under the floor. This avoids the necessity of a switch compartment, and so the new six-car train has approximately the same sitting accommodation as the existing seven-car train. The acceleration has been increased to two miles per hour per second and the braking rate (deceleration) to three miles per hour per second. The increased power has been gained partly by driving directly fifty per cent of the axles and by arranging so that more of the weight of the train is available for cohesion. The total horse-power of the new trains will be 1,650, as compared with 960 for the existing six-car trains. Several firms have suggested various schemes for operating the trains, but the following features are common to them all. All the control is operated at 50 volts and each car is separate and complete. Resistance switches are never called upon to brake under load. Each of the bogies is of all-welded construction and each carries one traction motor on the inside axle. This arrangement provides 58 per cent of the available weight of the car for adhesion. Three of the trains are streamlined at the driving end. The driver's seat is in the centre of the cab, with the master controller and braking controller on either side. The air-operated sliding doors are electrically controlled. Particulars with photographs are given in the *Electrical Review* of November 20.

Steamship Communication between Europe and America

In the *Metropolitan Vickers Gazette* of October, Mr. Leivesley continues his papers on notable ships and their equipment. He points out that it is now ninety-six years since a regular steamship communication was inaugurated between Europe and America. This was first established by the Cunard S.S. *Britannia* in July 1840, which crossed from Liverpool to Boston via Halifax in 14¼ days. She was equipped with steam engines driving paddle wheels, and her average speed was 8½ knots. Since then, the speed of the steamers has increased uniformly up to the present when it is 30 knots. The tonnage of the *Britannia* was 1,154 and her length was 207 ft. The tonnage of the *Queen Mary* is 80,773 and her length 1,020 ft. When it is realized that the former ship was equipped with engines barely equal to the power equipment of a modern trawler, our respect for the pioneers in sea transport is greatly increased. The horse-power of the *Queen Mary* is nearly 200,000 whilst that of the *Britannia* was 740. The author deals with the auxiliary plant which the Metropolitan-Vickers Co. supplied to the *Queen Mary*. These have chiefly to do with the winches and the ventilating system. There are six cargo winches, the same number of gangway winches and three baggage winches. These three types are all self-contained water-tight units. The ventilating system is naturally very extensive. There are no less than 40 miles of duct through which 118 million cubic feet of air are driven per hour.

Mediterranean Unity and Diversity

THE unity of the Mediterranean world in all geographical aspects, physical, climatic and vegetational, is a familiar conception to all geographers, and nowhere has the theme been more ably expounded than in a lecture by Dr. G. Sarton on "The Unity and Diversity of the Mediterranean World" (*Osiris*, 2, Part 9). While he dwells on this unity, enhanced by relative enclosure, he points out also the effective channels by which the area is linked with the outer world, especially with the civilizations of the East in ancient times, and the diversity within the larger unity owing to enclosed seas and restricted area of high fertility. These ideas he expounds as a background for a study of Mediterranean civilization. Among many links between geographical conditions and human development, Dr. Sarton takes the myth of St. George. Everywhere in the Near East, Al-Khidr, the young or ever-living one, is venerated by Muslims as well as by Jews and Christians. The festivals of Al-Khidr, Elijah and St. George occur on the same day, April 23, which, irrespective of religion, is one of the important holidays. St. George or Al-Khidr is not simply an ever-living one but a giver of life, for he is the most powerful rain-bringer, and in the Mediterranean rain has a vital significance. His name is connected with the struggle against darkness, winter and drought. He is the recrudescence of spring and he symbolizes the struggle against evil and ignorance. Dr. Sarton suggests that if ever the historian of science should need a patron saint, he could not find a better one than Al-Khidr or St. George, the ever-living symbol of Mediterranean unity and diversity, of our culture and ideals, and of the everlasting struggle between truth and superstition.

Forests of Trinidad and Tobago

THE forests of Trinidad are not one of the least of its beauties, and a recent informative statement on them ("Forests and Forestry in Trinidad and Tobago". Govt. Printer, Trinidad, 1935) was drawn up by Mr. R. L. Brooks, the conservator of forests, for the British Empire Forestry Conference held in South Africa last year. The statement covers the whole field of forestry administration tracing the past history, geographical position, geology, climate and distribution of the forests in the Islands; and the botanical types of the forest growth. There is a small amount of private planting undertaken, but forestry activities are chiefly confined to the Department of Forestry. Co-operation exists between the Agricultural Society of Trinidad and Tobago and the Department. This Society publishes a quarterly record of its work in its *Proceedings*, but the chief scientific journal of Trinidad is *Tropical Agriculture*, the monthly journal of the Imperial College of Tropical Agriculture, in which forestry articles occasionally appear. The problems connected with forestry in its professional aspects are discussed in some detail by the conservator, Mr. Brooks, whose statement may be confidently recommended to those visiting Trinidad wishing for information on the Islands not available in the ordinary popular guide books. It suffers, as is the case with others submitted to the Empire Forestry Conference, in having been drawn up on a common prescribed schedule. A "Progress Report on Exotics" and a statement on "Timber Consumption and Marketing" were also drawn up for Trinidad and Tobago for the Empire Conference.

The Lyre-bird in Victoria

CONCERN has been expressed at the possibility of the extinction of the lyre-bird in Victoria, but F. Lewis, chief inspector of fisheries and game, points to the improvement which has taken place in public opinion, the more rigorous protection by law, and the fact that a great deal of the land inhabited by lyre-birds is rough and inaccessible (*Victoria Naturalist*, **53**, 12; May 1936). He is of opinion that the future of the lyre-bird is assured, granted that public opinion in favour of protection continues to be educated in country districts as well as in the cities, and that a stop should be put to the clearing of lyre-bird gullies and the destruction wrought by bush-fires and the activities of egg-collectors. In another paper in the same journal (p. 3), R. T. Littlejohns states that no other Australian bird adheres so strongly to a definite area. In this case, the territory is two or three acres in extent, and for week after week, especially during the singing season, the place of any particular individual may be known exactly. It is seldom indeed that a bird is to be found outside its own area.

Allotments as an Amenity Asset

ALTHOUGH few will question the value of allotments, their frequent unsightliness is one of the chief reasons why there is so little public support for including them in town-planning schemes or otherwise making their tenure secure. Useful work has already been done by the National Allotments

Society and the Society of Friends, but expenditure on outlay is necessarily restricted when the land may (after three months notice) be sold to a speculative builder. Lady Allen of Hurtwood discusses this problem in a booklet entitled "How Allotments could be made an Amenity Asset to the Community". Constructive suggestions for the development of the allotment garden as an outdoor social centre are made, stress being laid on the necessity for well-considered planning of the land from the start, if possible in conjunction with other forms of social activity. An illustration is given of a suitable lay-out designed by the author herself, and sketches for a community centre building and hut units by William Tatton Brown are also included. The booklet (price 4*d.* post paid) may be obtained from The Housing Centre, 13 Suffolk Street, London, S.W.1.

Professional Workers in the Ukraine

FIGURES have recently been issued by the Soviet Union Year Book Press Service relating to the increase in the number of Soviet professional workers in the Ukraine. In 1914, the territory now constituting Soviet Ukraine had 44,083 teachers ; at the beginning of the school year 1936–37 the number had risen to 150,000. The number of medical men in 1913 was 5,192, in 1936 it was 19,266. The number of secondary medical staff in 1913 was 8,357 and in 1936 40,243. In 1934 there were 83,390 engineers and technical experts employed in the Ukraine ; in 1936 the number had increased to 116,600. The number of agronomists employed by the Commissariat of Agriculture in the Ukraine three years ago was 8,200 ; in January 1936 it was 12,346.

The Public Health Act, 1936

THE Ministry of Health has issued a circular to local authorities reminding them that the above Act, which passed into law in July last, comes into operation on October 1, 1937 (Circular No. 1576. H.M. Stationery Office). Attention is directed to some of the more important changes introduced in the new Act and to matters which call for early consideration. This Act consolidates in some 350 sections the provisions of more than six hundred sections contained in some sixty existing Acts.

Gift to the Royal Aeronautical Society

MR. C. R. FAIREY, past president of the Royal Aeronautical Society, and Mr. F. Handley Page, vice-president, have jointly agreed to give £750 a year for seven years to the Society. The object of this gift is to enable the Society to carry out as fully as possible its main object, "the general advancement of aeronautical science and engineering", and to enable it to be placed on a self-supporting basis. The intention is that the Society should become completely independent of donations from outside bodies, so that it may be free to express opinions upon aeronautical research and engineering when necessary, and can encourage the dissemination of papers, etc., on all matters pertaining to aeronautical research and engineering.

Announcements

THE Right Hon. the Viscount Falmouth has been appointed a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. Prof. A. C. G. Egerton has retired from the Council on completion of his term of office.

SIR JOHN PARSONS, the new president of the Royal Society of Medicine, has recently returned from the United States, where he was awarded the Lucien Howe Medal of the American Ophthalmological Society.

PROF. NOCHT, the founder and former director of the Institute of Marine and Tropical Medicine at Hamburg, has been awarded the Gold Medal of the University in recognition of his great services to the University in the domain of scientific work overseas.

ERRATUM. In NATURE of November 21, p. 875, paragraph entitled "Grassland of Great Britain", line 16, for "150 ft. contour" read "1500 ft. contour".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :

Two male pharmacists in the Royal Naval Hospitals—The Medical Director-General of the Navy, Admiralty, S.W.1 (November 28).

A mechanical and automobile engineer in the Yorkshire Traffic Area office at Leeds—The Establishment Secretary, Ministry of Transport, 6 Whitehall Gardens, S.W.1 (November 30).

A chief agricultural officer to the Salop County Council—The Clerk of the County Council, Shirehall, Shrewsbury (December 5).

An assistant physicist in the Radiotherapy Department, Royal Infirmary, Bradford—The Secretary-Superintendent (December 7).

Assistants (Grades II and III) in metallurgy in Admiralty Dockyard Establishments—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (quote *C.E.* 7180/36) (December 12).

A lecturer in mining surveying and economics in the Bulawayo Technical School—The Official Secretary, Office of the High Commissioner for Southern Rhodesia, Rhodesia House, 429 Strand, London, W.C.2 (December 12).

An assistant director, with a knowledge of textiles, of the Testing House and Laboratory of the Manchester Chamber of Commerce—The Director, Testing House, Royal Exchange, Manchester (December 15).

A taxidermist and an articulator in the National Museum, Melbourne—The Agent-General for Victoria, Victoria House, Melbourne Place, Strand, W.C.2 (January 4).

A professor of mechanical engineering in the Benares Hindu University—The Pro-Vice-Chancellor, Benares Hindu University, Benares, India (January 15).

A county agricultural organizer in Leicestershire —The Director of Education, Gray Friars, Leicester.

A lecturer in mathematics (woman) in the Avery Hill Training College, Eltham, S.E.9—The Principal.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 934.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Atrophy, Burial, Suppression or Total Loss in Evolution

AN examination of a series of sheep embryos has indicated that the ungulates are not removed from the general mammalian plan to the extent usually indicated by the specialization of their fore- and hind-limbs in the earliest Tertiary period. In 1890[1] Wincza described a transient rudiment of a bony clavicle in the embryo of a sheep at the site of the fibrous raphe of Leisering in the muscle sheet spreading from the head to the trunk and forelimb. The study of a group of fossil forms by Cuvier, Darwin, Owen, Cope, Matthew and others has brought to light a number of extinct suborders, of which the Typotheria, alone amongst the adult ungulates, possess definite bony clavicles.

The clavicle is visible by strong trans-illumination in the sheep embryo of 39–42 days and in a radiograph taken with a 'soft' tube; it is still more easily seen on staining the skeleton with alizarin or on histological section. In a transverse section of the neck of a sheep embryo of 36 days the clavicle appears (Fig. 1) as a condensation of mesenchyme cells. At 39 days the cells enlarge and become osteogenic in character; bone is laid down (Fig. 2) and appears as a system of trabeculæ in the intracellular matrix. Ten days later, the bony clavicle disappears leaving only a fibrous raphe in the occipito-humeralis muscle.

This transient waxing and waning of the bony clavicle in the sheep embryo suggested that the bony elements of the limb should be examined. The cannon bone of the adult sheep consists of the fused third and fourth metacarpals or metatarsals. The first, second and fifth bones are absent. In the fore-limb of a sheep embryo of 65 days, the fifth metacarpal is visible as a thin long bone of about 0·4 mm. in diameter in the radiograph, in the specimen stained with alizarin (Fig. 3) and in histological section. A week earlier the fifth metacarpal is entirely cartilaginous (Fig. 4). At 90 days there is no trace of this fifth metacarpal.

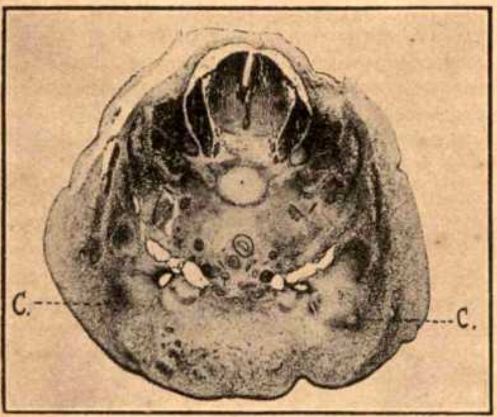

FIG. 1. Transverse section of the neck of a sheep embryo of 36 days. The condensation of mesenchyme cells to form a clavicle (*C*) is marked. (× 12·5.)

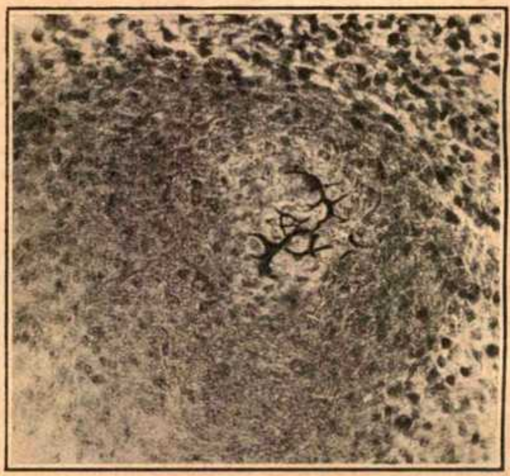

FIG. 2. Ossification centre with osteoblasts and bone trabeculæ in the clavicle of a sheep embryo of 39 days. (× 160.)

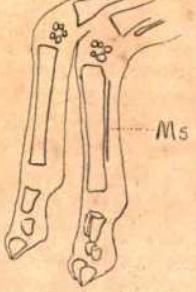

FIG. 3. Tracing of the fore-foot of a sheep embryo of 65 days indicating the cannon bone (fused metacarpals three and four) and the transient fifth metacarpal (*M*.5).

Transverse sections of the metatarsus of the sheep embryo of 36–42 days have been examined. Four metatarsals are present at an early stage. Two of these (the third and fourth) become centres of rapid growth, whereas the second and fifth grow slowly. The subsequent growth in diameter of the third and fourth becomes so great that they soon touch the second and fifth respectively, and eventually bury them, so that the shafts of the two latter are in process of being enclosed within the shafts of the actively growing bones (Fig. 5, *a* and *b*). The reduction of the metatarsals is thus not accomplished by suppression but by incorporation. At a later stage no trace of the buried elements is seen. Thus it is possible to see in a few days in the life of the sheep embryo a process of evolutionary reduction which has taken aeons of geological time—a story worked out in the study of ungulate fossil forms by Cuvier, Owen, Darwin, Cope and Matthew.

Edgeworth[2] has recently indicated that the important problem in morphology is to ascertain whether a given structure undergoes atrophy during life or whether it has ceased to exist. It is well known that a separate bony costal element near the transverse process of the seventh cervical vetebra is present in almost all human fœtuses. After birth this fuses with the transverse process. Occasionally it continues to grow and gives rise to the condition known as 'cervical rib'. The cervical rib sometimes gives rise to a palsy of the small muscles of the hand as a result of pressure on the brachial plexus. The patient is not to be regarded as a freak who has grown a new cervical rib, but as an unfortunate who has failed to keep the embryonic rib within normal bounds by fusion and suppression. Similarly, many of the abnormalities of the hands and feet in the quadrupeds are a failure to absorb and suppress various elements in the normal embryological sequence, rather than the acquirement of additional bony elements in the limbs.

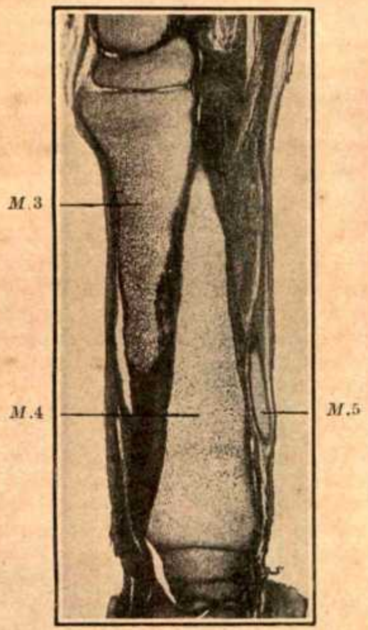

FIG. 4. Longitudinal section of the fore-foot of a sheep embryo of 56 days, showing metacarpals three and four and the transient small fifth metacarpal (*M*.5) in the cartilaginous state.

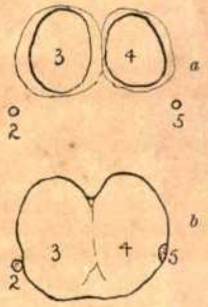

FIG. 5. Tracings of the transverse sections of the metatarsus in a sheep embryo of 39 days to indicate the gradual incorporation of the second and fifth metatarsals in the rapidly growing third and fourth metatarsals which fuse to form the cannon bone.

The process of burial and absorption of the bony elements of ungulates may be significant in the study of the distribution of tumours and cysts in this area, for the sites of embryological happenings may often be the sites of pathological changes. Finally, it is not without interest that the date of ossification in the clavicle of the sheep, the 39th day, is identical with that in the human embryo, as is the ossification in the transverse fifth metacarpal in the 8th–9th week of fœtal life. The divergence in the pattern of ossification in the sheep and human forms is negligible in the first 6–8 weeks and becomes of rapidly increasing significance, inasmuch as the sheep at birth has reached a measure of skeletal ossification which is not reached by man until seven years after birth.

H. A. HARRIS.

Anatomy School,
Cambridge.
Oct. 17.

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[1] H. Wincza, *Morph. Jahrb.*, **16**, 647 (1890).

[2] F. H. Edgeworth, "The Cranial Muscles of Vertebrates" (Cambridge, 1935).

Physiological Potency of Dilute Traces

THE attention of readers must have been arrested by the brief reports contributed to NATURE[1] at various times by Mr. Hugh Ramage, an eminent spectroscopic chemist, on the concentration of certain metals in special tissues of plants and animals, up to amounts spectroscopically measurable. The explanation would be that the ultra-infinitesimal amounts of these metallic substances that are present in the food that passes through the organism must be arrested in the organs concerned until the accumulation becomes sensible. An opening seems here to arise into the chemistry of minute traces, which is the aspect of that science that promises most for mathematical development.

But my present motive is a different one. In a recent report of the Medical Research Council astonishment is expressed at the potency, continued for as long as a month, of a minute injection of a substance refined from liver extract, in staving off pernicious anæmia—a result with which the writer has unfortunately some practical acquaintance. On the analogy of the metallic accumulations above, this substance may be arrested, but now more rapidly, in the lumbar bone marrow which is the seat of the production of the red blood corpuscles, so as to restore its function to a degree that may last a month before decay has again set in. At any rate this analogy, perhaps not novel, renders its efficacy in one respect less wonderful.

The relations of a virus and its counteracting serum may perhaps provide an illustration. For example, the virus of hydrophobia is distributed through the system by the circulation of its fluids, so that it soon becomes very dilute: where this flow passes through the nervous structures the virus is arrested chemically by some type of affinity, and gradually accumulates until its destructive action on the nervous framework acquires full play. This process may take a long time. The antidotal serum spreads also dilute throughout the system; but at *every* place in it the two dilute constituents virus and antidote come together by intimate diffusion, which is a rapid process, with destructive result by their mutual combination.

The principle underlying the production of a blocking or destructive serum as an *excretum* limiting or destroying the activity of the agent that emits it need not be involved here. The antidotal serum introduced quite late has thus time to overtake the virus. This is only an amateur analogy, effective just by reason of its limitation of range, as this indeed may be all that is open to us in such organic structural problems: there may be nothing essentially novel in its present explicit statement. Yet even Pasteur was an amateur.

The phenomena which used to be grouped under the name chemotaxy, and also the mode of transfer of hormones, might arise from cognate activities.

JOSEPH LARMOR.

Holywood,
Co. Down.
Oct. 31.

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[1] H. Ramage, NATURE, **138**, 762 (Oct. 31, 1936).

Gaseous Combustion

IT was shown by Mallard and Le Chatelier more than fifty years ago that, during the passage of flame through an inflammable gaseous mixture, two types of flame movement were clearly distinguishable, namely, the initial uniform slow movement and the very rapid movement known as detonation which is set up—if the mixture is strong enough—after the flame has travelled some distance.

Prof. W. A. Bone states that there is now much evidence for the view that, during the initial slow movement, combustion is far from being complete in the flame front, but that as the detonation stage is reached, combustion in the flame front becomes practically complete[1]. With this view I am in agreement, provided that incomplete combustion is not identified with incomplete combination but is to be accounted for by a stable form of latent energy formed in the flame front and left behind in the flame gases. The nature of the latent energy must for the present be left vague, but it seems probable that it will be found to be located in metastable molecules of some kind or other which result from the reactions in the flame front.

The reason why incomplete combination would appear to be ruled out is that it must remain constant in amount for a very long time after the flame front has passed if it is to explain flame temperature[2] and explosion and heat-loss[3] measurements, and this, of course, is most unlikely. Furthermore, had the photographic studies by H. B. Dixon, Bone and others of flame-travel in tubes been made with tubes of very large diameter, so that the cooling of the inflamed gases did not take place rapidly, it would have been found that the duration of the after-glow of the inflamed gases was so long as to be inconsistent with an explanation in terms of incomplete combination. Indeed, in some explosion experiments made in a very large vessel, the after-glow continued for at least 14 seconds[4], and it is a fair inference that had the explosion vessel been still larger so that the cooling would have taken place much more slowly, the luminosity would have lasted for a longer time than this.

It has been shown that the latent energy left behind in the flame gases decreases markedly with the pressure at which the gases are burnt[5] and, since the pressure in the flame front during detonation is very high, it is to be expected that the latent energy in the detonation phase would be much less than in the initial slow movement phase. Assuming also, as would appear to be legitimate, that the latent energy decreases with distance of travel of the flame front, a completely satisfactory explanation is obtained as to why there is a smaller proportion of latent energy in large vessel explosions than in flames[3].

Our experiments, so far as they have gone, have shown latent energies varying between 1 per cent and 10 per cent of the heat of combustion in explosions[3], and between 6 per cent and 28 per cent of the heat of combustion in flames[5]. Doubtless further experiments will show that these limits may be extended in either direction. There seems little doubt that the amount of the heat of combustion remaining in flame gases as latent energy depends not only on the pressure at which combustion takes place in the flame front, but also upon the nature of the combustible gases and the diluent gases[3,5].

Ordinary gas calorimetry shows that the latent energy, which our experiments show to be long-lived, entirely disappears during the passage of the flame gases through the calorimeter. The after-glow shows that it tends to disappear when the temperature is sufficiently high to produce collisions of the kind which will enable the metastable molecules to attain the ground state, but this is clearly a very slow process, and it seems probable that the bulk of it disappears when the flame gases come into contact with surface. Preliminary experiments designed to test this have been apparently successful, but they have not yet reached a stage at which publication is desirable. Meanwhile, attention may be directed to Dr. F. W. Lanchester's calorimeter experiment, in which there was no surface and in which he could only account for at most 85 per cent of the heat of combustion[6]. It is of interest, too, in this connexion to point out that flame gases, after having been cooled to a temperature so low as 200° C. in the cylinder of a gas engine, have been made luminous again by adiabatic compression[4]. The adiabatic compression ignition experiment of Tizard and Pye in which explosion took place on the second compression[7] would also appear to be relevant.

W. T. DAVID.

Engineering Department,
University,
Leeds.
Nov. 9.

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[1] *Phil. Trans. Roy. Soc.*, **230**, 364.

[2] *Phil. Mag.*, **17**, 172, **18**, 228 and *Proc. South Wales Inst. Eng.*, **51**, 375.

[3] *Phil. Mag.*, **22**, 513.

[4] *Phil. Mag.*, **9**, 399.

[5] *Phil. Mag.*, **21**, 280.

[6] *Proc. Inst. Civ. Eng.*, **237**, 200.

[7] "The Internal Combustion Engine", D. R. Pye (Clarendon Press 1931), Fig. 20, p. 98.

Red and Sunlit Auroras and the State of the Upper Atmosphere

ON October 16 this year, a strong auroral display was observed at Oslo. It commenced as an arc fairly low on the northern sky, but at intervals it took the form of a drapery-shaped band with pronounced ray structure, and sometimes—for example, between 22^h and 23^h in the evening—rays of quite unusual length (several hundred kilometres) were observed.

These observations show that extremely long rays may appear also on the night side of the earth, and that they are not restricted to regions exposed directly to sunlight.

Our direct measurements from auroral band spectra gave a night temperature of −30° to −47° C. in the auroral region. Thus the slow rate of decrease of density from 100 km. and upwards as shown by the long auroral rays cannot be accounted for by a high temperature, but as I have stated in previous papers, it must be due to an electrical state of the atmosphere, resulting from the action of ultra-violet light or corpuscular rays entering the atmosphere during auroral displays and magnetic disturbances.

On account of these influences, a large proportion of the matter in the auroral region consists of electrons and free atoms, and *this dissociated state will have an effect on the distribution of matter similar to that of a large reduction of average molecular weight or increase of temperature.*

In the morning (of October 17) a spectrogram of sunlit auroras was obtained on panchromatic plates[1]. In this case, the red line (6300) appeared with a photographic density even considerably greater than that of the green line. If the line 6300, which is enhanced from sunlit auroras and for red auroras of type A, is due to the transition $({}^1D_2 - {}^3P_2)$ of oxygen, then the two other weaker components ought also to be enhanced. In previous spectrograms of red and sunlit auroras, only the strongest component has been observed. On the spectrogram obtained on the morning of October 17 the second weaker line $({}^1D_2 - {}^3P_1)$ was also observed. *This result shows that it is the oxygen triplet* $({}^1D - {}^3P_{012})$ *which is enhanced in the sunlit and red auroras (of type* A*).*

Red auroras of type A were observed for long intervals during the night; *but they were restricted to certain fairly limited regions of the sky* (mostly the north-east), while at the same time auroral bands, streamers and long rays appeared with the ordinary greenish-white colour.

As a rule, the red auroras of type A are red throughout the whole length of the streamer from top to bottom. In this case, however, we found that the red colour was restricted to the upper region, while the lower part had the ordinary greenish colour. This was verified by spectroscopic observations. In the upper red part of fairly small intensity, the red line 6300 was clearly visible, while the lower more intense part, where the green line appeared very much stronger, the red line could not be seen.

In this way we have proved that, at any rate under certain conditions, *the intensity of the red line* 6300 *relative to that of the green one* (5577) *increases upwards.*

If the life-time of the metastable $({}^1D_2)$-state is of the same order of magnitude as the average time between molecular collisions in the auroral region, the intensity of the red triplet O I $({}^1D_2 - {}^3P_{012})$ must increase with diminution of density and increasing height.

In this way we might account for the observed altitude effect. The fact that most auroras—even very long rays—do not appear red at the top, shows that the enhancement of the O I $({}^1D_2 - {}^3P_{012})$ triplet of the sunlit and red auroras cannot be entirely due to a change of density, but, as I have previously mentioned, there must be some excitation process which brings the oxygen atom to the $({}^1D_2)$-state and not the ${}^1S_0$ state, and this process must be attached to some *variable* component of the atmosphere.

Some years ago I suggested that the enhancement of the red line was due to the action of activated nitrogen on ozone molecules, resulting in the expulsion of an oxygen atom in the $({}^1D_2)$-state. This explanation is supported by the fact that the red colour is, for long intervals of time, restricted to certain regions of the sky. This gives indications of a very variable ozone concentration—perhaps due to violent or eruptive motions or local precipitations of corpuscular rays—occurring in the upper regions.

L. VEGARD.

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Oct. 28.

Clocks showing Mean and Sidereal Time Simultaneously

IN the Paris Observatory a number of clocks provided with two dials showing sidereal and mean time were installed last year as part of the permanent equipment of the Observatory. This suggested to me an investigation of the many ingenious attempts to achieve it, and to seek a simpler and better method.

The problem involves the precise expression of the ratio between the sidereal and mean time in the form of a train of gear wheels. Since one mean solar day is $24^h\ 03^m\ 56{\cdot}555\ 36^s$ in sidereal time, the ratio of sidereal to mean is 1·002 737 909 3. . . . This ratio must be expressed by a fraction; for our purpose the numerator and denominator of this fraction must both be factorizable into factors not exceeding a few hundreds, as the number of teeth on any wheel cannot reasonably exceed this. Moreover, the number of factors (or suitable combinations of them) in the numerator and denominator must be the same, as wheels must work in pairs.

The first to accomplish it was George Margetts, a member of the Clockmakers' Company *circa* 1800. It is in the form of a large watch and is to be seen in the Company's collection in the Guildhall. It has separate dials for hours, minutes and seconds, each having a smaller dial mounted concentrically with the larger ones. These inner dials were gradually revolved backwards by gearing, so that the same three hands indicated simultaneously mean time on the outer dial and sidereal time on the inner dial. His train includes a wheel of 487 teeth so fine that they are invisible to the naked eye. The ratio is $\frac{1465}{1461} = \frac{5 \times 293}{3 \times 487} = 1{\cdot}002\ 737\ 85$, which is correct to the sixth decimal. The sidereal component would lose at the rate of $1{\cdot}8^s$ in a year.

In the Science Museum there is a clock designed by Joseph Vines a hundred years ago (1836), with two dials coupled by the ratio $\frac{43 \times 247}{32 \times 331}$. This is 1·002 737 915 4, which is correct to the seventh decimal. It will take 5·2 years for the sidereal dial to be in error relatively to the solar dial by one second.

Paris adopted a train by Ungerer, of Strasbourg, $\frac{119 \times 317}{114 \times 330}$, which is 1·002 737 905 4, and correct to the eighth decimal; it will be 8·2 years before it is a second wrong.

Sir George Airy contributed to the *Monthly Notices of the Royal Astronomical Society* in 1850 a train by Dr. Henderson, $\frac{50 \times 182 \times 196}{30 \times 211 \times 281}$, a ratio of 1·002 737 908 5. This is very close, being correct to the ninth decimal, and requiring forty years to accumulate an error of 1 sec.

At this stage of the investigation, I was fortunate in interesting Dr. L. J. Comrie who, as a result of "a pleasant week-end's arithmetical recreation", summed up the whole matter and contributed a solution which we may accept as final. He gives the true ratio as 1·002 737 909 265, plus the centennial term, and a wheel train of $\frac{45 \times 71 \times 257}{29 \times 151 \times 187}$ which is the value of the precise ratio required in the year 1955, namely, 1·002 737 909 297. The error would amount to one second in about 100,000 years.

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[1] Cf. L. Vegard and E. Tönsberg, NATURE, **137**, 778 (1936).

The Paris installation mentioned above suffers from a shortcoming common to every combined mean solar and sidereal clock yet made. They have invariably derived their time from a pendulum driven by an escapement in steps; hence it is necessary to decide whether to rate it for mean solar time and gear it up to sidereal or vice versa. Whichever is chosen, the progression of the wheelwork, and therefore the hand of *both* dials, will advance in seconds of the same length. If it is dead-beat on the divisions on the mean time dial, the pointer will creep forward progressively on the sidereal dial, gaining a second in about six minutes; conversely, if the clock is rated to be dead-beat on the sidereal dial it will creep backwards on the mean dial. Thus a dead-beat reading on both dials is never attained.

By means of a simple device, however, the problem of giving dead-beat seconds hands on both dials has been solved. A synchronous motor of 50 cycles per second is applied to the mean time end of the train and is driven by the alternating current on the Grid. Since the *average* frequency of 50 cycles is rigidly maintained, there is no cumulative error. The automatic time control of the speed of our turbo-alternators is an ambition that has already been realized in individual stations. The conditions laid down by the Central Electricity Board for the technical management of the Grid are such that the disturbances inevitably caused by load sharing will be progressively diminished. Astronomers can help the campaign to improve the timing of the Grid by making their requirements known.

In the meantime, either end of the wheel train of these clocks can be synchronized from the Royal Observatory's standard slave clock. For those who fear breakdowns, in spite of the steady progress of our generating stations towards the high standard of continuity of service that they have set themselves, a simple little instrument is available to take up the duty automatically if the alternating current is cut off.

Synchronous motor clocks are destined to prove extraordinarily useful for purposes that were not visualized at the time of their introduction in the United States in 1919, although forty years ago I forecast that they would be the electric clocks of the future. This combination of mean time and sidereal time clocks is just another instance of the utility of the synchronous motor method.

F. HOPE-JONES.

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Nov. 3.

Stability of Rotating Threads

STUDIES of rotating threads have disclosed some curious features with regard to the spiral sinusoidal forms which they assume. Two simple cases were first examined experimentally in order to explain anomalies in the third. The three cases are (1) a long freely hanging thread, attached to a horizontal rotating arm, supporting a spherical weight (M), (2) a thread similarly rotated about a horizontal axis, the thread passing over a light pulley at the loaded end, and (3) a thread withdrawn vertically at high speeds from its rest position closely coiled on a vertical cylindrical surface (that is, a full parallel-wound yarn bobbin) through an eyelet situated at an axial distance (L) above the surface.

Case (1) is illustrated in Fig. 1, *a* and *b*, and Case (3) in Fig. 1*c*. Fig. 1*b* shows two spiral stroboscopic images and the general form of the thread. The images were obtained by using a beam of light interrupted by an inverted metal bowl (containing two diametrically opposite slots) attached to the rotating head.

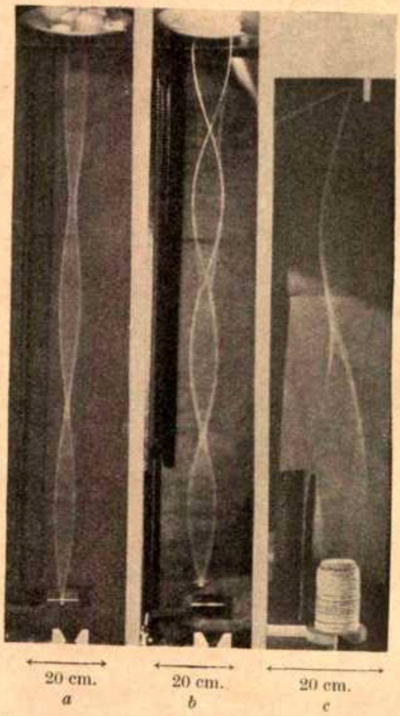

FIG. 1.

In the first two cases, measurements of the average loop lengths (l) agree closely with the well-known formula for plane vibrations in a thread

$$l = \frac{1}{2n}\sqrt{\frac{Mg}{m}}$$

even for an arm radius as high as 5 cm., n being the revolutions per second of the rotating arm and m the mass per centimetre of the thread.

In the third case a tension recorder was placed in the path of the thread above the eyelet, and records were obtained showing the tension varying from a maximum to a minimum as the thread uncoils from the base to the top of the bobbin. With uniform close coiling on the bobbin, L being fixed, the tension traces rise and fall in a series of sharp steps and are symmetrical about the peak value. These 'jumps' and 'drops' to new tension levels (T) occur when instability of the thread causes it to change to a new form containing a greater or smaller number of loops. The tension peak values vary discontinuously with the value of L, other things being constant. On plotting the tension levels, T, against L, the points tend to lie on a series of approximately co-axial parabolas represented by

$$L = \frac{s}{2n}\sqrt{\frac{T}{m}}$$

where s is somewhat less than 1, 2, 3, etc. The smaller the bobbin radius, however, other things being equal, the more closely s approaches 1, 2, 3 . . . etc.

If the thread in Case 1 be progressively shortened, alternating ranges of stable and unstable length are traversed. Further, if cathetometric measurements are made of the rise h of the weight M due to rotation, it is found that (*a*) h rises regularly to approximately the same maximum for lengths of thread accommodating a complete number of stable loops; (*b*) h falls to a minimum for lengths accommodating approximately $(p+\frac{1}{2})$ stable loops, p being integral; (*c*) in the range of thread length which accommodates $(p+\frac{1}{2})$ to $(p+1)$ loops the loop form is stable: for lengths accommodating p to $(p+\frac{1}{2})$ instability occurs, but transition points from stable to unstable lengths are not experimentally very sharp; (*d*) the loop length is not measurably dependent on the total thread length.

Since h is indirectly a measure of loop amplitude (the arm radius, etc., being constant), the amplitude must depend on the total length of the thread, the number of complete loops and the fraction of a loop which it accommodates.

Examination with stroboscopic illumination showed that in air and under all conditions imposed, the thread spirals through an angle π for each complete loop.

It is hoped to publish further details and a mathematical treatment of the first two cases elsewhere.

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Oct. 23.

State of Ascorbic Acid in Plant Tissues

THE cause of the apparent gain in the ascorbic acid content of vegetables brought about by cooking has given rise to much correspondence in these columns. An attempt has been made in this laboratory to explain this phenomenon along the lines of either the 'combined ascorbic acid' or 'oxidase' theories, experiments being conducted along the following lines:

25 ml. aqueous extracts of cauliflower (C) or potato (P)

Expt. No.	Treatment	Ascorbic acid found before H_2S reduction (mgm.)	Ascorbic acid found after H_2S reduction (mgm.)
1	C (*a*) 6·25 ml. water added	0·20	2·42
	(*b*) 6·25 ml. 10 per cent metaphosphoric acid added. Precipitate filtered off		1·60
	(*c*) As in 1(*b*) using 13·3 per cent trichloracetic acid		1·04
2	P (*a*) 6·25 ml water added	<0·06	2·36
	(*b*) As in 1(*b*)		2·26
	(*c*) As in 1(*c*)		
3	P (*a*) 6·25 ml. water added	<0·06	2·31; 2·20
	(*b*) As in 1(*b*)		1·76; 1·76
4	C (*a*) 6·25 ml. water added	<0·06	2·48
	(*b*) Boiled 20 min. (reflux). Cooled. 6·25 ml 10 per cent $(HPO_3)_x$ added		0·28
5	P (*a*) 6·25 ml. water added	<0·06	2·36
	(*b*) As in 4(*b*)		0·28
6	C (*a*) 6·25 ml. water added	<0·06	1·24
	(*b*) Boiled 20 min. (reflux)		0·11
	(*c*) As in 1(*b*)		0·71
	(*d*) As in 6(*c*). Boiled 20 min.		0·30

The first three experiments confirm the presence of combined ascorbic acid in potato and cauliflower as demonstrated by McHenry and Graham[1]. 2 per cent metaphosphoric acid gives the true value of free ascorbic acid in the extracts, bearing out the findings of Fujita and Iwataka[2] that this acid is preferable to trichloracetic acid.

Experiments 4 and 5 show the tremendous losses in 'total ascorbic acid' experienced on boiling. Van Eekelen[3] has obtained similar results. This indicates that the oxidases are still active during the heating, and must be only slowly destroyed. If the oxidases were completely inactivated, then the length of time of heating should not affect the ascorbic acid content at all.

Experiment 6 demonstrates that the oxidase activity of acidified extracts is somewhat decreased, indicating the important part played by the acid in the destruction of the enzymes. Also aqueous extracts with the vitamin present in the reversibly oxidized form are more liable to loss in activity during boiling. The statement of McHenry and Graham[4] that reduced aqueous extracts of cauliflower give the same titration values as an equivalent amount of the vegetable after heating and subsequent reduction can only be explained by the fact that cold aqueous extraction is far from complete.

The failure of Mack[5] to observe any increase in the ascorbic acid content of cabbage on heating while repeating the experiments of Guha and Pal[6] is probably due to the very small content of the combined acid in cabbage. In fact this vegetable always shows a decrease of between 40 and 50 per cent in ascorbic acid on boiling.

In view of the above, it is evident that the combined ascorbic acid hypothesis for the apparent increase must be accepted, but at the same time it must be taken into account that oxidases are active during the boiling process which brings about the hydrolysis of this compound. Indeed, this increase in titration is not even as high as it would be, if the oxidases were rapidly and completely destroyed on heating.

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Oct. 27.

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[1] McHenry and Graham, NATURE, **135**, 871 (1935).
[2] Fujita and Iwataka, *Biochem. Z.*, **277**, 293 (1935).
[3] Van Eekelen, NATURE, **136**, 144 (1935).
[4] McHenry and Graham, *Biochem. J.*, **29**, 2013 (1935).
[5] Mack, NATURE, **138**, 506 (1936).
[6] Guha and Pal, NATURE, **137**, 946 (1936).

Luminosity of Meteoric Trains

IT is well known that the portion constituting *nearly, but not quite*, the end part of a meteoric train is generally brighter and more persistently visible than the rest of it. Charles P. Olivier also refers to it in his book on meteors. The phenomenon may be explained as due to:

(1) The peculiar effect of density, composition and condition of the atmosphere between altitudes which mark the limiting points of persistent visibility of meteoric trains.

(2) The effect of velocity: only certain velocities that obtain along particular portions of a meteor track giving rise to persistent visibility.

As the velocity would obviously be smaller near the end part of meteoric trains, and it is more appropriate to associate better visibility with greater velocity as giving rise to more vigorous ionization of the surrounding air, it appears that the phenomenon is due only to the effect of atmospheric condition and composition.

It would be worth while, therefore, to collect data concerning the height and velocity of meteors along their tracks of *maximum* visibility, as distinct from their entire visible courses.

Meteors seen with very long streaks are doubtless those that move more or less horizontally, the major part of their journey being accomplished in the region of right density and composition.

It is common knowledge that only the brighter meteors have more or less persistent trains. This may be due to the 'gas-mantle' surrounding them, which gives them a higher luminosity and the air left in their tracks greater facility of ionization.

Meteors of low luminosity that appear as reddish (or reddish-white) specks, moving generally with small apparent velocity, rarely, if ever, develop persistent trains. Their tracks probably lie above the region of appropriate density and composition.

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Oct. 22.

Curve Fitting

In *Biometrika*, 28, 34–59, the late Prof. Karl Pearson published a severe criticism of some work on curve fitting by the Indian statistician, R. S. Koshal. Since the criticism, if taken at its face value, is likely to injure the reputation and prospects of Mr. Koshal, I take this opportunity to point out that in the table (p. 44) in which Pearson contrasts his results with those of Koshal, much to the latter's disadvantage, Pearson's theoretical frequencies, said to be derived from his equation (v), are seriously in error. In consequence, his equation is made to appear to be a closer fit than that obtained by Koshal, although in reality it does not fit the data so well.

In this letter I cannot deal with the numerous points of Pearson's criticism. It is only fair, however, to recognize that it was evidently written under a misapprehension of the numerical values he was discussing.

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Nov. 14.

Points from Foregoing Letters

PROF. H. A. HARRIS puts forward the view that the even-toed ungulates are not so highly specialized as would appear to be the case in view of the reduction of the digits to two and the absence of a clavicle. In the sheep embryo, a clavicle appears and various additional digits in the fore and hind foot. These are rapidly lost, either by absorption as in the case of the clavicle, or by incorporation in the neighbouring bony elements. The second and fifth metatarsals are buried in the substance of the rapidly growing third and fourth, which fuse to form the cannon bone.

Sir Joseph Larmor suggests that the potency of a minute amount of active principle from liver extract in staving off pernicious anæmia, may be accounted for on the supposition that the active principle is arrested in the affected lumbar bone marrow which, under normal conditions, is the seat of production of red blood corpuscles, and that it restores to it for a while its function.

Prof. W. T. David agrees with Prof. W. A. Bone that during the passage of a flame through an inflammable gaseous mixture the initial slow movement is accompanied by 'incomplete combustion'. He stipulates, however, that this incomplete combustion does not imply incomplete combination, but indicates that a certain amount of 'latent energy' formed in the flame front is left behind in the flame gases. This assumption he considers to be necessary in order to account for the duration of the afterglow of the inflamed gases, seen in wide tubes.

Recent observations of the spectra of northern lights (both 'red' and 'sunlit' auroras) indicate, according to Prof. L. Vegard, that the night temperature in the auroral region is − 30° to − 47° C. Therefore, he concludes, any inferred decrease in the density of the atmosphere from 100 km. upward cannot be accounted for by an increase in temperature; it may, however, be due to the presence of electrons and of free atoms, which would be equivalent to a decrease in the average molecular weight. Prof. Vegard finds, further, that under certain conditions the intensity of the red line (6300 A.) relative to the green line (5577 A.), increases upwards, and recalls his previous suggestion that the enhancement of the red line is due to the action of 'activated nitrogen' upon ozone molecules.

F. Hope-Jones describes a new clock showing simultaneously mean and sidereal time. With the help of a more accurate value for the ratio between the solar and the secular day, calculated by Dr. L. J. Comrie, and with a corresponding train of gears in the ratio $\frac{45 \times 71 \times 257}{29 \times 151 \times 187}$, the clock error has been reduced to one second in about 100,000 years and, by means of a simple device, the problem of giving dead-beat seconds hands on both dials has been solved.

Features concerning the stability of the spiral sinusoidal forms assumed by threads under rotation are described by H. W. Hall. Conditions of rotation for three cases have been examined; in the first two, fixed lengths loaded by weights were used, and, in the third, the thread was withdrawn vertically at high speeds from a stationary bobbin. Examination with stroboscopic illumination showed that in air and under all conditions imposed, the thread spirals through an angle π for each complete loop.

New determinations of the ascorbic acid (vitamin C) in cauliflower and potato, carried out by Dr. L. F. Levy, employing several methods of extraction, lend support to the hypothesis that the ascorbic acid exists partly in a combined state and is freed during boiling. On the other hand, oxidases which are active during the boiling process reduce the amount of ascorbic acid.

Research Items

Indian Temple Architecture

A VAST amount of fresh information necessitates a revision and simplification of Fergusson's treatment of styles in Indian architecture, towards which an interpretation of the facts and suggestions as to terminology are offered as a basis by Dr. F. H. Gravely, of the Madras Government Museum ("An Outline of Indian Temple Architecture." Bull. Madras Government Museum. N.S. General Section, 3, pt. 2). The separation of Buddhist, Jain and Hindu is unsound; Buddhism and Jainism sprang from Hinduism, and there is every reason for believing that their temples have a similar history. No essential architectural difference seems to exist. Pending the working out of the evolution of the decorative detail, form is the only available criterion of a system of classification. The *vimāna*, or shrine, has long been found the most helpful in distinguishing styles. In the northern form, the so-called 'Indo-Aryan', the vertical lines predominate over the horizontal, and the 'crown' resembles the *amalaka* (myrobalan) fruit. In the south, of various forms the most characteristic and widely distributed has a *vimāna* which consists of a series of successively smaller and smaller tiers of miniature pavilions, in which horizontal lines predominate over vertical, capped by a cupola-like 'crown'. Two styles are distinguishable in the southern temple, that of the Kanarese country, Early Chalukyan, and that of the Tamil country, which differs from the Kanarese in details of both decoration and form. In the west are two styles, that of the ancient Kadamba kingdom, in which the *vimāna* is square in plan with a pyramidal tower composed of a series of horizontal stages, and the Malabar, in which the walls resemble a wooden railing with a simple or multiple pitched roof suggesting similarities to those of Nepal and China. Multiple roofs are also found in the temples of Kashmir. Lastly, in Bengal, is a form of temple with a tendency to the multiple roof, which is evidently a copy from the leaf huts common in the area.

Effect of Noise

RECENT experiments by Dr. Foster Kennedy on trephined patients at the Bellevue Hospital, New York, have demonstrated that the noise resulting from the explosion of a paper bag raised the brain pressure to four times normal for seven seconds, and that thirty seconds elapsed before the pressure returned completely to normal. According to Dr. Kennedy (*N.Y. State J. Med.*, Oct. 5), the undoubted effect of constant noise is disturbance of the circulatory system and an increase in the degenerative processes in the heart and arteries.

Metabolism at High Altitudes

ACCORDING to the Soviet Union Year Book Press Service, a Soviet expedition sent out under the joint auspices of the Academy of Sciences of the U.S.S.R. and the All-Union Institute of Experimental Medicine to Elbrus, the highest mountain in the Caucasus and in Europe, has recently been making a study of metabolism at high altitudes. Analysis of the blood of donors revealed that the blood becomes thicker, the potassium content increases and the quantity of nitrogen falls. Studies were made of the relative change in the organs of persons who ascend to high altitudes directly and those who break the ascent by remaining at different altitudes for a period of time. The expedition also studied changes in the function of the organs of smell, circulation and respiration with the view of ascertaining the cause and course of mountain sickness. It is reported that the skin became hypersensitive to the sun's rays at high altitudes.

Pacific Dinoflagellates

DR. ANTON BÖHM has described the dinoflagellates, excluding *Ceratia*, from a collection of plankton made in the western Pacific by Dr. Victor Pietschmann in 1927–28 (Dinoflagellates of the Coastal Waters of the Western Pacific. Bernice P. Bishop Museum, Bulletin 137, January 1936). The material was collected with the ship's pump from depths of 1–6 metres during one or more hour's run and was filtered through nets. The author has already published a paper on the *Ceratia* (1931), from the collection in this same publication. This is the most comprehensive account of the group in these regions so far published, 111 species in all being described, 46 being new records for the district, 5 of which are new species. The distribution of these dinoflagellates in the east Asiatic waters shows the same arrangement that was found for the *Ceratia* population. The coastal waters from Singapore to Shanghai (in summer at the time of the south-west monsoon stream) show two strongly marked distribution areas which are connected by a transition zone. Area I, Singapore to Hong Kong, besides eurythermal and euryhaline forms, harbours the typical population which is neither purely oceanic nor purely neritic; Area II, the transition zone, shows warm water forms, and Area III, approximately the population of the East China Sea, the Yellow Sea and its boundary (Korea Strait), chiefly warm water forms. Certain widely distributed species, such as *Ceratium furca*, *Peridinium conicum*, *P. depressum* and others were observed in all the samples. The diagrammatic drawings of the variation, and measurements of the different species are interesting; some of the species vary enormously.

Coral-infesting Crabs

THE *Hong Kong Naturalist* (Supplement) for June 1936 (No. 5) contains Part 5 of a description with illustrations of the Hong Kong seaweeds, Sargassaceæ, by W. A. Setchell. Besides this very useful memoir, there is a paper by Dr. Chia-Jui Shen entitled "Notes on the Family Hapalocarcinidæ (Coral-Infesting Crabs) with Descriptions of Two New Species". These crabs usually inhabit the cavities or pits in living coral and "owing to their peculiar habitat their size is small and the anterior portion usually depressed and narrower than the posterior, so that the former can come out of the pit and the latter remain within". The author shows that there are only two valid genera in the *Hapalocarcinidæ* Stimpson, namely, *Hapalocarcinus* and *Cryptochirus*. The two new species described are *Cryptochirus hongkongensis* from Hong Kong and *C. granulatus* from Christmas Island [specimens from the British Museum (Natural History)]. Good figures are given of both species.

Northern Spy Apple Stock

A recognized means of combating the attacks of woolly aphis (*Eriosoma lanigerum*) is to use an immune root system and main stem on which desired varieties can be budded or grafted. The 'Northern Spy' stock has been widely used in this way, particularly in Australia, New Zealand and South Africa. Unfortunately, it cannot be regarded as a desirable rootstock from other points of view, and this view is confirmed by the work of Miss J. Hearman (*J. Pom. and Hort. Sci.*, 14, 3, 246; 1936). The characteristics of the stock were compared with those of several well-known Malling types by detailed examination of a number of root systems at the East Malling Research Station. Besides being difficult to propagate vegetatively, it appears that Northern Spy recovers very badly after transplanting. It is generally very shallow rooted, rarely sending down deeper roots from the periphery of the root system. On the whole, the growth habit can be described as weak and uneven, and compares unfavourably with such stocks as Malling Types I, II and IV.

Rejuvenating Old Rubber Trees

Although for some time past inorganic fertilizers have been successfully used for young *Hevea* trees, of late they have scarcely been used at all for old or deteriorated stands, partly owing to the economic depression in the rubber world, and partly because many planters were not convinced that it 'paid to fertilize'. During these last five or six lean years, however, Dr. W. B. Haines, of Dunlop Plantations, Ltd., and E. Guest have been conducting a series of large-scale experiments on the manuring of *Hevea* in Malaya, and have arrived at some important conclusions (*Empire J. Exp. Agric.*, Oct. 1936). These authors give 'chapter and verse' for their conclusion that the primary need of old or deteriorated rubber trees is nitrogen; young trees, however, mostly need 'minerals' as well. Response to manuring with nitrogen (4 lb. of sulphate of ammonia per tree) usually occurs in two stages. In the first, which is associated with improved foliage, the yield of latex increases by about 10 per cent; in the second, associated with improved bark renewal, the increase in yield averages about 35 per cent but does not begin until the second or third year after the initial application. As a rule, it does not pay to apply nitrogen unless the latex-yield has fallen below 400 lb. per acre; and it is suggested that the best criterion of the need of nitrogen is given by the growth-rate of the tree: when the annual girth-increment has fallen to, or below, ½ inch per annum, quick response to nitrogen may be confidently expected. The authors also review past experimental work, and discuss problems related to manuring, such as the use of cover crops and *Oidium* leaf-disease.

Recent Earthquakes in California

The latest quarterly number (for July 1936) of the *Bulletin of the Seismological Society of America* contains several papers on recent earthquakes in California. Messrs. P. Byerly and J. T. Wilson (pp. 207–213) continue their valuable list of Northern California earthquakes from April 1, 1934, until December 31, 1935, the number of earthquakes recorded being 170, and the number of centres in action 106. Only one of these earthquakes, that of Parkfield on June 7, 1934, was of destructive intensity. From the map and tables, it follows that, though there was an increase of activity in the Pacific region off the coast of Humboldt County, the coastal region between that county and San Francisco Bay was comparatively free from epicentres. The region lying to the east of Monterey Bay was remarkably active, and activity on the San Andreas fault crept northward to San Francisco. Mr. J. T. Wilson (pp. 189–194) also considers the distribution of the fore-shocks and after-shocks of the Parkfield earthquake. The epicentres of the principal earthquake and of all the minor shocks lay on the San Andreas fault, those of the three fore-shocks on the north-west side of the main epicentre and within 3 km. of it, while those of the eight after-shocks all lay on the other side at distances between 3 km. and 17 km. Thus, the total length of fault in action was about 20 km.

Tropical Storms

The mechanism of tropical revolving storms is not yet understood, for although theories about them abound, these do little more than show that certain factors not inimical to their development are present in the tropics, and there is still no way of foretelling where and when the storms must appear. Meanwhile, the volume of statistics relating to their incidence and life-history grows apace. The latest contribution to the statistics of the tropical storm is in the form of a memoir by V. Doraiswamy Iyer, entitled "Typhoons and Indian Weather" (*Mem. Indian Meteorol. Dept.*, 26, Part 6; 1936). Typhoons of 1884–1930 which came from the China Sea or the Pacific Ocean and had moved westwards to strike the coast of Indo-China or South China were studied, and it was found that 135 out of 370 re-developed into storms or depressions over India after having died out or become indistinguishable on entering the mainland lying in their path. This is contrary to the generalization of Sir John Eliot made many years ago in the infancy of synoptic meteorology, to the effect that "All cyclonic storms in the Bay of Bengal originate or are produced in the Bay itself"—a generalization that Eliot began to modify at the end of last century. The effect of these reconstituted storms on Indian weather is discussed, although not in great detail. The author follows the custom of to-day, according to which few students of storms of any kind fail to make a great effort to connect the storm with some kind of 'front'—in this case what is described as "the climatic front between the humid monsoon current and the comparatively drier winds from the north". The success of this effort can in this instance only be gauged by those who make a special study of synoptic meteorology, and are familiar with Indian weather.

Order – Disorder Transition in Alloys

C. Sykes and F. W. Jones (*Proc. Roy. Soc.*, A, 157, 213; 1936) have studied experimentally the order – disorder transitions in the alloy Cu_3Au. They examined the variation of specific heat with temperature, and also devised a method for finding directly the variation of energy content with temperature. This was valuable, since the alloy could first be brought to any condition, not necessarily that of equilibrium, and the energy change measured on heating to a standard temperature at which equilibrium was always attained. The specific heat method is only applicable to conditions in which the substance is always in equilibrium. The X-ray examination of heat-treated specimens was also used. The theories of Bragg and Williams and of Bethe and Peierls differ mainly in that the latter takes account of a 'local order' persisting above the transition point and due to nearly neighbouring atoms not being strictly random, although the superlattice structure has disappeared. Neither theory gives quite correctly the energy changes just below the critical temperature, but the Bethe-Peierls view explains correctly the existence of an abnormal specific heat above the critical temperature and fits well with evidence that nuclei of local order exist in the metastable structure obtained by quenching.

Molecular Weight of a Virus Protein

THE isolation by W. M. Stanley in 1935 of a crystalline protein showing the properties of the tobacco-mosaic virus was the first example of a chemically well-defined virus, previous preparations having been defined by means of biological tests only. Preliminary measurements gave molecular weights of the order of millions. I. B. Eriksson-Quensel and The Svedberg (*J. Amer. Chem. Soc.*, 58, 1863; 1936) have now examined the protein by sedimentation (ultra-centrifuge) and electrophoresis methods. The results show considerable inhomogeneity of molecular weight. At $pH = 6 \cdot 8$, about 65 per cent of the material has a molecular weight between 15 and 20 millions, provided the dissymmetry constant is the same as for other high molecular proteins. It is not improbable that the virus protein might be homogeneous with regard to molecular weight in its native state. Electrophoretic determinations showed the virus protein to be chemically well defined and practically homogeneous.

Electrolytic Oxidation

IN a series of recent papers by S. Glasstone and A. Hickling, the view has been put forward that hydrogen peroxide may be formed at the anode in aqueous solutions by the combination of discharged hydroxyl radicals, and some examples of electrolytic oxidation have been explained in this way. If this is the case, it might be expected that an anode would exhibit some of the apparent reducing properties of hydrogen peroxide, notably in reducing acidified solutions of permanganate and dichromate. Large effects are not to be anticipated, since the rate of spontaneous decomposition of the peroxide at an anode is high, and there is the possibility that any reduction which occurs may be masked by re-oxidation. The point has been investigated (A. Hickling, *J. Chem. Soc.*, 1453; 1936) and the predicted effects, although small, have been observed, so that the interesting result of apparent reducing properties of an anode has been established. The general method was to collect the oxygen evolved at the anode under consideration along with hydrogen from the cathode in a separate voltameter in series, and to show that the oxygen–hydrogen ratio is greater than that, 0·500, expected for the electrolysis of water. In the case of permanganate, the ratio was above 0·65 for favourable current densities, whilst in the case of dichromate a smaller but definite increase was observed. Other possible explanations are discussed, but the author considers them less probable than the one given above.

Impulse Voltages for Transformer Testing

THE apparatus required to get the high voltages necessary in order to test the devices used on the Grid is very expensive. An alternator which can produce a million volts for breakdown tests is not only expensive but also requires a large laboratory in which to operate. A simpler way of getting a million volts is to charge a hundred high-tension condensers in parallel to 10,000 volts, then connect them in series and so get a million volts between the electrodes. The apparatus necessary is much cheaper and the cost of operating much less. It has, however, the drawback that, as Kelvin pointed out many years ago, the discharge in certain cases is oscillatory, and so the maximum electric stress on which the breakdown depends is difficult to compute. A paper was read on this subject by Dr. T. E. Allibone, D. B. McKenzie and F. R. Perry before the Institution of Electrical Engineers on November 5. They have analysed theoretically and experimentally impulse voltages of varied wave-shapes applied to transformers having different winding characteristics, and obtained good agreement between theory and experiment. Hence tests of this nature should be of use in testing apparatus for use with the Grid so as to find out the effect of surge voltages and probably improve the continuity of the service. Tests of this nature have been employed for some years both in Switzerland and Germany which have enabled the engineers to improve their transformers. Further tests are in progress both in the United States and Great Britain, and the method of the authors in checking the theoretical results by means of oscillographic records promises to be of great value.

Air Locks in Aeroplane Fuel Systems

As a possible explanation of one type of failure of aircraft engines, the presence of an air or vapour lock in the fuel system and its prevention have been studied at the Royal Aircraft Establishment, and a discussion of the subject, the nature of the investigation, and the conclusions reached are now published (Air Ministry: Aeronautical Research Committee. Reports and Memoranda, No. 1693 (2237): Air and Vapour Locks in Fuel Systems. By M. A. A. Allfrey. Pp. 14+9 plates. London: H.M. Stationery Office, 1936. 1*s*. 3*d*. net). Several unavoidable causes operate to enable air to collect in the petrol pipe line, and in order to ensure the release of such bubbles as might, from any such cause, be entrapped, experiments were made by introducing air into glass pipes down which petrol was flowing under conditions comparable with those in practice. These showed that perfection of venting can be attained either by so building the pipe system that the air vents upwards at all flows, in which case the critical flow at every point is greater than the maximum demand of the engine, or by arranging that the critical flow never increases downwards. The first alternative being impracticable in that it requires pipes and cocks of excessive size, the second, which leads to an ideal system, was investigated, and the report sets out in detail the results and recommendations essential to its successful incorporation in petrol pipe lines, distinguishing between those applicable to air locks and those found to be successful in preventing locks caused by evaporation of the fuel itself, which is liable to give trouble at great heights.

Chemical and Physical Basis of Pharmacological Action

A JOINT discussion in which pharmacologists and chemists took part was organized by the Royal Society at Burlington House on November 12.

Prof. A. J. Clark opened the discussion with a general review of the difficulty of obtaining quantitative pharmacological data and of interpreting these data when obtained. The observations are subject to large errors, and the results are affected by so many factors that it is usually possible to explain them in several different ways. It is never possible to obtain formal proof of any one explanation, but in many cases the analogy between the action of drugs on living organisms and their actions under simpler conditions is close enough to establish a strong presumption as to the mechanisms involved. The most hopeful line of approach lies in the study of the form of the curve connecting the concentration of a drug with the magnitude of its effect after dynamic equilibrium is obtained. Such concentration-action curves can be divided into three distinct classes:

(1) It has been shown, in many cases, that the relation between the concentration of adrenaline, or acetylcholine, and its action on an isolated piece of muscle is accurately expressed by a hyperbola. This relationship can be interpreted in terms of mass action. If the drug, present in large excess, combines reversibly with a limited number of receptors in the muscle, simple calculations suggest that the curve connecting concentration and uptake would be a hyperbola. It is only necessary to assume that the effect on the muscle is directly proportional to the number of receptors acted on by the drug. Similar calculations have been used to explain quantitatively the uptake of gases by adsorbents, of oxygen by hæmoglobin, and of poisons by enzymes.

(2) Concentration-action curves for narcotics are usually nearly linear for small concentrations, and resemble closely the curves connecting the concentration of these substances with their effect on surface tension. Since the active narcotics are those which have most effect on surface tension, it is probable that this relationship is not fortuitous. Similar curves are obtained for the action of certain drugs on enzymes.

(3) In certain cases the concentration-action curve for effects, both on living tissues and on enzymes, is *S*-shaped. This can be interpreted as an irreversible all-or-none action on a collection of cells or other elements, the accessibility, or sensitivity, of which varies.

These three types of curve are found not only in the study of the action of drugs on isolated tissues and on enzymes, but also among the 'characteristic curves' which show the relationship between the dose of a drug and the percentage mortality which it causes in a large group of animals.

These curves were also discussed by Prof. J. H. Gaddum. It is true that, when characteristic curves are plotted on an arithmetic scale of doses, the curves may be either symmetrical or asymmetrical. When they are plotted on a logarithmic scale of doses, they are always approximately symmetrical. This fact is an example of the general law, which is justified both by theory and in practice, that the logarithm of any biological measurement is more likely to be normally distributed than the measurement itself (Galton, 1879). These facts are exemplified by the work of Hemmingsen (*Vidensk. Medd. fra Dansk naturh. Foren.*, 98, 125; 1934) who showed that the logarithms of the measurements of different species of animal in one phylogenetic group are normally distributed. Curves were shown in which the effect of drugs on isolated tissues, and on enzymes, and the effect of oxygen on hæmoglobin, were plotted both on arithmetic, and on logarithmic, scales of concentration. Plotted in these ways, all these curves looked similar to the characteristic curves, and it was suggested that the shape of the curves might be explained in terms of variations among the cells in the isolated tissue, or the protein molecules in the enzyme or the hæmoglobin.

Prof. W. Straub, of Munich, said that it is premature to speculate on the mechanisms behind the action of drugs until more is known of the actual effects produced. The central problem lies in the fact that atropine will act only on cells of a certain kind, and has no apparent action on all the other cells in the body. Some of the facts are illustrated by the inhibitory action of muscarine on the frog's heart. The action takes only a fraction of a second to develop, and when the solution is changed the heart recovers in a few seconds. If the muscarine is left in contact with the heart it diffuses into the heart. When diffusion ceases, the heart recovers from the inhibition. At this stage, the heart contains large quantities of muscarine. Inhibition only occurs while there is a potential gradient, or concentration gradient of muscarine, and the drug is diffusing into the heart. Drugs which act like this are called *potentialgifte*. Acetylcholine and adrenaline act as *potentialgifte*, but these two drugs, being natural constituents of the body, are destroyed in the cells, so that they can go on diffusing for long periods without the gradient disappearing. This is the reason why these substances can cause prolonged effects if the external concentration is maintained.

According to Prof. R. A. Peters, the time has come to replace the old biochemical concept of the cell as an unorganized colloidal solution by one of the cells as a co-ordinated structure. In 1929 he postulated what J. Needham has since called a cyto-skeleton for cells: by this he means a three-dimensional mosaic throughout the cell, composed of a network of protein molecules, the surface proteins being connected with the nuclear proteins by threads of cytoplasmic proteins. The amino and carboxyl groups of protein must play an important part in this pattern. The organization envisaged is submicroscopic; it provides the cell with means for independent and localized reactions, and is the cellular counterpart of a nervous system. Since these ideas were put forward, a clearer picture of the sort of organization which might exist has been obtained by the work on the X-ray structure of proteins, on surface films and by such protein models as those suggested by Drs. D. Wrinch and Jordan Lloyd. The cell contents appear to correspond more closely to a thixotropic gel than to a simple solution. Some enzymic systems appear to be structurally related, for example, the lactate and pyruvate system in brain. The cellular organization proposed might allow drug action to be explained in chemical terms, drugs reacting with specialized features of the cell structure.

Dr. J. F. Danielli discussed the structure of cell surfaces. The simplest possible concept of the cell plasma-membrane which is compatible with permeability data, surface tension data, and wetting properties, consists of a lipoid layer at least two molecules thick, with an adsorbed protein layer at each oil-water interface. The external oil-water interface must have an excess of acidic groups. Points of interest in this conception from the aspect of drug action are : (*a*) the excess acidity of the surface, which may be modified by surface active acids or bases ; this change will in turn affect the adsorbed protein layer, enzyme activity at the surface, and the permeability of the lipoid layer ; (*b*) the potential gradient at the interfaces, which will be of the order of 10^7–10^8 volts/cm. ; (*c*) the kinetics of penetration of such a membrane provide for high temperature coefficients for the simple process of penetration of the membrane by a drug, which may mask the temperature coefficient of drug action ; (*d*) it is of interest to know whether the enzyme centres on the cell surface are arranged in an organized fashion. This can be done by using poisons of the type A'–$(R)_n$–B' where A' and B' are specific poisons for the centres of type A and B. If there is any typical distance between A and B, there will be a sudden increase in efficiency of the poison for a particular value of n.

Dr. J. H. Quastel described the experiments with isolated pieces of tissue which have led him to the conclusion that the action of narcotics on the brain is due to their action on carbohydrate metabolism. Luminal reduces the oxygen consumption of slices of brain. It is particularly effective when glucose, lactic acid, or pyruvic acid is used as a substrate. It has no action on the oxidation of glutamic acid or succinic acid. Other narcotics have a similar action, and among narcotics of one type those which are powerful narcotics are also powerful reducers of oxygen consumption. The effect is reversible. The concentrations present in the blood during narcosis would be sufficient to have an action on the oxygen consumption of slices. Slices of tissues other than brain are less sensitive to narcotics. The action of narcotics on slices of brain is antagonized by potassium, but is not affected by calcium. The temperature coefficient of the effects on isolated slices is large ($Q_{10} = 6 \cdot 6$) as is also the temperature coefficient of narcosis in the whole animal.

It was pointed out by Dr. H. R. Ing that the pharmacological properties of many drugs have been shown to depend on definite functional groups or combinations of groups. The recognition of such pharmacologically active groups is exploited in chemotherapy. Some hormones and vitamins have also been shown to contain such groups. Aliphatic narcotics do not appear to contain active groups, and consequently the drug action must depend primarily on their physical properties. Drugs with active groups of quite different structure may also show similar pharmacological properties. When gross physiological changes, for example, the death of bacteria, are involved, several mechanisms may achieve the same gross effect ; but it is difficult to account for drugs so unrelated chemically as muscarine and pilocarpine acting selectively at the same sites and producing similar results. Again, drugs of the same structural type may have different actions, for example, butyl trimethyl ammonium augments, but octyl trimethyl ammonium antagonizes the action of acetylcholine on the frog's auricle.

Pharmacologically active groups seem to imply a chemical mechanism for drug action. The difference in the activity of stereo-isomeric drugs also suggests chemical combination of the drug with receptor molecules in tissues. Homologous series of drugs frequently show maximum activity for one member of the series, for example, alkylcresols, alkylamines, etc. In these cases, the activity may represent the summation of two opposite effects, depending on at least two physical properties. Other factors may be involved, such as the length of chain between two active groups, but in some series, for example, choline esters, the relatively high activity of one member is difficult to account for on these simple lines.

The factors affecting the action of chemotherapeutic drugs on Protozoa were discussed by Prof. Warrington Yorke. *Trypanosoma rhodesiense* is normally resistant to organic arsenicals, but when it is passaged through mice, there is a change in its morphology, and it becomes not only more pathogenic for mice, but also more sensitive to arsenicals. Similar changes occur more slowly when it is passaged through guinea pigs. *T. gambiense*, on the other hand, is comparatively easily killed by drugs, but if infected mice are treated with ineffective doses of organic arsenicals or antimonials or with acridine dyes, the Protozoa become resistant to all drugs of these classes. They remain sensitive to arsenious acid, tartar emetic and Bayer 205. It has been found impossible to develop resistance to tartar emetic, and difficult to develop resistance to Bayer 205. This artificially produced resistance differs from the natural resistance of *T. rhodesiense*, since it survives prolonged passage through mice and tsetse flies.

These facts represent a real danger in Africa, where these drugs are being injected into whole populations of people without proper precautions to ensure that the treatment is always continued until it is effective. It is probable that a strain of trypanosomes is being developed which will resist treatment. Later in the discussion, however, Dr. C. M. Wenyon gave reasons for believing that this development of immunity is due to the selection of resistant trypanosomes.

Sir Henry Dale, in opening the general discussion, expressed the belief that quantitative studies can only give superficial information. He agreed with Prof. Straub that the most important problem is the explanation of the fact that certain drugs affect certain tissues in very low concentrations and have no action on other tissues.

Among those who made impromptu contributions was Dr. F. Hawking, who discussed the effect of chemical structure on the action of organic arsenicals consisting of a benzene ring, a side chain containing arsenic, and a second side chain. The absorption of such substances by trypanosomes can be demonstrated. Trypanosomes which are resistant to treatment *in vivo*, fail to absorb substances containing the second side chain. Similar substances containing no second side chain are taken up, even by undamaged resistant trypanosomes.

Sir Rickard Christophers, discussing the chemical structure of antimalarial drugs, pointed out that it is difficult to predict the action of new substances. This is perhaps because insufficient attention is given to the physicochemical properties of these substances.

Preliminary measurements of solubilities and of pK's might discriminate between substances worth testing and those which would be useless.

Prof. R. Robinson asked why it is that plants so often contain alkaloids with marked actions on animal tissues. This may be explained by some theory of the biological history of the animals and plants which have developed together, or it may be due to the fact that the alkaloids are probably degradation products of proteins, since their structure can usually be derived formally from the naturally occurring amino acids.

Magnetic Properties of the Nickel-Iron Alloys

IN a pamphlet issued by the Bureau of Information on Nickel of the Mond Nickel Co., Ltd., Millbank, S.W.1, an account is given of nickel-iron alloys and their characteristics which will be of special value to electrical engineers and manufacturers.

The magnetic properties present very striking contrasts. The permeability of pure iron, for example, is gradually reduced by additions of nickel exceeding ten per cent, until in the region of 30 per cent the alloys are completely non-magnetic. Further additions of nickel give a range of alloys containing 35–85 per cent of nickel, which have a very high magnetic permeability and are in fact the softest materials magnetically that are commercially available. New alloys have now been developed by adding substantial proportions of nickel and aluminium, which are very hard and form permanent magnets of great strength. The 25 per cent nickel steel is characterized by an extremely high ductility and is corrosion resisting. It is practically non-magnetic and is used extensively in electrical engineering.

The group of iron alloys having 35–80 per cent of nickel, on account of their high permeability, are of great commercial importance. In 1921 the Western Electric Co. of America took out a patent for an alloy consisting of 78·5 per cent nickel and 21·5 per cent iron, all impurities being kept as low as possible. The heat treatment necessary consisted in heating the alloy to 900° C. and then cooling at a definite rate. The alloys patented by this company are given the general name of 'permalloy'. Since then, patents have been taken out for other nickel-iron alloys, containing small proportions of other elements. 'Mumetal', patented by the Telegraph Construction and Maintenance Co., Ltd., London, is one of these. It contains 6 per cent of copper, which facilitates heat treatment and stabilizes the alloy.

The first use to which the high permeability alloys were put was for the 'loading' of submarine cables. In accordance with Heaviside's theory, this would prevent distortion of the signals and also their attenuation. Simultaneously with the development of the loaded submarine cable, continuous attention was given to long-distance land line cables, and nickel-iron devices were found very helpful. Afterwards, in order to save space, it was found advantageous to employ the magnetic alloy in the form of dust or powder. Various chemical and physical methods are used to produce the alloy in this form. A drawback is that the powder has very low permeability, but the energy losses in it are much smaller.

In the year 1930, news first came from Japan of the discovery of a new series of permanent magnet alloys in which the principal alloying elements were nickel and aluminium. Since their introduction, these new magnet steels have been intensively studied, and they are now superseding the cobalt and other steels previously used for these applications. These alloys offer the maximum magnetic energy per unit volume yet available to manufacturers. One of the most important applications of the new magnets is for radio loud speakers. In the manufacture of small motors, magnetos and other small-sized dynamo electric equipment, the nickel alloy magnets are found very efficient and adaptable. They are used in the magnetic detectors used in 'automatic' traffic signalling.

On the theoretical side, our knowledge of magnetic alloys is far from complete. When we have a better knowledge of how heat treatment affects them, still more useful alloys may become available.

Educational Topics and Events

CAMBRIDGE.—The Vice-Chancellor has received a letter from Sir Harry McGowan, chairman of Imperial Chemical Industries, Ltd., stating that it is not proposed to continue to support financially the work on molecular rays carried out since 1929 by Mr. R. G. J. Fraser, who has now been appointed to the research staff of I.C.I. (Alkali) Ltd. The apparatus and equipment installed, at a cost of about £2,500, is being offered to the University for the use of the Departments of Chemistry and Physics, and Sir Harry hopes that it will continue to be used for research on molecular rays.

The Managers of the Benn W. Levy Fund have appointed K. P. Harrison, of King's College, to the studentship in biochemistry.

J. H. Gaddum (Trinity College), W. B. R. King (Magdalene College) and Dr. O. M. B. Bulman (Sidney Sussex College) have been approved for the degree of Sc.D.

The Governing Body of Emmanuel College invites applications for a research studentship which will be awarded in July 1937. Preference will be given to candidates who have already completed one but not more than two years of research. The studentship, which must be held at Emmanuel College, and has a maximum annual value of £150, is awarded and normally held for two years, but may be renewed for a third. Further information can be obtained from the Master of the College.

LONDON.—The title of professor of pathology of mental disease in the University has been conferred on F. L. Golla, in respect of the post held by him at the Maudsley Hospital; that of professor of psychiatry in the University on Dr. Edward Mapother, in respect of the post held by him at the Maudsley Hospital, and that of reader in mathematics in the University on Dr. L. S. Bosanquet, in respect of the post held by him at University College.

The following doctorates have been conferred: D.Sc. in botany on H. Chaudhuri (Imperial College—Royal College of Science); D.Sc. in horticulture on R. G. Hatton (East Malling Research Station); D.Sc. in physics on F. C. Chalklin (King's College).

Prof. F. A. Cavenagh has been appointed, as from September 1, 1937, to the University chair of education tenable at King's College. Since 1934, he has been professor of education in the University of Reading.

OXFORD.—In Congregation on November 21 the honorary degree of D.C.L. was conferred upon the American Ambassador, Mr. R. W. Bingham, and on J. L. A. Avenol, secretary-general to the League of Nations.

Dr. W. Stephenson, assistant director of the new Institute of Psychology, has been given the degree of M.A. by decree.

Convocation and Congregation, with Lord Halifax, the Chancellor, as president, assembled in the Divinity School on November 24 to assist at the promulgation of the decree respecting Lord Nuffield's benefaction to the Medical School. Speeches were made conveying the thanks of the University for his magnificent gift. The most dramatic speech, however, was made by Lord Nuffield himself in which he announced that he proposed to raise the original sum of £1,250,000 to £2,000,000. This sudden and quite unexpected announcement was received with a curious mixture of astonishment and gratitude. The trustees of the new trust will consist of a chairman and three others nominated by Lord Nuffield, the vice-chancellor and another member of Hebdomadal Council, the professor of medicine, and three representatives of the two hospitals in Oxford concerned in the scheme. There will also be a committee for carrying out the scheme in detail—the vice-chancellor, the professor of medicine, the director of the Nuffield Institute, three members of the faculty of medicine, three representatives of the hospitals, and the four new Nuffield professors of surgery, clinical medicine, anæsthetics, and obstetrics. The new professors are to be appointed as soon as practicable and already their chairs have been allotted to four colleges. The mode of their appointment, and the regulations governing them, will be very similar to those affecting other professors. The salary attached to each chair, however, will be £2,000 a year. The new professors may not engage in private practice but they will be allowed to receive fees from some of the patients they attend in the hospitals associated with the scheme.

THE University of Leyden has been awarded a sum of 20,000 dollars by the Rockefeller Foundation for researches to be made in the course of five years on infantile psychology.

ON the proposal of the Minister of Public Health, the Belgian Government is to create a second Superior School of Physical Education at Liège similar to that attached to the medical faculty of Ghent.

AT the reopening ceremony of the University of Paris held in the great amphitheatre of the Sorbonne on November 7, in the presence of M. Albert Lebrun, President of the French Republic, the Minister of Education and the Rector of the University, the degree of doctor *honoris causa* was conferred on Dr. Israel Holmgren, professor of physiology at the Caroline Institute of Stockholm, and on Prof. George David Birkhoff, professor of mathematics at Harvard University.

Science News a Century Ago

Schönbein and Faraday

ON November 26, 1836, Schönbein wrote from Basle to Faraday: "The Philosophical Society of Bale in one of their last meetings elected you their honorary member and I am charged by our President to forward the diploma and ask you the favour to accept of the latter as a weak expression of the high esteem which our Society entertain for you, on account of the eminent services you have rendered natural Science". Schonbein then went on to refer at length to his own observations of the behaviour of iron wires in acids, and concluded his letter by remarking: "Before closing this letter, I take the liberty to ask you a favour. Our Establishment wants to get a good magnetic-electrical Machine, by means of which the principal experiments on Magneto-Electricity may easily be made in classes. Now if it be not too much asked, the Committee of our Museum should feel themselves laid under great obligations to you, would you be so kind as to order such an apparatus to be sent to us by a London instrument-maker."

Berzelius awarded the Copley Medal

AT the anniversary meeting of the Royal Society held on November 30, 1836, the president, H.R.H. the Duke of Sussex, returned to the chair, after an absence of two years owing to severe eye trouble. The report of the proceedings of the Council, read by the secretary, said "The Council have awarded a Copley Medal to Baron Berzelius for his application of the Doctrine of Definite Proportions in Determining the Constitution of Minerals. To the labours of this distinguished chemist, science is indebted for many of the facts by which the Laws of Definite Union were established. As early as 1807, soon after Dalton and Gay-Lussac had made known their views on this vital branch of chemistry, Berzelius commenced an elaborate examination on the proportions in which the elements of compound bodies are united, beginning with the salts, and subsequently extending his researches to all other departments of his science, as well to the produces of organised existences as to those of the mineral world. . . . His numerous analyses of minerals enabled him at once to elucidate their nature through the light derived from the laws of definite combination, and at the same time to supply in the composition of minerals a splendid confirmation of those laws. . . ."

As had been the case in 1821, 1825, 1827, 1832, a second Copley Medal was awarded, Edward Kiernan receiving the medal for his discoveries relative to the structure of the liver. "Before the researches of Mr. Kiernan," the report said, "the liver was supposed to consist of two dissimilar substances. . . . The relation of the vessels and excretory ducts to those supposed dissimilar substances was not known. . . . Mr. Kiernan's discoveries show that in place of two textures there exists but one, but that the difference in colour results from the accidental congestion of one or other of the system of vessels which are found in the liver. He has demonstrated the size and limits of the internal glandules of which the liver consists; has traced the relation to these glandules of the different orders of vessels, which are distributed through the organ and has explained the mechanism of biliary secretion."

Pierre-Simon Girard (1765–1836)

On December 1, 1836, the eminent French civil engineer Pierre-Simon Girard died in Paris at the age of seventy-one years. Born in Caen on November 4, 1765, he was trained as an engineer and in 1792 attracted attention by his essay on "Locks for Navigation", for which he was awarded a prize by the Paris Academy of Sciences. Thus brought into notice, he was chosen with Monge, Berthollet, Fourier and other scientific men to accompany Napoleon to Egypt, and became one of the members of the short-lived Institute founded in Cairo. On his return to France, he was appointed engineer-in-chief of the Canal de l'Ourcq and entrusted with the water supply of Paris. His "Recherches sur les Eaux Publiques de Paris" published in 1812 contains a historical account of the water supply of the city. Girard was elected a member of the Academy of Sciences in 1813 and six years later superintended the installation of a gas supply for the streets and theatres of Paris.

Opium Eating and Health

In a lecture on opium eating published in the *Lancet* of December 3, 1836, Dr. George G. Sigmond remarked that a very interesting question had arisen as to the effect of the habit on health and on longevity. He instanced the case of the late Earl of Mar, who had insured his life in an Edinburgh office to a large amount. Although he consumed two to three ounces of laudanum daily, he did not state the fact when he obtained the policy of insurance, and on his death from jaundice and dropsy two years later, the company declined payment of the policy on the grounds that his lordship had concealed from them a habit which tended to shorten life. The bank that held the policy as security for money lent entered on an action, with the result that the insurance office had to pay the amount, not, however, on the ground that the habit was fatal to life, but because the office had not shown the proper degree of caution when the insurance was effected.

St. James's Ornithological Society

In the last part for 1836 of the quarterly journal the *Analyst* (5, 314), under the heading "St. James's Ornithological Society", it is stated that "this Society is instituted for the purpose of forming a collection of water birds in the garden of St. James's Park; and its operations will subsequently be extended to the waters in the other parks, if the funds of the Society be found sufficient. The first object will be to exhibit a complete collection of British Anatidae, both resident and migratory. . . . It is intended to keep the whole, as far as practical, in a state of nature, and the collection, being formed in the public parks, will, of course, be open to the view of every one. As there is in London no other exclusively Ornithological Society, it is unnecessary to point out to the ornithologist the advantages which may result from an institution possessed of a locality so admirably calculated for a collection of aquatic birds, and for affording facilities for observations on the changes of plumage from sex, age, or season, which are so interesting to Naturalists, and so difficult to be observed elsewhere."

The Earl of Liverpool was president of the Society, and its proceedings were sanctioned by the Commissioner for Woods and Forests.

Societies and Academies

London

Royal Society, November 19.

W. A. Bone and L. E. Outridge: Some influences of dilution on the explosive combustion of hydrocarbons. Certain effects are dealt with of dilution with inert gases (Ar, He and N_2) upon explosions of equimolecular mixtures of ethylene, or acetylene and oxygen, such as $C_2H_4 + O_2$ and $C_2H_2 + O_2$ which normally give rise to carbonic oxide and hydrogen, without any separation of carbon or steam-formation in accordance with the equations:

$$C_2H_4 + O_2 = 2CO + 2H_2,$$

and

$$C_2H_2 + O_2 = 2CO + H_2,$$

respectively. Chemical, photographic and spectrographic tests show that sufficient dilution of such media, while not much affecting the main result, may induce some secondary carbon deposition and steam-formation on explosion, when the mean flame temperature is thereby reduced to a point well below 2,000° C., such result being probably due to the fall in flame temperature induced by dilution.

W. Payman and W. C. F. Shepherd: Explosive waves and shock waves. (4) Quasi-detonation in mixtures of methane and air. Experiments on a small and on a large scale have been carried out to investigate the possibility of detonation in mixtures of methane and air. In small-scale experiments the resulting explosion is in some respects similar to detonation; but it is unlike detonation in that the speed is not uniform and in that the wave or flame front is partly sustained first by the flame and then by hot particles from the detonator. The explosion is described as 'quasi detonation', since the energy maintaining the wave is not wholly derived from the combustion of the methane. An explosion which is similar to detonation was also established in large-scale experiments in which a 9·1 per cent methane-air mixture was contained in a gallery 30·5 cm. in diameter and ignited by means of a charge of high explosive. This quasi-detonation is propagated through quiescent mixture at a uniform rate of 1,900 metres per second, and the flame is intensely luminous and accompanied by high pressure.

Paris

Academy of Sciences, November 3 (*C.R.*, 203, 833–900).

Edouard Chatton and Félix Villeneuve: The evolutive cycle of ***Eleutheroschizon Duboscqui***. Experimental proof of the absence of schizogony in this form and in ***Siedleckia Caulleryi***.

Paul Delens: The anallagmatic geometry of the tetrahedron.

P. Bonét-Maury: A manometer for high vacua. A modified manometer of the Knudsen type.

Pierre Chevenard: A very small testing machine with photographic recording, and its application to the study of textile fibres. The machine is constructed to test single fibres, with a maximum load of 50 gm. The record shows the relation between elongation and load.

Jean Chazy: The almost circular movements due to a nearby force of Newtonian attraction.

Emile Sevin: The influence of a magnetic field on the atom of hydrogen.

Roger Mérigoux: The movement of contaminated liquid surfaces.

Félix Ehrenhaft: The experimental determination of the mobility of small spheres in a gas.

Arcadius Piekara and Bruno Piekara: Electrical saturation in pure liquids and their mixtures. Study of the influence of the electric field on the dielectric constant of mixtures of benzene and nitrobenzene at varying concentration. The effect of traces of moisture.

Ouang Te-Tchao: Counting particles in suspension in air.

Gabriel Foex and Charles Fehrenbach: The calculation of the magnetic moment of the ions.

Ny Tsi-Zé and Weng Wen-Po: The absorption spectrum of cæsium.

Georges Bruhat and Pierre Guénard: Study of the circular dichroism of solutions of camphor in water and in acids.

Théodore V. Ionescu: The structure of the photon.

Louis Cartan: The application of the methods of electronic optics to mass spectrography.

Robert Tréhin: The application of certain physical methods to the search for complex compounds in solution. The variation of a physical property of a liquid mixture with the composition is frequently used for detecting the formation of a complex compound. The method fails when more than one complex compound is present, and generally it is not possible to prove or deny the existence of such compounds on such evidence alone.

Guillaume Rumeau: Optical antipodes and velocities of crystallization.

Mordechaï Bobtelsky and Mme. Ljuba Bobtelsky-Chajkin: Mixed catalytic effects in the decomposition of hydrogen peroxide in the presence of sodium tungstate and other catalysts.

Marc Antoine Foex: The action of hydrogen on alkaline glasses at a high temperature. Alkaline glasses suffer marked loss of weight when heated in hydrogen at 850°–1,150° C., and this is due to loss of alkali.

Mlle. Marie Falinski: Study of the system ZrO_2–SO_3–H_2O. The conditions for the existence of a new acid zirconium sulphate, $Zr(SO_4)_2,H_2SO_4,2H_2O$.

Mme. Léone Walter-Lévy: Contribution to the study of the double decomposition between solutions of magnesium sulphate and potassium carbonate at the boiling point.

Henri Lefebvre and R. Faivre: Contribution to the study of the oxidation of coal. At temperatures between 150° and 300° C., oxygen rapidly penetrates coal, especially the vitrain. The coal becomes poorer in hydrogen and more resistant to oxidation.

Jean Feldmann and Robert Lami: The growth of the mangrove at Guadeloupe.

Jean Chaze: Intoxicating rye-grass (*Lolium temulentum*) and the pure culture of its endophyte.

Joseph Magrou: The culture and inoculation of the symbiotic fungus of *Arum maculatum*, the cuckoo-pint.

Yves Le Grand: Binocular vision through crossed polarizers.

Albert Vandel: The appearance of colourless mutations in *Trichoniscus* (*Spiloniscus*) *elisabethæ* and their hereditary behaviour.

Paul Meunier: The presence and distribution of aluminium in animal tissues. Aluminium is always present in animal tissue, but in much smaller proportions than in plants.

Albert Peyron and Henri Limousin: Intravascular polyembryony and the metastases with multiple tissues in the embryomes of the testicle.

André Lwoff and Mme. Marguerite Lwoff: The physiological role of the co-dehydrogenases for *Hæmophilus parainfluenzæ*.

Constantin Levaditi, Carl Kling, Mladen Païc and Perez Haber: The approximate size of the poliomyelitic virus.

Washington, D.C.

National Academy of Sciences (*Proc.*, 22, 525–566, Sept. 15).

Ernst Öpik: Meteor heights from the Arizona Expedition. About 22,000 meteors were observed between October 1931 and July 1933; of these, 3,540 were observed simultaneously from two stations and their heights could therefore be calculated. 80 per cent of the objects observed were sporadic meteors and only 7 per cent belonged to the major showers. It is deduced that meteors meeting the earth are vaporized 23 km. higher than those overtaking the earth, due to greater relative velocity. Seasonal variation of height suggests an annual fluctuation of height of the atmosphere of amplitude 3·7 ± 0·7 km. There is no evidence of a hydrogen atmosphere, at least to a height of 130 km.

A. W. Bellamy: Inter-specific hybrids in *Platypœcilus*: one species *ZZ–WZ*; the other *XY–XX*. The results are discussed from the point of view that there is a single sex differential which prejudices development in the direction of maleness or femaleness.

G. W. Beadle and Boris Ephrussi: Development of eye colours in *Drosophila*: transplantation experiments with suppressor of vermilion.

G. A. Miller: Groups containing a relatively large number of operators of the same order.

John H. Lawrence, Paul C. Aebersold and Ernest O. Lawrence: Comparative effects of X-rays and neutrons on normal and tumour tissue. Normal healthy albino mice and pieces of an easily transplantable mouse tumour (Sarcoma 180) were submitted to filtered 200 kv. X-rays and to neutrons from the cyclotron, the doses of the two types of radiation being measured in r units by a Victoreen condenser type r meter. After irradiation, the tumour tissue was implanted into susceptible mice and its development watched. It is concluded that, per unit of ionization, neutrons are much more effective than X-rays in destroying normal mice *in vitro* and Sarcoma 180 *in vitro*.

F. Zwicky: Characteristic temperatures in supernovæ. A theoretical discussion.

Carroll C. Pratt: Interaction across modalities: simultaneous stimulation. A lowering of the apparent pitch of musical instruments in a concert hall on dimming the illumination has not been generally remarked. Conversely, an experimental test in which observers compared an illuminated source with a previously illuminated standard source while listening by ear-phones to a high- or a low-pitch tone, showed no significant influence of the sound stimulus on the estimates made of the illumination of the light source. It seems unlikely that two psychological events from different modalities, operating at a sensory level, will influence each other.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, November 30

Royal Geographical Society, at 8.30.—Lincoln Ellsworth: "A Recent Flight across Antarctica".

Tuesday, December 1

Royal Society of Arts, at 4.30.—Brigadier J. G. Browne: "The Assyrians".

Pharmaceutical Society of Great Britain, at 8.30.—(in the Great Hall, University College, London, W.C.1).—J. Davidson Pratt: "The Defence of the Civil Population against Gas".

Wednesday, December 2

Institution of Heating and Ventilating Engineers, at 7.—(at the Institution of Mechanical Engineers, Storey's Gate, S.W.1).—Dr. M. C. Marsh: "Humidity in Industry".

Friday, December 4

Society of Chemical Industry (Liverpool Section).—Prof. I. M. Heilbron: "Modern Technique in Biochemistry" (Hurter Memorial Lecture).

King's College, London, at 5.30.—Dr. J. Johnson: "Methods of Excavations for Greek Papyri in Egypt".*

Royal Institution, at 9.—Sir Stephen Gaselee: "Natural Science in England at the End of the Twelfth Century".

British Institute of Radiology, December 2–4.—Annual Congress and Exhibition to be held in the Central Hall, Westminster, S.W.1.

Official Publications Received

Great Britain and Ireland

Education in 1935: being the Report of the Board of Education and the Statistics of Public Education for England and Wales. (Cmd. 5290.) Pp. xiii+281. (London: H.M. Stationery Office.) 3*s*. 6*d*. net. [911

University of Durham. Abstracts of Theses for Doctorates presented by Candidates who have received the Degrees in Convocation during the Academical Year 1935–36. Pp. 17. (Durham: University of Durham.) [911

Society of Chemical Industry: Chemical Engineering Group. Proceedings, Vol. 17, 1935. Pp. 128. (London: Chemical Engineering Group.) 21*s*. [1111

A Chapter in the Chemistry of Essential Oils. By Prof. John Read. (Nineteenth Streatfeild Memorial Lecture, 1936.) Pp. 34. (London: Institute of Chemistry.) [1211

Technical Publications of the International Tin Research and Development Council. Series A, No. 46. The Spectrographic Analysis of Tin. By D. M. Smith. Pp. 26. (London: International Tin Research and Development Council.) Free. [1211

The British Science Guild. Science in Development. By the Rt. Hon. Lord Rutherford. (The Norman Lockyer Lecture, 1936.) Pp. 20. (London: British Association.) 1*s*. [1211

A Survey of the Present Organization of Standardization—National and International. Pp. viii+55. (London: World Power Conference.) 3*s*. 6*d*. net. [1211

Third Report of the Commissioner for the Special Areas (England and Wales). (Cmd. 5303.) Pp. xii+210. (London: H.M. Stationery Office.) 3*s*. 6*d*. net. [1211

University of Reading: National Institute for Research in Dairying. Annual Report for the Year ending 30th September 1935. Pp. 66. (Shinfield: National Institute for Research in Dairying.) [1311

University College of North Wales. Calendar for Session 1936–37. Pp. 441. (Bangor: University College of North Wales.) [1311

Proceedings of the Royal Society of Edinburgh, Session 1935–1936. Vol. 56, Part 3, No. 14: Genetical and Cytological Studies of the Intergeneric Hybrid of *Cairina moschata* and *Anas platyrhyncha platyrhyncha*. By Prof. F. A. E. Crew and Dr. P. C. Koller. Pp. 210–241+4 plates. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 3*s*. 6*d*. [1311

Air Raid Precautions. Handbook No. 6: Air Raid Precautions in Factories and Business Premises. (Issued by the Home Office: Air Raid Precautions Department.) Pp. 69. (London: H.M. Stationery Office.) 6*d*. net. [1611

Conference on Atmospheric Ozone held at Oxford, September 9th to 11th, 1936. Papers read at the Conference. Pp. iv+76. (London: Royal Meteorological Society.) 5*s*. 1711

Other Countries

Regenwaarnemingen in Nederlandsch-Indië. Vijf en vijftigste Jaargang, 1933. Pp. 129. (Batavia: Koninklijk Magnetisch en Meteorologisch Observatorium.) [911

Memoirs of the Geological Survey of India. Palaeontologia Indica, New Series, Vol. 21, Memoir No. 4: Fossil Algæ from the Uppermost Cretaceous Beds (The Niniyur Group) of the Trichinopoly District, S. India. By L. Rama Rao and Dr. Julius Pia. Pp. v+49+6 plates. (Calcutta: Geological Survey of India.) 4.10 rupees; 7*s*. 9*d*. [911

League of Nations: Eastern Bureau, Singapore. The Soil in relation to Malaria. By K. B. Williamson. Pp. ii+7. (Singapore: Government Printing Office.) [1011

Imperial Agricultural Research Institute, New Delhi. Report of the Director for the Year ending June 30, 1936. Pp. 18+2 plates. (New Delhi: Government of India Press.) [1011

Sveriges Geologiska Undersökning. Ser. C., No. 401: Berggrunden inom Kantorps malmtrakt. Av Nils H. Magnusson. Pp. 88+1 plate. 2.50 kr. Ser. C, No. 404: Auftreten und Paragenese der Antimonminerale in zwei Sulfidvorkommen im Skelleftefelde, Nordschweden. Von Sven Gavelin. Pp. 20. 0.50 kr. (Stockholm: P. A. Norstedt and Söner.) [1211

New Zealand: State Forest Service. Annual Report of the Director of Forestry for the Year ended 31st March 1936. Pp. 19. (Wellington: Government Printer.) [1311

Geofysiske Publikasjoner utgitt av det Norske Videnskaps-Akademi i Oslo. Vol. 11, No. 11: The Water Transport of Gradient Currents. By Anton Jakhelln. Pp. 14. (Oslo: A. W. Brøggers Boktrykkeri A/S.) 2.50 kr. [1311

Cornell University Agricultural Experiment Station. Bulletin 643: Prices of Farm Products in New York State, 1841 to 1935. By S. E. Ronk. Pp. 76. Bulletin 646: Growth Experiments with Pin Oaks which are growing under Lawn Conditions. By Donald Wyman. Pp. 23. Bulletin 647: An Economic Study of Part-Time Farming in the Elmira and Albany Areas of New York, 1932 and 1933. By Kenneth Hood. Pp 139. Bulletin 648: An Economic Study of Land Utilization in Tioga County, New York. By Paul B. Jones. Pp. 40. Memoir 189: Effect of Packing Materials on the Flavor of Storage Eggs. By Paul F. Sharp, George F. Stewart and J. C. Huttar. Pp. 26. (Ithaca, N.Y.: Cornell University.) [1311

Meddelelser om Grønland. Bind 78, Nr. 4: Die Godthaabexpedition 1928—Bericht über die chemischen Arbeiten, 2. Von S. Kuhnel Hagen. Verteilung von Phosphat und Nitrat im Gewässer zwischen Grønland und Kanada. Pp. 36. 1.75 kr. Bind 80, Nr. 3: The Godthaab Expedition 1928—Tomopteridæ and Typhloscolecidæ. By Elise Wesenberg-Lund. Pp. 17. 0.75 kr. Bind 88, Nr. 2: Researches into Norse Culture in Greenland—Sandnes and the neighbouring Farms. By Aage Roussell. Appendix: Greenland Runic Inscriptions, 4, by Erik Moltke. Pp. 232+6 plates. 11.00 kr. Bind 88, Nr. 3: Researches into Norse Culture in Greenland—Animal Remains from the West Settlement in Greenland, with Special Reference to Livestock. By Magnus Degerbøl. Pp. 55. 2.50 kr. Bind 88, Nr. 4: Researches into Norse Culture in Greenland—Evidence of Iron Extraction at Sandnes, in Greenland's West Settlement. By Niels Nielsen. Pp. 14. 0.75 kr. Bind 95, Nr. 7: Treaarsexpeditionen til Christian den X's Land, 1931–34—On the Crystalline Complex of Liverpool Land. By E. H. Kranck. Pp. 122+4 plates. 6.00 kr. Bind 97, Nr. 2: Treaarsexpeditionen til Christian den X's Land, 1931–34—On the Placodermi of the Upper Devonian of East Greenland; Supplement to Part 1. By Erik A:son Stensiö. Pp. 52+30 plates. 5.00 kr. Bind 100, Nr. 6: Treaarsexpeditionen til Christian den X's Land, 1931–34—The Larval Development, Growth and Metabolism of Arctic Marine Bottom Invertebrates compared with those of other Seas. By Gunnar Thorson. Pp. 155. 7.00 kr. Bind 104, Nr. 10: The Scoresby Sound Committee's 2nd East Greenland Expedition in 1932 to King Christian IX's Land—The Former Eskimo Habitation in the Kangerdlugssuak District, East Greenland. By Magnus Degerbøl. Pp. 48. 2.50 kr. Bind 109, Nr. 2: 6 og 7 Thule-Expedition til Sydøstgrønland, 1931–33—The Former Eskimo Settlements on Frederik VI's Coast. By Therkel Mathiassen. Pp. 58. 2.50 kr. Bind 112, Nr. 3: Treaarsexpeditionen til Christian den X's Land, 1931–34—Some Few Preliminary Remarks on Triassic Fishes from East Greenland. By Eigil Nielsen. Pp. 55. 2.50 kr. Bind 118, Nr. 1: The Eskimo Archæology of Julianehaab District, with a Brief Summary of the Prehistory of the Greenlanders. By Therkel Mathiassen, in collaboration with Erik Holtved. Pp. 141+4 plates. 7.00 kr. Bind 118, Nr. 2: Revision of the Greenland Rock Ptarmigans. By Finn Salomonsen. (Miscellaneous Notes on Greenland Ornithology, 3.) Pp. 36. 1.75 kr. Bind 118, Nr. 3: On *Metopa Groenlandica* H. J. Hansen (Crust. Amphip.). By K. Stephensen. Pp. 8. 0.50 kr. Bind 118, Nr. 4: On the Amphipod *Metopa Groenlandica* H. J. Hansen found in the Mantle Cavity of the Lamellibranchiate *Pandora glacialis* Leach in East Greenland. By K. Stephensen and G. Thorson. Pp. 7. 0.50 kr. Bind 118, Nr. 5: Om Grønlands Areal. 1: Arealmaaling af Kommunerne i de Vestgrønlandske Kolonidistrikter Ritenbenk, Godhavn, Jakobshavn og Christianshaab. Af J. M. Danbo. Pp. 12. 0.50 kr. (København: G. A. Reitzels Forlag.) [1611

Catalogues

List of Publications. Pp. ii+14. (The Hague: Dr. W. Junk.)

Apparatus for the Measurement of Dielectric Constants. (Dipol 36.) Pp. 8. Colorimeter of Hymans van den Bergh—Grotepass. (Col 36.) Pp. 2. (Delft: P. J. Kipp and Zonen; London: W. Edwards and Co.)

The Use of Marmite Yeast Extract in the Prevention and Treatment of Nutritional Disorders: its Vitamin B Content and Antianæmic Potency. Pp. 32. (London: The Marmite Food Extract Co., Ltd.)

Biological and General Apparatus: Laboratory Equipment and Apparatus for Bacteriology, Pathology, Public Health, Chemistry and Cognate Sciences. (Catalogue No. 30K.) Pp. iv+537. (London: Griffin and Tatlock, Ltd.)

Zeiss Nachrichten. Folge 2, Heft 1, Mai 1936. Pp. 40. (Jena and London: Carl Zeiss.)

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[illegible]

The Indian Institute of Science

IT required the lessons of the Great War to bring home to those engaged in industry in Great Britain the benefits which accrue from scientific research. It speaks therefore highly of the acumen of the Parsee merchant, the late Mr. J. N. Tata, that forty years ago he proposed to endow an all-India Research Institute. After a careful consideration of the schemes drawn up by Sir William Ramsay, and by Sir David Masson and Colonel Clibborn, his plan came to fruition; and on a site at Hebbal, near Bangalore, given by the Government of Mysore, it was decided to proceed with the erection of the Institute. Unfortunately, Mr. Tata died in 1904, but his sons, the late Sir D. J. Tata and Sir R. J. Tata, gave effect to his wishes, and in 1906 the first director, Dr. Morris W. Travers, was appointed.

At the time when the scheme was first adumbrated, scientific research in India was confined almost entirely to the Government services comprised in the Survey of India, the Geological, Botanical and Zoological Surveys, and the various agricultural departments. With a few notable exceptions, mainly in the laboratories of Sir J. C. Bose and Sir P. C. Rây, the universities contributed little to the advancement of knowledge. The new institute filled, therefore, an obvious gap in the Indian educational system, providing for the first time facilities for the training of students in the methods of scientific research. The first students were admitted in July 1911 into the department of general chemistry (Prof. M. W. Travers), applied chemistry (Prof. Rudolf), and electrical technology (Prof. A. Hay), whilst in September of the same year a department of organic chemistry, under Prof. J. J. Sudborough, was added.

The exact functions of the Institute as set forth by Mr. Tata were somewhat vague, but the underlying idea was that it should work "for the benefit of India". It was naturally anticipated that the Institute would by its researches advance the development of Indian industries. The normal working of the Institute was upset in 1914 by the resignation of its first director, who was succeeded by Sir Alfred Bourne, and by the outbreak of the Great War, which naturally diverted its activities. On the retirement of Sir Alfred Bourne in 1919, it was felt that a clearer demarcation of the activities of the Institute was required, more especially since the Indian universities themselves were now active centres of research. In 1921 a committee, of which Sir William Pope was chairman, submitted a valuable report which recommended certain important changes. With the appointment of Dr. (now Sir) M. O. Forster as director, the Institute entered upon a fresh era, and although, as was perhaps natural, criticisms were heard, the period of his directorship, thanks to his great administrative ability and tact, was one of continued progress, numerous contributions of both scientific and industrial importance being made.

One of the recommendations of the Pope committee was that a reviewing committee should be appointed quinquennially to report on the working of the Institute, and a committee, of which Lieut.-Colonel Sewell was chairman, recommended in 1931 that greater attention should be paid in future to investigations likely to benefit Indian industries, since this appeared to be the desire of the founder. There has in the past been much criticism of the Institute, mainly in our opinion unfounded, on the grounds that the work carried out there was of purely scientific interest.

On the retirement in 1933 of Sir Martin Forster, the distinguished Indian physicist, Sir Venkata Raman, was appointed director. Sir Venkata was already well acquainted with the problems of the Institute since, not only had he been a member of the Pope committee, but he had served also on the council of the Institute. Since his appointment followed so soon after the report of the Sewell committee, it was naturally anticipated that he would endeavour to implement its recommendations and encourage industrial research. This has, however, proved far from being the case. As a physicist he has perhaps not unnaturally taken advantage of a recommendation of the Pope committee and developed a department of physics of which he himself is the head. Whilst this in itself was unobjectionable and a very necessary adjunct to a live department of physical chemistry, he would appear to have developed it at the expense of the existing departments, more especially those of general and organic chemistry. Simultaneously, considerable friction arose between the professorial staff and the director, resulting two years ago in the resignation of Profs. Watson and Mowdawalla.

We have now before us the report of the second quinquennial committee, presided over by Sir James Irvine, which was submitted to the Visitor (H.E. the Viceroy) last March and the recommendations of which have, we understand, been accepted in principle by the Council of the Institute. The committee found the internal affairs of the Institute to be in a most alarming condition, and to quote the report "the future of the Institute is evidently precarious". Brilliant as have been the contributions made by the director to physical science during the past four years, there is undoubted evidence that he has proved a signal failure as a director. Unlike his predecessors, he would appear to have interfered to an unwarrantable degree in the working of the various departments and rendered conditions so difficult that the resignations referred to above are readily understood. Further, he has seriously jeopardized the financial position, so that the budget can now only be balanced by drawing heavily upon reserves. It might be suggested that the Senate has been weak in allowing the continuance of the state of affairs now revealed, but it is doubtful if the protests, which it obviously made, were ever allowed to come before Council. Furthermore, the fact that two of the most important chairs, those of general and organic chemistry, were vacant, weakened its authority. If the present position had been allowed to proceed unchecked, there seems to be little doubt that practically the whole of the Institute's resources would have been devoted to the furtherance of research in pure physics, which, as the report remarks, would have been "a complete departure from the aims of the Founder".

Deeply impressed by the deplorable conditions now prevailing in the Institute, the Irvine committee makes far-reaching recommendations, some of which we print on page 981. These will, if adopted, make a complete change in the administration of the Institute, which is in many respects unnecessarily complex. Two outstanding features of the recommendations are (i) that the routine duties of administration, now in the hands of the director, should be entrusted to a registrar and (ii) that the Senate should have a direct representation on the Council. It is suggested that the registrar, who would be seconded from one of the civil services, should be secretary to the Council, Senate and Finance Committee and be responsible also for dealing with the correspondence of the Institute. This would eliminate the possibility, which at present exists, of the Senate's recommendations not being considered by the Council. Prior to the Pope committee, all heads of departments were members of the Council, and it is unfortunate that the direct representation of the Senate on the Council, a general feature in most British universities, should have been discontinued. The Council will be further strengthened, if the committee's recommendations are adopted, by the presence of a representative of the old students. This again is in accord with university practice in Great Britain.

A further recommendation of the committee is that staff appointments, in place of being for a limited number of years, should, after a probationary period, be continued until the age of retirement fixed by the Council. This once more is a reversion to the former custom, and should not only allow of a wider field of choice in making future appointments, but also enable present members of the staff to stand up for their rights and privileges.

The present unhappy position at the Institute has arisen largely from the defective administration of the director, and it is therefore natural that the Irvine report deals at length with methods for overcoming the present difficulties and preventing their recurrence. It discusses, however, the general working of the various departments in the Institute and it suggests certain economies which should result in the balancing of the budget. Whilst not desiring in any way to limit purely scientific activities, which are regarded as fundamental, the committee suggests how it should prove possible to develop research on industrial problems. The recommendation that an organic chemist of standing should be in charge of the departments of general and organic chemistry, with four assistant professors for various branches of the science, will meet with general approval. The committee comments severely, and in our opinion with reason, on the recommendation made by an economy committee that physical chemistry should be merged in the department of physics. In view of the fundamental and growing importance of physical chemistry to the chemical industries, it is amazing that such a recommendation should ever have been made. It is anticipated that, as funds become available, the various assistant professorships will be raised to the status of full professors.

We feel convinced that if the admirable recommendations of the Irvine committee are implemented, the happy spirit, which formerly prevailed at the Institute, will be restored. There is no doubt that, with a few desirable changes of organization, a competent director could lead the Institute to notable success; if, however, the director has not the confidence and trust of the staff, the Institute must fail of its essential purpose, however perfect the organization may be. Last July was the silver jubilee of the Institute: when the time comes to celebrate its golden jubilee we do not doubt that it will have justified the desire of its founder and will have worked "for the benefit of India".

European Civilization and the African

(1) Native Policies in Africa
By Dr. L. P. Mair. Pp. xi+312. (London: George Routledge and Sons, Ltd., 1936.) 12*s*. 6*d*. net.

(2) Reaction to Conquest:
Effects of Contact with Europeans on the Pondo of South Africa. By Dr. Monica Hunter. (Published, with the assistance of a Grant from the Carnegie Corporation through the Research Grant Board, Union of South Africa, for the International Institute of African Languages and Cultures.) Pp. xx+582+28 plates. (London: Oxford University Press, 1936.) 30*s*. net.

(3) Ten Africans
Edited by Margery Perham. Pp. 356+16 plates. (London: Faber and Faber, Ltd., 1936.) 15*s*. net.

IN affairs concerning native Africa the anthropologist is no longer, as a generation ago, a voice crying in the wilderness. An ever increasing literature offers studies of the problem of the native in a varying range and from various points of view; but the authors in the main are at one in making scientific investigation of native life and conditions the essential principle of argument in theory and practice. A further difference to be noted—and this is of no little importance in view of much misunderstanding—is that these scientifically trained students of native Africa argue with detachment. Unlike their predecessors, they neither play upon the strings of philanthropy, nor as anthropologists enter unqualified protests against the modification of custom, arguing that if preserved it might serve as material for scientific investigation. Recognizing that Africa cannot be kept as a museum piece, they accept the inevitability of change, and record the facts and appraise tendencies in relation to native institutions as social and economic phenomena *per se*. It follows, almost as a matter of course, that they are aloof from political prepossessions.

Of the three books under notice each serves to illustrate a distinct line of approach to the investigation of the effects of the impact of European civilization upon the character, the institutions and the mode of life of native Africa. Dr. Lucy Mair deals with the machinery of administration and the policies which have inspired its organization; Dr. Monica Hunter, following a more general convention, records and analyses the custom of an existing group, contrasting it with the conditions of an earlier period, as well as with the conditions of the urban population and dwellers on European farms; and Miss Margery Perham, in a series of autobiographies of individuals from contrasted environments in varying degrees of sophistication, exhibits in the round, the actual product of changing conditions at almost every stage between a 'savage' and a member (feminine) of the University of Oxford.

(1) Over Dr. Mair's book it is unnecessary to linger. Its scope and method call for little comment, while to discuss its subject matter adequately would call for no less space than the volume itself.

The policies, administrative methods and problems of the European powers in Africa are concisely summarized and discussed. British territory, as the most extensive and the most varied in method, naturally receives the most attention. Direct rule, segregation, the dual system and indirect rule, each is analysed in its environmental setting in turn and subjected to a criterion in which native well-being, native rights and native needs are the essential elements. Dr. Mair's book is an indispensable aid to anyone who seeks to understand the extremely complex question of native development and administration in Africa.

(2) The group selected by Dr. Hunter for investigation, the Pondo of South Africa, was not annexed to British rule until 1895. For the investigator they possess the advantage that not only have they suffered less change than most indigenous peoples of South Africa, but also there still survives among them a number of elders who remember ancient custom. Missionary effort, though of long standing and preceding annexation, has had less effect than the trader, also active before the coming of white administration. The vast majority of the Pondo are still pagan. The most potent influence, however, in bringing about change has been the demand for labour in the Union on farms, in the mines, and in other forms of industry. As natives now go, they are fairly prosperous; and the land question has not become acute as elsewhere. Conditions on the Pondoland reserve are contrasted with urban conditions in East London, S.A., where municipal regulations and conditions of employment have virtually eliminated native custom, especially in so far as cattle holding is impossible. On the European farms such institutions and customs as persist have, as a rule, suffered a radical modification.

Apart from its specific direction as a study of cultural modification, Dr. Hunter's book is a valuable contribution to the anthropological literature of South Africa. Her life-long acquaintance with the South African Bantu—she is herself a South African and was brought up at Lovedale—has been of the greatest service in admitting her to an understanding of the finer shades of meaning in custom and belief, which so frequently escape the no less highly trained, but less experienced observer.

(3) Miss Perham has added a few notes, but otherwise has scarcely touched the documents, which make up "Ten Africans". Her task has been that of selection, and the lives of the ten individuals here included have either been written by the subjects themselves, or have been reported verbatim. Not only are the narratives intensely entertaining in themselves, but for the social anthropologist they are also valuable raw material for judgment of the effects, psychological and other, of European contacts on the individual. The first life-history given here, for example, in which an aged member of the Babemba, who was brought up at the royal court, contrasts former conditions with those of to-day, incidentally affords a clue to weaknesses in the present system of administration, which sometimes has retained the form of native institutions, but has unwittingly destroyed the spirit which was its integrating force.

A Norse Settlement of the Viking Age in Greenland

Viking Settlers in Greenland:
and their Descendants during Five Hundred Years. By Dr. Poul Nørlund. Pp. 160. (London: Cambridge University Press; Copenhagen: G. E. C. Gads Forlag, 1936.) 7*s*. 6*d*. net.

FOR many years the attention of Danish archæologists has been directed to Greenland, not only by reason of the romantic history of the Norse settlement in that remote land, but also by the numerous remains of buildings—the farmsteads of the settlers, and their churches.

Brattahlid, believed to be the ruins of the homestead of Erik the Red, the first immigrant to go to Greenland from Iceland, in or about the year A.D. 985, was excavated and reported on by Dr. Nörlund and Dr. Marten Stenberger in 1934, and since then research has been carried on by Dr. Aage Roussell, whose account of his work under the title of "Sandnes and the Neighbouring Farms" has just been published.

Dr. Nörlund, in the volume under notice, has clothed with flesh and blood the dry bones of archæology, and told the story of the colonization of Greenland, and of the hard lives of the settlers in their valiant efforts to maintain themselves in an inhospitable land, utterly neglected by the Danish kings who claimed supremacy over this outpost of civilization. It is a sad tale of how the very monarchs who should have fostered and maintained the colony strangled its trade in the exercise of a monopoly, depriving the settlers of the necessities of their existence, and eventually bringing about the extinction of the colony. Dr. Nörlund estimates that in the 280 farms which there are said to have been, there must have been no fewer than three thousand inhabitants, and probably more when the settlement was flourishing. By the fourteenth century, privations were telling on the physique of the people, and they were being pressed by the Scraelings, as they termed the Esquimaux. In the fifteenth century, official communication with the mother land had entirely ceased. Neither the prelate, who bore the title of Bishop of Garda, nor merchants went thither, and by the commencement of the sixteenth century, the medieval Norse culture must have been entirely eradicated.

Dr. Nörlund's book is a fascinating tale, the record of a great adventure viewed from all its various aspects. It provides an admirable illustration of the life of a Norwegian settlement of the Viking age, when that robust people were the strongest sea-power in northern Europe, and the first navigators to reach the American continent, known to them as 'Vinland'.

Not the least interesting results of the research in Greenland was the discovery of numerous well-preserved garments in the frozen ground of an ancient cemetery, which was being gradually eroded by the sea. The dead had been shrouded in the clothes they wore when in life. The relics recovered by the explorers from the site filled twelve large cases. These garments, preserved in the National Museum at Copenhagen, form a unique collection of the everyday clothes of the ordinary folk of the Middle Ages.

To those interested in the recent discovery of Viking settlements in Orkney and Shetland, this book will be valuable as furnishing plans of contemporary houses and farm buildings, and by enabling them to realize to some extent how those Norse settlers lived, trading in furs of seal and otter, the produce of the islands, and cultivating their farms. It will help to eradicate the impression that the early Norse settlers on the shores of Britain were merely ruthless sea-rovers.

The book is fully illustrated, containing *inter alia* a series of illustrations of the Herjolfnes garments. The translation from the Danish has been well done, and the text is singularly free from typographical errors.

Modern Perfumes and Essences

(1) Perfumes, Cosmetics and Soaps: with Especial Reference to Synthetics. By William A. Poucher. Vol. 2: Being a Treatise on the Production, Manufacture and Application of Perfumes of all Types. Fifth edition. Pp. xiii+426+63 plates. 25*s*. net. Vol. 3: Being a Treatise on Modern Cosmetics. Fifth edition. Pp. xi+228. 21*s*. net. (London: Chapman and Hall, Ltd., 1936.)

(2) Flavours and Essences: a Handbook of Formulæ. By M. H. Gazan. Pp. vii+115. (London: Chapman and Hall, Ltd., 1936.) 25*s*. net.

(1) THERE can be scarcely any fashion so changeable and so demanding variation as that of modern cosmetics and perfumes. The last twenty years have seen bewildering progress, and manufacturers have been forced, time and again, to drastic revision of their products and to keen experimentation. Moreover, the future seems to offer no limits to this variety, and their manufacture now demands a deep knowledge and practical experience, for much of it has an empirical basis. The author's previous editions on these subjects are well known in the perfumery and cosmetic world, and have always been accepted as authoritative. The new edition is most comprehensive and, like the previous ones, gives a very practical account of the production, manufacture and application of perfumes and cosmetics. On account of the inclusion of much new matter, the author has made the wise decision to divide the work into two volumes, one dealing with perfumery (vol. 2) and the other with cosmetics and soaps (vol. 3).

Revision has been thorough, and much new matter has been included. Probably the most interesting revision is the section dealing with otto of roses which, although one of the oldest of perfumes, has from its beginning presented a most difficult problem to the would-be buyer. In spite of the great developments in our knowledge of the essential oils, and the application of this knowledge to their evaluation, the chemist has undoubtedly failed in his attempts to detect sophistication, except in very crude form, in this perfume, or to devise constants for its purity. The problem is most controversial, and the author's contribution is of exceptional value as it is a result of a personal visit to Bulgaria, where he was afforded every opportunity for investigation and where he personally conducted the distillation of a large batch of otto. He states that variation in genuine otto must be expected because of the varied methods of production and the varied types of flowers used, and concludes that, after full consideration, the only reliable method of evaluation of the oil must be an olfactic one. He moreover claims that this is also the opinion of the leading perfumery houses on the Continent. Such a conclusion contains little comfort to the would-be buyer, for the olfactic test, of which full details are given, appears to demand exceptional experience. It is, however, this type of information which makes the book so valuable to those whose business it is to handle the products.

The matter dealing with cosmetics (now included in vol. 3) has also been thoroughly revised, and in many instances rewritten. New chapters are given on such modern developments as sunburn preparations, the use of sulphonated alcohols in shampoos, and eye cosmetics. Exact details of preparation have been given, and the difficulties discussed in a manner which reflects the wide practical experience of the author. The work has been well done.

(2) The extensive use of both artificial and natural flavours and essences in confectionery, foods, soft drinks, ice cream, etc., has increased their value and made a study of their production and properties of great importance to the manufacturer.

Unfortunately, in the average book dealing with this subject, it is generally a matter of great difficulty to interpret the meaning of the ingredients specified in the 'recipe', as standards of strength and purity are often omitted. Thus a specified quantity of essence of vanilla is meaningless unless the strength and method of preparation and quality of the vanilla are laid down. The book under review, however, is not open to this objection, for it is devised on the lines of a pharmacopœia wherein all basic materials are of a standard quality, none of them of a proprietary nature, and the strength and method of each preparation are carefully defined. Workers should experience no difficulty in compounding.

An appendix gives simple methods for ascertaining physical constants to control the purity of all ingredients, and simple monographs on the various synthetic flavouring materials such as amyl acetate, phenylethyl acetate, etc. Some three hundred formulæ are given, all of which are woven into a scheme whereby a series of relatively simple basic preparations are first prepared, and then used for the more complicated preparations such as liqueurs and cordials. The author claims that all the preparations are stable during storage for several years. The methods of preparation are very simple, and distillation is rarely required.

A book of this type has long been needed by manufacturers concerned with these products.

H. BERRY.

Comparative Morphology of Plants

Vergleichende Morphologie der höheren Pflanzen Von Prof. Dr. Wilhelm Troll. Band 1: Vegetationsorgane. Lieferung 1. Pp. vii+172. (Berlin: Gebrüder Borntraeger, 1935.) 11.50 gold marks.

THE appearance of a new and, what appears to be, an outstanding work on the comparative morphology of plants is quite refreshing, and may we hope that it will prove to be the herald of a reawakening interest in this most important branch of botanical science.

In his foreword, the author states its scope and object:

> "It differs from other works of this kind in that it resumes once again the tradition of the comparative treatment of form which was lost sight of in the course of the last century, and takes for its guiding principle the idea of the type, that is, the typological unity of the higher plant-kingdom. It is the problem of the archetype [*Urpflanze*] which is here placed in the forefront and centre of morphology."

Morphology has for long been split up into a number of departments which, however useful for affording a knowledge of formative relationships, have missed the inner unifying link. The author's thesis is to restore them to the framework of comparative morphology.

> "Only comparisons founded on the concept of the *type* can demonstrate that the multiplicity of organs or groups of organs is solely conditioned by quantitative differences and divergences around a type as the dominating principle of construction. Morphology thus attains the character of an exact science.
>
> "The slackening of creative output in morphology in the last decades is due, not to the exhaustion of the problems to be solved, but to a failure to see these problems owing to a too intensive investigation of detail and an over-estimation of microscopic analysis which has blurred the vision for the perception of the organism and its organs as a whole."

The real cause of the downward grade of morphology lies in the domination of mechanistic thought over that of "independently-existing life [*Eigenständiges Leben*]". The process of thought from which morphology has degenerated had its origin in the genius of Goethe. Since his day the gradual lapse of morphology into the vogue of considering organic forms entirely from the mechanistic point of view is to-day exemplified by such works as those of Hofmeister and Goebel.

"A true rebirth of morphology is only possible on the assumption that the mechanistic mode of thought is conquered, and replaced by a deeply founded view rooted in a Platonic–Goethian and German mode of envisaging nature", namely, by the recognition of the principle of *unity* of the "*type*", which "type" cannot be analysed or demonstrated, but revealed only to the intuitional eye ; it is derived from an idea, the "*ewig Eine*" of Goethe, manifesting in its multiplicity. More concretely put, "the type must be come at by means of the comparison of organisms in order to discover what is common to them all, this common factor appearing as a *virtual picture* behind the concrete individual forms, and representing the central idea embracing all particular objects". Latter day morphologists, in dealing with the structure of the Ophioglossaceous fertile leaf, to take one example, "instead of basing their study on the typologically true comprehension of the peculiarity, have been content with the external impression of a splitting of the leaf, elevating that into the principle of explanation ; such erroneous paths can only be pursued by those morphologists who cannot distinguish between typological and external resemblance".

Under the heading "Morphology and Development", the author states that there has been a one-sided estimation of developmental history, due to lack of typological insight, and cites as instances of this Grégoire's view of the carpel, A. Foster on the nature of the bud-scale, and Goebel's view of the sympodial inflorescence of Boraginaceæ. Goebel never recognized the typological method, against which he always remained prejudiced. Under "Organography", the author analyses and acutely criticizes Goebel's method and objective, allowing that there are hints at the comparative method here and there in his work, "but that throughout it there exists the attempt to derive the particular form of organs, not from the type, but from the function-principle or the life conditions".

So much for the introductory section.

In Chapter i, entitled "Form-Relationships of the Higher Plants as Portrayed by Particular Examples", Prof. Troll comes to the main task of the work. After stating that "the fundamental thesis running through the whole of morphology is the problem of the archetype [*Urpflanze*]" (Goethe's original idea) and that it "would be a great mistake to connect this problem with propositions of descent-theories", the archetype in the phylogenetic sense being unknown, he begins the descriptive work dealing with the vegetative organs. "Seed Structure and Embryo", "Comparative Analysis of the Fruits of the Horse- and Sweet Chestnut", "Monopodial and Sympodial Branching", "The Bulb of the Snowdrop", "Turnip-rooted Plants and Geophytes", are a few of the headings which will give an idea of the subject-matter of this section of the book. The descriptions are original and perspicuous, and every subject is illustrated by admirable diagrams, drawings or photographs.

We heartily endorse the views of the author as set forth in the introductory section, being convinced that the position he assumes is the correct one for facing the problems of comparative morphology. Others, however, may not so readily accept this position. As regards the main, descriptive portion of this first part of the first volume, we feel sure that it will be of indispensable utility to the student of morphology. Moreover, we venture to prophesy that, when completed, this book will be, to judge by its first instalment, one of the best treatises of plant morphology extant.

W. C. WORSDELL.

The Science of Highway Engineering

Road Aggregates:
Their Uses and Testing. By Dr. Bernard H. Knight. (The Roadmakers' Library, Vol 3.) Pp. x+264. (London : Edward Arnold and Co., 1935.) 21*s*. net.

UNDER the pressure of modern conditions, the art of road-making has of necessity become the science of highway engineering, in the process beginning to borrow freely from those older branches of applied science—chemistry, physics, geology and engineering.

The literature which is rapidly growing up to serve the new purpose expresses the need of freedom from restraint and the necessity of treating certain sections of this field from the basic and more scientific aspect. The process can indeed be reciprocal, as when there is produced from actual practice some new matter to add to the sum of knowledge in the parent science.

The present volume is an excellent example of these principles. The petrology of rocks has been exhaustively studied in the past, and those general principles are here given a special emphasis by an author who has established a position of authority on the structure of rocks with special regard to road stone and aggregates, which forms one of the most important industrial applications of that knowledge.

Road-making to-day consists as to 99 per cent of various processes for the combination of road aggregates with a binding agent into a homogeneous structure. The binding agent and therefore the product respond to certain physical laws, but the value of the aggregate has to be appraised in terms of size, shape, toughness, proportions, texture and ability to amalgamate with binder, etc.

A fuller appreciation of these important and related factors is becoming increasingly more widely recognized, and the present volume is a most timely addition to the literature at a period when road policy and expenditure has attained a breadth and sweep never before exceeded. The subject has been carefully prepared, both in scope and treatment, by one who plainly embodies his own knowledge and practice, and the discussion and orderly presentation of the material at his disposal will make the volume of special use and acceptability to highway engineers.

The author has clearly set out a technique for the estimation and measurement of quality in these materials required to form the rock framework of modern road structures, whether assembled as concrete, asphalt, tarmacadam or just stone, and the structural considerations of rocks and the tests of their properties is well emphasized.

The work therefore merits the highest praise, that is to say, it will be of real service and guidance to all engineers responsible for expenditure on those works which have to be created to sustain the stress of modern road traffic.

R. G. H. CLEMENTS.

Heat for Advanced Students

By the late Edwin Edser. Revised edition by N. M. Bligh. Pp. x+487. (London: Macmillan and Co., Ltd., 1936.) 6*s*.

EDSER'S "Heat for Advanced Students" has been familiar to successive student generations in schools and colleges since it was first published in 1899. The essential character of the book is retained in this revised edition, prepared by Mr. N. M. Bligh after the death of Mr. Edwin Edser in 1932. The methods of the calculus have now been introduced, resulting in more concise treatment, and the term calorie, in conformity with present usage, replaces the therm previously used in the same sense. Recent developments of the subject have been described, and the chapter on radiation has been rewritten so that it now includes a simple introduction to the quantum theory. In its revised form, the book should make a fresh appeal to teachers and students.

Sacrifice to Attis:

a Study of Sex and Civilisation. By Dr. William A. Brend. Pp. v+350. (London: William Heinemann, Ltd., 1936.) 10*s*. 6*d*. net.

THE author directs attention to the menace of the falling birth-rate in Britain, and laments it. He refers to an article of his written in 1915 in which he says that "we may eventually see the Slav races increased relatively in such enormous proportion that they may come to dominate all Europe". Obviously the race of armament is of no matter; we must start a fierce race to have the highest birth-rate in Europe and so swamp the Slavs by sheer numbers! The author would include many of the psychoses and epilepsy as explainable on the grounds of repression and other psycho-analytic mechanisms. We would be interested to hear the results of treatment of these conditions on psycho-analytic lines. We have seen little good result in these psychoses. It is easy to advance theories but so difficult to convince scientifically minded people.

Essential Traits of Mental Life

By Truman L. Kelley. (Harvard Studies in Education, Vol. 26.) Pp. viii+145. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1935.) 11*s*. 6*d*. net.

PROF. KELLEY gives as the sub-title of the little book under notice, "the Purposes and Principles underlying the Selection and the Measurement of Independent Mental Factors, together with Computational Tables". He presents a new method of factorization which certainly appears simpler than that of Hotelling's method of analysis. He compares the work of Brown and Stephenson, of Tyner, of Godfrey Thomson, with Spearman. We cannot agree with the statement that "the line of argument . . . is so simple that the meaning of what is accomplished should be clear to the student familiar with the most elementary mathematics". The mathematics involved are by no means elementary. The author provides us with an analysis of the vocational groups in the United States.

An Elementary Survey of Modern Physics

By Prof. G. F. Hull. Pp. xxiv+457. (New York: The Macmillan Co., 1936.) 20*s*. net.

PROF. HULL has written a most interesting volume giving an account of modern physics suitable for an American college student in his second year. He has been successful in providing a book of an elementary character which may be recommended to other readers wishing for an up-to-date account of recent marvellous developments. It is not a 'popular' book in the sense that mathematical operations have been avoided altogether, but the mathematical difficulties have been reduced to a minimum. The properties of atoms, electrons and photons, and the relations between them are described in a stimulating way. Such subjects as cosmic rays and transmutation of the elements, and even such abstruse questions as the Schrodinger equation and the uncertainty principle are dealt with.

Progress in the Technique of Crystal Analysis*

By Sir William Bragg, K.B.E., O.M., F.R.S.

THREE years ago, Sir Gowland Hopkins in his presidential address spoke with admiration of the work of the organic chemist and in particular of the "emergence of power to grasp the architecture of complex invisible entities such as organic molecules and the ability to construct them at will". He told how under modern methods of investigation the picture which the chemist had formed of the invisible molecule had actually taken shape. His picture-making had been amply justified. His stereometry was not, as some thinkers had maintained, to be swept away in favour of a mathematical symbolism.

This anticipation has been fully realized during the last few years, mainly through the remarkable increase in the accuracy with which the structure of molecules, molecular aggregates and solid bodies in general can be determined. For this the methods of X-ray analysis of crystalline structure have been largely responsible. Moreover, other methods have been greatly strengthened by the example set by X-ray analysis and by its reactions upon themselves. Optical, electrical, magnetic and other properties have been successfully studied with the same great purpose, namely, the correlation between the properties of a substance and the spatial arrangements of its components.

While the X-ray methods have been mainly useful in describing the arrangement of the atoms in assemblages surrounded by others of like nature and conditions, the methods of electron-diffraction are giving a remarkable insight into the modifications of arrangement that are to be found on surfaces. The extraordinary interest of such knowledge arises from the fact that natural processes so largely depend on surface actions.

For many years after its inception, the X-ray analysis was, as might be expected, engaged in trying its own powers and learning how to apply them. It cleared up many structural problems on which older methods had little to say that was definite, as for example the distinction between ionic, metallic, adamantine, and molecular compounds. Many crystalline structures were determined, and the results, as is well known, have been serviceable in a wide field of scientific research, and in many industrial processes. The methods of analysis, the technique and the interpretation of results have been greatly improved, as might be expected, by the researches of many hundreds of workers. The increase in accuracy is so great that new possibilities of usefulness come into view.

The improvement appears in two ways. In the first of the two, the measurements of the dimensions of the unit of pattern of a structure can now be made to one part in several thousand. Consequently, the determination of the electron charge *e*, made by the X-ray method, can stand beside the older determinations of the oil-drop method. There is a persistent discrepancy of about one part in two hundred, the former giving the value $4{\cdot}80 \times 10^{-10}$, the latter $4{\cdot}77 \times 10^{-10}$; but it is clear that the larger value is at least as near the true value as the smaller. A full discussion of the X-ray method is given by Compton and Allison in their recent book on "X-rays in Theory and Experiment", and a critical examination of some outstanding points is made by du Mond and Bollman (*Phys. Rev.*, Sept. 1936).

Again, as has been observed by Bernal, the use of high-precision determinations of the lattice constants of metals will soon become the most reliable gauge of purity of a metallic element. Accuracy has here been pushed to one or two parts in forty thousand. The phase boundaries of an alloy also can be very closely and conveniently defined by observations of such a character. Accuracy has been of great importance to the well-known work of Hume-Rothery on alloy structures, and to the curious and very important relations between order and disorder in alloys which have been specially studied at Manchester.

The accuracy with which the position of each atom in the unit cell can be measured is of quite a different order. Thanks in particular to the use of Fourier analyses by J. M. Robertson and others, the distances separating the atoms, centre to centre, can be found to about 1 per cent, even when the complicated molecules of organic crystals are under examination. This is a great advance on the possibilities of even a few years ago, and it has important consequences. In particular, fresh light is thrown upon the problem of the chemical bond. At one time, single, double, and triple bonds were considered to be distinct and definite phenomena. The tetravalency of carbon, for example, was described as an assemblage of four equal powers of combination, of which one or more might be exercised in the same direction. When the diamond structure was found by the X-ray methods, it was no matter of surprise that the four separate single bonds were displayed in the attachment of each carbon to four neighbours. In the structure assigned by the chemist to benzene, the fact that each atom had but three neighbours presented difficulties; various theories have been suggested in explanation, mostly little more than different ways of drawing diagrams, in which four single bonds were made to act somehow. In recent years, it has been more usual to propose that bonds may alternate between single and double, and that the tetravalency of carbon in the benzene ring is satisfied because three of the six links are double and three single, the two kinds alternating both in time and in order round the ring. The conception can be extended to cases much more complicated provided that the two forms between which alternation occurs do not differ much either in form or energy. The effect is described as one of 'resonance', a term due to Hund but applied to organic chemistry mainly by Pauling and his collaborators. Its bearing on structural chemistry was discussed by Sidgwick a few months ago in a presidential address to the Chemical Society.

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* From the presidential address to the Royal Society, delivered on November 30.

When substances in which this 'resonance' is supposed to occur are examined by the X-rays, it is found that the actual centre to centre distance of two atoms connected by a link alternating between single and double is characteristic of neither of the two extremes. These last two are definite quantities, and the length of the varying link lies between them. An actual link is rarely a pure single or double or triple link. Pauling and Sidgwick both discuss a number of cases in which the centre to centre distances can be correlated with a probable or possible amount of resonance. An excellent example is furnished by oxalic acid, which was examined by Zachariasen in 1934, but has just been remeasured by Robertson, using the powerful Fourier method of analysing the observations. The distance between the carbon atoms is 1·43 A. The length of the single link of diamond is 1·54 A. The length of a double bond is very nearly 1·33 A. It might seem that in oxalic acid the link is actually more nearly double than single; but this is not so A small proportion of double linking seems to shorten the distance considerably. For example, each link in the hexagonal network of graphite must be two-thirds single and one-third double, yet its length is 1·41 A. In benzene, the half and half arrangement (following Kekulé) is correlated with a length of 1·39 A. or 1·40 A. Thus the actual length of a bond may prove to be a safe indication of its nature. Robertson points out that the oxalic acid molecule is always planar, which may be accounted for on the ground that rotation is restricted round a link which is even partially of a double character.

It has recently been shown by Bernal and Megaw (*Proc. Roy. Soc.*, A, 151, 384; 1935) that in all probability there are two types of bond linking oxygen atoms through intermediary hydrogens. One is the 'hydrogen bond'; it is found, for example, in acids, and it corresponds to a separation distance, oxygen to oxygen, of 2·55 A. The other is the hydroxyl bond; it is found in a number of hydroxides, and its length is about 2·8 A. By the use of this conception it has been found possible to locate the positions of the hydrogen atoms in several hydroxide structures, particularly in the clayey mineral hydrargillite. The oxalic structure of Robertson seems to supply a new and interesting example of the difference between the two kinds of bond. One of the oxygens at each end of the oxalic acid molecule is bound to a water molecule in the crystal by a link 2·87 A., the other by a link 2·52 A.

It has been pointed out (Fricke, *Koll. Z.*, 69, 312; 1934) that the linking up of hydroxyl bonds explains the properties of the gels that are formed by neutral hydroxides.

These few examples may serve to show how improvements in the technique of X-ray analysis are sharpening a tool which has already been of assistance to research in many directions and now seems to be acquiring a new usefulness.

The chemist has already shown that the properties of the molecule depend on the internal disposition of its atoms. The characteristics of the solid state depend also on spatial relations, and in a manner which is even more complicated, much more complicated than in the case of the independent molecule. Accurate measurement of the spatial arrangements lays a firm foundation for the study of the properties of a substance in relation to its structure and its composition. The problems to be solved are, of course, extremely complex, but it is surprising how much can be done towards the examination of intricate molecular associations when the spatial relations between the most commonly occurring atoms are known. This applies, for example, to the study of the proteins, which has already gone far; to the clays, and to the glasses and other extended structures. At one time it seemed hopeless to expect to learn much of the structure of bodies which were so irregular as to give no sign of crystallinity. But it is now possible to work from the regularity in occurrence of a few definite separation distances, even when regularity in orientation does not exist: and methods have been devised by which these distances can be determined by the X-ray methods.

It is clear that the stereometry which the chemist has developed so successfully is acquiring new powers which will have the widest applications.

Nature and Control of Potato Virus Diseases

By Prof. Paul A. Murphy

THE discussion on September 15 in Section M (Agriculture) of the British Association on "Scientific Aspects of Potato Growing" proved useful and timely. Inevitably the discussion was entirely pathological, ranging from virus diseases to potato sickness caused by the eelworm, *Heterodera Schachtii*, which may reduce the value of potato land from £2 to 10*s*. per acre. Most of it, however, concerned virus diseases and the raising of healthy seed potatoes. The magnitude of the question is shown by the fact that there are half a million acres of potatoes in England and Wales, and of these some 120,000 acres are planted with Scottish or Irish seed potatoes annually. The balance is planted with local seed, and it is a question to what extent this could be profitably replaced, for fresh seed is estimated to increase yields by one ton per acre. Much also could be done, as has been shown by Bryan at Ormskirk, to maintain the health of the imported seed so as to make it last longer.

The best way to improve the potato crop as a whole, however, is to increase the vigour of the imported seed stocks. It should now be possible to guarantee the entire absence of leaf roll, which is the principal cause of degeneration. This disease depends on the aphis, *Myzus persicæ*, for its spread, and Davies has shown that its prevalence depends on such simple physical factors as temperature, humidity, wind, and system of cropping. It hibernates on Brassicas and migrates to potatoes from May on, whenever the temperature rises above 55° F. (optimum 70°–80° F.); the humidity is 70 per cent or less, and the wind does not exceed 5–6 m.p.h. This knowledge enables one to avoid the indifferent districts, but not to turn them into good ones. It also explains why the best seed is to be found in exposed, wet and windy places, particularly near the sea, where farming is mainly pastoral and potato fields isolated. The connexion of good seed with islands is proverbial.

The potato mosaic question has been in danger of becoming a mystery, but the time has come at last when a clarification is possible. Some of the difficulties have been artificial ones. In the laboratory a single virus can be made to produce mottling, streaking, or no symptoms, by choice of the proper variety, but the general rule in Nature is that the virus is either carried or expresses itself as a mottle only. In other words, those varieties in which a virus causes streak, as virus X does in Arran Crest or virus A in British Queen, are free from that infection, for the virus either kills the plant and tubers, or kills itself while localized in the necrotic spots. Virus Y, which is the usual cause of streak, is sometimes an exception, but the general rule holds good: one virus, one disease. This is an enormous simplification.

It is probable that no virus is entirely harmless, although in some cases no natural spread or effect on yield has been demonstrated. Omitting such, it is found that the principal potato mosaics are caused by the four viruses X, F, Y and A, alone or in combination, and these form the types of three natural groups, viruses Y and A, though distinct, being at present placed together on account of the occurrence of intermediate forms. These groups are very shortly characterized as follows:

Group 1. X-type viruses. Mottle on *Datura* and tobacco; pass $L3$ filter; vector unknown (not *Myzus persicæ*); typical disease, simple mosaic.

Group 2. F-type viruses. Spots on *Solanum nodiflorum* and *Capsicum annuum*; carried by tobacco and *Datura*; held by $L3$ filter; vector, *Myzus persicæ* under certain conditions; typical disease, yellow or aucuba mosaic.

Group 3. Y-type viruses (including virus A and vein-banding virus). Vein-banding on tobacco; not inoculable to *Datura*; held by $L3$ filter; vector, *Myzus persicæ*; typical disease, veinal mosaic or leaf-drop streak.

The four viruses mentioned, together with their four combinations, produce eight diseases as follows, though complexes of more than two terms also occur:

1. $X =$ simple mosaic.
2. $F =$ yellow mosaic
3. $A =$ veinal mosaic.
4. $Y = \left\{\begin{array}{l}\text{veinal mosaic.}\\ \text{leaf-drop streak.}\end{array}\right.$
5. $X + F =$ interveinal mosaic.
6. $X + A =$ crinkle.
7. $X + Y = \left\{\begin{array}{l}\text{rugose mosaic.}\\ \text{leaf-drop streak.}\end{array}\right.$
8. $A + F =$ double virus aucuba

The first three diseases are normally passed over in the field, the eighth is not very common, and the remainder make up the mosaic of the practical man. These, as will be seen, are caused by a virus transmitted by *Myzus persicæ*, either alone or in combination with X. This, therefore, reduces the mosaic problem to two dimensions: the control of *Myzus persicæ*, which is only the leaf roll problem over again with the additional complication of carriers, and the control of virus X. The latter is still an enigma, for though it spreads so freely as to be almost ubiquitous, occurring for example throughout the variety Up-to-Date, and in all American commercial potatoes without exception, its vector is unknown. It infiltrates rapidly into virus-free stocks even when grown in isolation in the best districts, and is not entirely unknown in experimental glasshouses. As part of the basis of all the severe mosaics it is an active danger, but the question still awaits answer whether it is economically possible or necessary to control it as well as the aphis-borne viruses.

The viruses mentioned are not uniformly distributed throughout Great Britain and Ireland. In the best districts, leaf roll is absent, *Y* is rare, *A* is more common and *X* is nearly universal, while in the south-east leaf roll and virus *Y* become comparatively common. The useful life of a variety depends on its reaction to the local viruses, and the moderate reactors suffer most and last shortest, a good example being Arran Chief. The carriers and strong reactors escape best. Outstanding varieties, such as the famous Up-to-Date and British Queen, are intolerant of *A* and probably resist infection with it as well. Up-to-Date tolerates *X* and British Queen resists it. It appears to be the reaction to these two viruses which determines the survival of a variety in Great Britain. If it tolerates *Y* as well so much the better, but our best potatoes lack this quality, a fact which explains the failure of Up-to-Date in the interior of the United States and Canada, as probably also in Central Europe. The control of virus *Y* at home depends on the use of Scottish and Irish seed potatoes.

Dental Caries and Diet

IN spite of the facts that there are more dental clinics, that many more people brush their teeth and that more dental treatment is practised to-day than ever in the world before, dental disease seems to be as prevalent as it has ever been, especially among civilized peoples. The experimental work of Mrs. Mellanby has shown that there is an intimate relationship between the diet and the structure of the teeth in both animals and man, and that there is similarly a close relationship between structure and liability to caries in man. It remained to be proved that the incidence and progress of the disease could be influenced by alterations or additions to the diet.

The results obtained in the first stages of the investigations carried out with this object have already been referred to in these columns (NATURE, 129, 83; 1932: 133, 820; 1934). The final report* of the Committee for the Investigation of Dental Disease describes the influence of diet upon caries in children's teeth and shows that the teeth, like other organs of the body, are strongly influenced by nutritional factors brought to bear upon them, whether through their blood supply or the saliva. The dental decay that developed in the children receiving an addition of vitamin D to their diet was definitely less than in the control children not receiving extra vitamin, and its influence in inhibiting the initiation and spread of caries was especially impressive when the addition was made during the period of development and before full eruption of the teeth.

The investigations were made in three similar institutions in the neighbourhood of Birmingham, maintained on the Cottage Home System, under the Poor Law authority and later under the local education authority. It was at first hoped to divide the children in each institution into three groups, each receiving a different supplement, so as to avoid the possible influence of slightly differing conditions in the homes affecting the results, but administrative difficulties prevented this and all the children in one home were given the same addition. Analysis of the basal diets showed that they were fairly similar in the three institutions: the variations, described in the report, probably did not affect the general conclusions drawn from the results obtained. Three experiments were carried out. In the first, the three institutions had daily additions to the diet of treacle (28–42 gm.), olive oil (14–21 c.c.) and cod liver oil (14–21 c.c.; 50–100 units of vitamin D per c c.) respectively. In the second, carried out in one institution only, one group of children received the olive oil and the other vitamin D in olive oil (625 units per c.c.: 14–21 c.c.). In the third, the children were younger (2–5 years old) instead of 5–14 years old, and the additions were treacle, vitamin D in olive oil and cod liver oil in daily doses of 7 gm. or 7 c.c., in three different institutions. Although about 1,600 children were under observation for varying lengths of time, the number who received the special additions for the full period of three years was much less.

Six-monthly examinations were made of the mouth and of the general physical condition with

* Medical Research Council. Special Report Series, No. 211: The Influence of Diet on Caries in Children's Teeth (Final Report). By the Committee for the Investigation of Dental Disease (assisted by Alan Deverall and Mabel Reynolds). Pp. ii+137. (London: H.M. Stationery Office, 1936.) 2*s*. net.

special reference to the bones. The surface structure of the teeth, their arrangement in the jaws, the number of carious teeth and the extent of caries in each, as well as the condition of the gums and the general physical state were noted at the beginning of the investigation and at each subsequent examination. The differences between the findings at the first and final inspections in each diet group were then compared.

This investigation has shown again that there is a definite direct association between the structure of the teeth and the amount of caries present in a mouth: this relationship was found in the case of both the original and newly erupted permanent teeth in the olive oil group. Although no definite evidence was obtained that diet had an effect upon the structure of the permanent teeth, there were indications that the addition of vitamin D during the period of development tends to improve the structure of the first permanent molars. On the other hand, it was proved conclusively that a high vitamin D intake before the full eruption of the permanent teeth significantly diminishes the incidence of caries in such teeth after eruption: this protective effect was especially striking in the case of the premolars and second permanent molars, which erupt later than the first permanent molars. As regards the deciduous teeth, only in the case of the youngest children could any effect of the additions to the diet be expected; evidence was obtained that caries was less progressive in the vitamin groups than in that receiving treacle.

It is of interest to note that although the incidence of fresh caries in the permanent teeth present at the beginning of the investigation was the same in the two control groups, yet the spread and degree of softening were significantly greater in the olive oil group: in the case of the deciduous teeth, however, there was a greater increase in the percentage of carious teeth in the treacle than in the olive oil group.

Summing up the results of these extensive experiments, it may be concluded that a relatively high intake of vitamin D can do much to diminish the incidence of caries if the vitamin is given during the period of development of the teeth: that a beneficial effect may be obtained if it is given at a fairly late stage of development; and that even when it is given after the eruption of the teeth, the onset and spread of caries are delayed.

Problems of Plantation Economy

IN choosing the subject of "Plantation Economy" for his presidential address to Section F (Economics and Statistical Science) of the British Association, delivered at Blackpool on September 11, Dr. C. R. Fay rightly directed attention to a neglected corner of knowledge which has lessons of much interest to the sociologist as well as the economist, to the historian, the geographer and the administrator as well as the agriculturist. Dr. Fay was clearly inspired by a recent tour in the East, and dealt mainly with the tea plantations of India. He contented himself with a straightforward account of the industry, and refrained, perhaps wisely, from comment on the wider issues.

The Royal Commission on Labour in India (1931) pointed out the similarity between a plantation and a factory—both employing a considerable number of persons under the control of a manager. The chief difference is that the work in one case is essentially agricultural and is not concentrated in a large building. The analogy is important; until regulated by factory acts, 'exploitation' of labour too often characterized the growing manufacturing industry just as exploitation of labour—including slavery—characterized the early plantation industry. Tobacco in the south-eastern United States, and sugar in the West Indies a hundred or more years ago, ought to be thought of in comparison with the Lancashire cotton mills of the same period. It is scarcely possible to contemplate the modern world without a factory system, yet the corresponding plantation system is not only less important than formerly, but also may be described as 'suspect'. To-day, India, Further India and the East Indies are the home of the greatest plantation industries, tea and rubber, and this is considered by Dr. Fay to be due in considerable measure to Government opposition to the system in Africa. Dr. Fay quotes figures in his opening paragraph to show that, despite a relatively small area, plantation products (mainly tea) account for nearly a fifth by value of the agricultural exports of India. This statement has little meaning—what one would like to know is the relative productivity of a given area of land under plantation organization and under unregulated native cultivation, and the relative cost per unit of production, having due regard to quality.

Since the bulk of the world's tea is produced in plantations, it will be of interest to detect the reasons for the persistence of plantation economy in the case of this commodity. In the first place, tea is in large demand among the white races, yet is the product of a tropical or sub-tropical shrub growing under conditions unsuited to white manual labour. Here is the essential basis for the old plantation industry in sugar, cotton, tobacco and indigo, and the modern industry in rubber. In the second place, rigid adherence to a daily time-table is essential—tea leaves must be plucked exactly when they are ready; the 'flush' must be dealt with immediately at the factory, withering must go on until almost exactly 42 per cent of the moisture is lost—after about eighteen hours. This all means adequate organization and supervision, or the quality of the resulting tea will suffer. There would be no market for the output of a factory which did not maintain an even standard. So much so is this the case that most factories consider it unwise to use supplies from other than their own plantations. Herein lies an important difference from other plantation industries—cotton can be bought according to quality from the small-holder; sugar cane can be brought to the sugar 'central' and does not deteriorate so rapidly. With tea the deterioration after plucking is so marked that 'lorry tea' (that is, brought in by the quickest method of transport) is regarded as superior.

Dr. Fay points out that, in the early European settlement of the New World, 'plantation' and 'colony' were virtually synonymous; the plantation was the economic instrument whereby colonies were established. Conditions of life were difficult for employee and manager alike. To be sent to the plantations was equivalent to disciplinary banishment for the turbulent younger sons. The negro States and the West Indies owe their population—and many of their present-day problems—to the system. It is curious that the present home of the plantation—the East—was, with its existing large population, at this earlier date recognized as a field for trade rather than colonization. Thus India and the East Indies had trading posts and forts to guard them, but not plantations. Since tea and rubber planting began there much later, its history has been happier. The tea-gardens of Assam attracted to that pleasant province labourers from overcrowded Bihar who, after their term of work was finished, settled down to work the land under conditions far superior to those in their home areas. Four fifths of the people of Assam are 'foreigners' by birth or origin—the tea-gardens have enabled this important migration to take place and have done much to relieve one of the pressing population problems of India. To a less degree the rubber plantations of Malaya have had the same effect, with the difference that the Indian coolies have not been encouraged to settle. But rubber has given Malaya and the Dutch East Indies fine roads and railways and a vastly improved standard of living for the people.

The plantation system, under modern humane supervision, may thus confer great benefits on a world the agriculture of which is in a state of chaos. Not only may it provide diverse parts of the earth with commodities otherwise unobtainable—a good example is the highly organized banana industry—but it may also prove the way to development and settlement of tracts to which the individual settler without capital neither could nor would be attracted. Our economists and sociologists would be doing a great service by studying dispassionately the application of a modern plantation economy in Africa, Australia and other sparsely populated parts of the world.

L. DUDLEY STAMP.

The Hexlet*

HOWEVER ill-assorted in girth three spheres may be
Each one can kiss the other two and simultaneously
A ring of six about them all kissing serially.

Though any necklet of graded beads
May fit in general the she-sex,
This Hexlet of mine of novel design
Caresses not one but three necks.
However it's worn it alters its grade
To suit its tri-spherical prison,
Plays kiss-in-the-ring and merry-go-round
Whilst hugging three necks with precision.
Like bubbles that blow and dwindle and go
It holds up to light-hearted derision
The terrible muddle mathematical fuddle
Makes of the pure circumflex
And its pet aversion is the mental inversion
That will have 'It's $1/x$'.

All saints and sages throughout the ages
From one doxy never have swerved,
To hold fast unto what in change changes not
And ferret out what is conserved.
Now these beads without flaw obey this first law
For the aggregate sum of their bends.
As each in the tunnel slims through the funnel
Its *vis-à-vis* grossly distends.
But the mean of the bends of each opposite pair
Is the sum of the three of the thoroughfare.

FREDERICK SODDY.

Nov. 7, 1936.

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* *vide* "The Kiss Precise" (NATURE, 137, 1021, June 20, 1936).

Obituary

Prof. W. J. Sollas, F.R.S.

IN the death on October 26, at the age of eighty-seven years, of William Johnson Sollas, the University of Oxford and the science of geology have lost an outstanding personality. To a liberal culture, especially on the scientific side, he added a wide and ever-increasing knowledge of his own subject, a genius for research which extended to all its chief branches, and a philosophical point of view which always penetrated to the deeper and more theoretical bearing of the subjects with which he dealt.

Born at Birmingham in 1849, Sollas was educated at the City of London School, where chemistry was the chief subject of his interest, and at the College of Chemistry in Oxford Street, London, where he worked in Frankland's laboratory. He passed with a scholarship to the Royal School of Mines, obtained the A.R.S.M., and finally, with two of his brilliant contemporaries, Liversidge and Garnett, obtained a scholarship at Cambridge, he and Garnett being admitted to St. John's College. Here T. G. Bonney was not only his tutor, but was also acting as deputy professor of geology in Sedgwick's declining days. His influence turned Sollas towards geology as his principal subject, and he graduated with first class honours in the Natural Sciences Tripos in 1873. He was a fellow of his college in 1882–84.

Sollas's first appointment was on the University Extension, where his lectures were most successful and bore traces of the influence of Huxley and Tyndall in their clarity and attractiveness, and of Ramsay in their imagination and enthusiasm. In 1879 he was appointed professor of geology and zoology at University College, Bristol, a post he held until 1883, when he passed to Trinity College, Dublin, as professor of geology and mineralogy. Finally, in 1897, he became professor of geology and palæontology at Oxford, a chair he occupied until the end of his life, thirty-nine years, having been also elected a fellow of University College in 1901.

The anomalous "Cambridge Greensand", which inspired the early work of so many students of the Cambridge school, had its influence on Sollas, in the direction taken by his work on fossil sponges, on which he published more than thirty papers before 1890. This stage culminated in a new classification of the Spongida, articles in Cassel's "Natural History" and the "Encyclopædia Britannica", and a monograph on the Tetractinellidæ collected by H.M.S. *Challenger*. In his work he was interested not only in the systematic and anatomical results, but also in the physical principles involved in the development of the skeleton, and in the chemical interchanges of silica and carbonate of lime in their formation. The latter led him directly to study the origin of flint and chert, on which he evolved a theory that has stood the test of time. To help his work on minute organisms he devised a new use for heavy liquids, arranging them in a 'diffusion column', in which the specific gravity of such bodies could be determined by the depth to which they sank. This method he later applied to minerals and rocks, and to such fluids as blood.

Sollas's palæontological work was extended to brachiopods, echinoderms, Foraminifera, and to *Oldhamia* and its allies; he also described a new species of *Plesiosaurus* and worked out the geographical range of this genus. But perhaps his most outstanding work on organisms other than sponges was his application of the method of serial sections to the study of fossils. The ordinary zoological method was impracticable because of the intervals lost in grinding down successive slices. Sollas, therefore, worked out a mechanism and technique for grinding down specimens by stages, and, at intervals of a fraction of a millimetre, photographing and drawing in reflected light the surfaces thus obtained. Models of each section in gelatine or other medium could then be made and the organism built up at any desired magnification on successive contours, yielding a restoration of all the detail that it had preserved. A remarkable early success was obtained with *Monograptus*, and this was followed by work on a Silurian brittle-star, a Devonian fish, the skull of *Ichthyosaurus*, and, with the co-operation of his daughter Miss Igerna Sollas, a dicynodont skull. It may fairly be said that nothing has done more to advance knowledge as to the intimate anatomy, and even physiology, of extinct animals than this technique in the hands of its inventor and his successors.

When he had rounded off his sponge work, Sollas turned eagerly to petrology, and his researches on the Wicklow granite and the Carlingford complex were the most elaborate investigations undertaken up to their date. In one case he saw that the pleochroic haloes must be attributed to a new element, since identified by Joly as radium, and in the other he did much on the mixture, hybridism and metamorphism of rocks. Acting for a few years as petrographer to the Geological Survey of Ireland, he put out other work on rocks, and also assembled the evidence collected by the Survey for the issue of a map of the glacial esker system of the country. Work upon minerals was confined to a couple of papers on zinnwaldite and riebeckite, but he made a strenuous endeavour to discover the molecular structure of crystals, a subject which had awakened his interest when he first learnt at the School of Mines of Haüy's contributions to crystallography, and when Garnett advised him to test his early speculations by the atomic volumes. The data at his disposal were inadequate to carry him so far as X-ray investigation has taken Laue and the Braggs and their successors, but a series of papers published by the Royal Society indicates that he was on the right track.

The chief researches conducted by Sollas in later years were concerned with early man. He definitely assigned the Gibraltar skull to Neanderthal man, explored the Paviland Cave with its relics of Cro-Magnon man, dealt with *Pithecanthropus* and *Eoanthropus*, and applied the use of sagittal sections of the skull to a critical study of most of the Palæolithic skulls that have attracted recent attention.

Wide as is the range of work thus briefly outlined, Sollas's many activities included others of which only the barest mention is possible. Such are his application of the idea of evolution in place of uniformitarianism to geological history, his study of the geology of Bristol, Dublin, Oxford, and the Silurian Inlier of Rhymney near Cardiff, his ingenious method of studying tidal movements and their effect on the estuarine sediments of the Severn, his philosophical explanation of the origin of freshwater faunas, his study of a bog-flow in Kerry, his attempt to bore through a coral reef in the Ellice Islands, afterwards carried to success by Edgeworth David and his colleagues, his addresses and books on the age of the earth and on ancient hunters in comparison with those of to-day, and the fostering care with which he watched the translation by Miss Hertha Sollas of Suess's great work "Das Antlitz der Erde", a remarkable service to British geology for which we are deeply indebted to both father and daughter.

Sollas was awarded the Bigsby Medal and the Wollaston Medal by the Geological Society, of which he became president in 1908, a Royal Medal by the Royal Society, and the Huxley Medal by the Royal Anthropological Institute. He was made an honorary fellow of the Imperial College, and received honorary doctorates from the Universities of Bristol, Dublin, Christiania and Adelaide. His death leaves, with his associates, pupils and successors, the memory of a lovable and constant friend, a gallant and doughty foe, a sprightly debater and formidable controversialist, a daring climber and diver, an omnivorous reader, a writer of clarity, vigour and humour, an investigator of untiring energy and unimpeachable accuracy, and, whether as host or guest, a genial and most courteous gentleman.

W. W. WATTS.

An anthropological correspondent writes as follows :

Although Sollas entered upon active study of the problems of early man late in life, he rapidly became an outstanding authority. His training and experience as geologist and palæontologist inspired confidence in his balanced judgment in the discussion of chronological and morphological problems relating to early man; while his originality and constructively critical attitude of mind, which refused to be dominated by traditional methods or accepted opinion, found ample opportunity for exercise in his studies of the various types of fossil man, in which his development of the method of craniological investigation by sagittal sections showed a remarkable grasp of the morphological and metrical problems involved in comparative study.

One of Sollas's earliest archæological investigations to attract widespread interest was his exploration of the Aurignacian site in the Paviland cave of the Peninsula of Gower, South Wales, in which a prehistoric skeleton, known as the "Lady of Paviland", was found. Here Sollas discovered painting in red on the wall, which, notwithstanding counter-argument —to be anticipated in the circumstances—that it was the recent work of a fisherman, remains the only example of cave-painting in Great Britain for which the claim of palæolithic age makes any showing.

Sollas published in scientific periodicals a number of papers on early man, which are of permanent value; but his most considerable contribution to the literature of the subject is—and will continue to be notwithstanding later discovery and development in method and classification—his "Ancient Hunters" (third edition, 1924). Sollas had been much impressed by the Bushman tribes he had seen in the Kalahari, when the British Association visited South Africa in 1905. The influence of that experience is to be seen in the degree to which he made use of the cultural complexes of modern hunting peoples in the interpretation of the archæological evidence bearing upon the cultures of the hunting peoples of the Old Stone Age. As a general principle the method was not new to archæology, but Sollas gave it scientific precision. His references to Bushman art and associated custom and belief in certain respects anticipated later studies and discovery; while in his comparisons of Magdalenian culture with that of the Eskimo he directed attention once more to matters from which interest had been diverted. It was in this connexion that he entered into one of the most strenuous controversies of his later life when he produced his study of the late Palæolithic Chancelade skull and affirmed its affinities to that of the modern Eskimo.

We regret to announce the following deaths :

Prof. J. T. Cash, F.R.S., emeritus regius professor of materia medica in the University of Aberdeen, on November 30, aged eighty-two years.

Sir Edwin Deller, principal of the University of London since 1929, as the result of an accident, on November 30, aged fifty-three years.

Prof. E. H. Kettle, F.R.S., professor of pathology, British Postgraduate Medical School, University of London, and consulting pathologist to St. Bartholomew's Hospital, on December 1, aged fifty-four years.

Mr. W. H. Macaulay, fellow of King's College, Cambridge, author of "The Laws of Thermodynamics" and "Solid Geometry", on November 28, aged eighty-three years.

Lady Ramsay, widow of Sir William Ramsay and affectionately associated with many friends at University College, London, and other scientific circles, on November 26, aged eighty-two years.

Prof. Wilhelm Schmidt, professor of physiography in the University, and director of the Central Institute for Meteorology, Vienna, on November 27, aged fifty-four years.

Dr. Lilian Veley, an original woman fellow of the Linnean Society of London, known for her work in entomology and microscopy, on November 27, aged seventy-five years.

News and Views

An Institute of Chemotherapy

THE malaria epidemic in Ceylon in 1934–35 directed attention anew to the importance of chemotherapy, particularly in relation to malaria, and the subject received full discussion at a joint meeting of Sections B (Chemistry) and E (Geography) of the British Association at the Norwich meeting. Last July, the Royal Society decided upon a scheme for research on malaria, and, as part of it, Lieut.-Colonel J. A. Sinton was appointed for a period of five years to work at the Malariatherapy Centre at Horton, where he would be able to include chemo-therapeutic testing and experimentation in his investigations. Hitherto, little work has been done in Great Britain on this subject, in spite of the fact that the British Empire includes vast malarious areas in Africa, India and the Far East. In the British Association discussion referred to above, Colonel S. P. James stated that of the 3½ million deaths annually from malaria, the great majority occur in the British Empire, and that the Empire spends £450,000 annually on quinine for combating malaria. It is now announced that Great Britain is to have an institute of chemotherapy, and at the annual dinner of the Royal Society, Mr. Neville Chamberlain stated that, as Chancellor of the Exchequer, he had just consented to give a grant of £30,000 a year towards the establishment of such an institute. It is difficult to foresee, he said, all the possibilities of the new institute, but the fact that the grant has been made is evidence that the Government is not indifferent to the duty of one generation to carry on investigations which may benefit only the generations to come.

Royal Society Research Funds

ACCORDING to the annual report for 1936 of the Council of the Royal Society, Mr. H. B. Gordon Warren, who died in 1932, directed that the income of his residuary estate should be used for the promotion of scientific and industrial research, and in particular to advance knowledge in metallurgy, engineering, physics and chemistry. The trustee of the estate, Williams Deacon's Bank, Ltd., has agreed that the trust shall be administered by a committee consisting of two members appointed by the Bank and eight others appointed by the Royal Society. It is understood that the fund will be slightly in excess of £200,000. The Society has also received the residuary estate of the late Sir Joseph Petavel, which amounts to about £40,000. During the past year, the Society applied to H.M. Treasury for an increase of £1,000 annually for the grant-in-aid for scientific investigations, and an increase of £500 annually for international research associations and scientific congresses. These applications have been approved by Parliament, so that the annual grants for 1936–37 for scientific investigations and for international and other congresses will be £7,000 and £2,500 respectively. From the Parliamentary grants-in-aid, a sum of £6,000 has been allotted to scientific investigations, and a sum of £1,775 to scientific publications of institutions other than the Royal Society. The Council has also decided unanimously to propose to the Society that the number of annual elections to fellowships should be increased from seventeen to twenty.

Charles Frederick Chandler, 1836–1925

ON December 6, the centenary occurs of the birth of the distinguished American chemist, Charles Frederick Chandler, who in 1899–1900 served as president of the Society of Chemical Industry. He was brought up in New Bedford, Mass., being the son of a draper. As a schoolboy he contracted with his father to sweep out and open his shop every morning for a dollar a week, in order to buy chemicals and apparatus. From school he passed to Harvard and the Lawrence Scientific School, afterwards studying chemistry under Wöhler at Gottingen. On returning home, he obtained a post as janitor under Prof. Joy at Schenectady, becoming successively instructor first in mineralogy, then in geology and eventually professor of chemistry. It was at Schenectady that he began his lifelong efforts to bring chemistry into daily life and into industry. In 1864, when the School of Mines was organized as part of Columbia College, he was invited to occupy the chair of chemistry, and thus began his great career as a teacher in New York. He was a founder and sometime president of the New York College of Pharmacy, served as president of the American Chemical Society and president of the Metropolitan Board of Health. For many years he edited *The Chemical News*. He died on August 25, 1925, at the age of eighty-eight years.

Destruction of the Crystal Palace

THE destruction by fire of the greater part of the Crystal Palace on the night of November 30–December 1 will be widely regretted, for, although its general form and architecture have often made it the subject of good-humoured ridicule, sometimes of derision, it held a unique position and was one of the most famous landmarks of London. As is well-known, it originated from the Great Exhibition of 1851 in Hyde Park, where the Crystal Palace was constructed by Sir Joseph Paxton. When the Exhibition was closed, this "blazing arch of lucid glass" was removed to Sydenham. There it was extended, and finally opened by Queen Victoria and the Prince Consort in 1854. Through public subscription, the grounds became public property in 1913. Though fantastic in appearance, the Palace has for many years been symbolic, and apart from this sentimental loss, its destruction is to be regretted since it had become a centre for music, chiefly choral and orchestral, and for various types of exhibitions. The fire affected the Research Laboratories of Baird Television, Ltd., situated at the Palace, but the part of the building leased by the Baird Company for the production of receiver sets and their testing fortunately was sufficiently remote from the main building not to be damaged in any way. While, therefore, a great amount of research apparatus was destroyed, the delivery of Baird receiving sets will not be seriously affected. Immediate measures are being taken to find alternative accommodation for the Baird Company's large number of research workers and for the re-equipment of the laboratories, and it is not considered that the research programme of the Company will be seriously prejudiced. The fire at the Crystal Palace does not affect the B.B.C. television programmes being broadcast from the Alexandra Palace by the Baird system and by the Marconi E.M.I. system.

Television in the London Area

THE issue of *Television and Short Wave World* of December makes some critical comments on the programmes that have been transmitted from the Alexandra Palace. Complaints are made that intervals, sometimes totalling more than fifteen minutes, occur in a programme of an hour. These intervals are usually filled up by gramophone records, but the owner of the set feels that it is extravagant to run about twenty valves together with a cathode ray tube merely to hear these records. It is unfair to be too critical in the early stages of development, but it looks as if more should be spent on the programmes. Television receivers are being advertised for immediate delivery at prices ranging from 85 to 135 guineas, the picture size being about 12 in. by 9 in. Free demonstrations are given by various manufacturers in London. The Science Museum is still giving demonstrations, and the Southern Railway is giving demonstrations at Waterloo Station to railway ticket holders. Carrington House, a large block of flats in Mayfair, has been equipped for 'bulk reception' of television signals and of ordinary broadcast programmes. The building contains seventy-three flats each of which is fitted with plug points for both kinds of services. The residents of any of these flats can purchase a television or a radio set or both with confidence that the programmes will be produced without interference. It is possible that the actual Coronation ceremony in Westminster Abbey may be televized. The two great difficulties are relaying the signals to the Alexandra Palace and the provision of the necessary bright light.

Derbyshire Caves Exhibition

ON behalf of the Derbyshire Caves Exploration Committee appointed by the British Association, Mr. Leslie Armstrong has excavated Pin Hole, a cave in Creswell Crags inhabited in Upper Palæolithic times and exceptionally rich in prehistoric remains. A preliminary report was published in the *Transactions of the Hunter Archaeological Society*, **4**, part 2, with a diagram showing the brick-earth, red above and yellow below, which underlay the present stalagmitic floor, with layers of slabs fallen from the roof marking periods of exceptional cold. The palæolithic cultures represented are Le Moustier and Aurignac, the latter persisting through the glaciation associated elsewhere with La Madeleine; and the fauna shows severe and temperate conditions alternating. There are chipped pebbles of quartzite, and flint implements of excellent workmanship, nearly all with white patina; also slight engravings on bone, a bone blade regarded as a bull-roarer, as well as a cowrie shell and piece of mother-of-pearl. Mr. Armstrong has also excavated Mother Grundy's Parlour in the same valley, and published an account in the *Journal of the Royal Anthropological Institute*, **55**, Jan.–June 1925, with eight pages of careful drawings of the stone implements mostly of Aurignac types, but with a microlithic industry in the uppermost layer, and chipped quartzite at the base. The cave-earth of the Parlour has large stones from the roof incorporated throughout, not at intervals, and shows the same difference in colour as Pin Hole. Engravings of animals on bone in the Aurignac style and the best of the finds from both sites are now exhibited in the Department of British and Mediaeval Antiquities at the British Museum, near the top of the main staircase, and will, by the kindness of Mr. Armstrong, remain there for the rest of the year.

Romano-British Pottery Kiln from Berkshire

A ROMANO-BRITISH pottery kiln removed intact to the Science Museum, South Kensington, from its original site in Berkshire was exhibited to the public for the first time on December 1. The kiln, now shown with a reproduction of its original surroundings painted by Mr. E. M. Dinkel as a background, is one of two discovered through the introduction of the tractor-drawn plough in the cultivation of a field overlooking the dried-up bed of the River Pang on Woodrows Farm, Compton, near Aldworth, Berks. The deeper ploughing in soil only a few inches deep on chalk turned up a darker earth mixed with potsherds, which on investigation by General W. K. Hardy proved to be due to the presence of two pottery kilns. Of these, one was found to be intact, while the other had been broken up by the ancient potter. The kilns had been constructed by digging an oval hole in the chalk about four feet deep. One half of this was taken up by a rough oven of clay with a front wall of clay and stones, in which was a stoke-hole. A floor of clay, supported by a wall from centre to back, an inch or two below the level of the chalk, served as the stand on which were placed the 'green' pots for firing, heat from the fire passing through holes in the floor. Over the pots had been a dome-shaped cover of clay, which had to be broken at each firing, but of which fragments were found nearby. Pots reconstructed from the numerous sherds collected, as well as coins associated with the find, give a date not later than the beginning of the fourth century A.D. The removal intact of the undamaged kiln entailed not a little skill and ingenuity, as with reinforcement it weighed nearly five tons. Recent archæological discovery, notably in Yorkshire, at Colchester and most recently at Lincoln, have made familiar the kiln and mode of firing employed by the Romano-British potter; but as a rule the conditions of discovery have precluded preservation for general inspection. The kiln now on view at the Science Museum is the only example of the period exhibited in Great Britain.

Exhibition of Kinematography

THE fourth Exhibition of Kinematography, arranged by the Royal Photographic Society, was opened at the Society's premises, 35 Russell Square, London, on November 28 and will remain open until December 19. A large selection of still pictures illustrates the ever-widening scope of kinematography, and includes examples of the work of many producing companies and amateur societies, and of films—scientific, instructional and for purposes of entertainment and publicity. Much recent apparatus, standard and substandard, is on view, this section including exhibits by most of the leading manufacturers. A Vinten gyroscopic tripod for 16-mm. work is particularly worthy of note. Stock manufacturers are also to the fore. Kodachrome is being exhibited in 16-mm. and 8-mm. sizes, the smaller size being not yet on the market in Great Britain. On this stand, too, Messrs. Kodak show samples of 16-mm. work with Pola screens. Messrs. Ilford have staged an exhibit with photographs illustrating the manufacture and testing of Cine products. Examples of their various products, including Dufaycolor, are on view. A comprehensive programme of lectures has been arranged on subjects varying from sound recording to the making of cartoon films. No charge is made for admission to the Exhibition, to the meetings, or for reserving seats.

Dr. E. Bausch and the Optical Industry of America

THE American Society of Mechanical Engineers made its annual awards for distinguished service in engineering and science, and "for great and unique acts of an engineering nature that have accomplished a great and timely benefit to the public" on December 1 to Dr. Edward Bausch and Mr. Henry Ford, when Dr. Bausch received the A.S.M.E. Medal and Mr. Ford the Holley Medal, the former established in 1920 and the latter in 1923. The A.S.M.E. Medal is awarded once a year, "and that only for inventions and improvements of great merit in the technical and public sense". Among the previous recipients have been H. G. Carlson, Dr. Robert A. Millikan, Dr. Ambrose Swasey, and other distinguished contributors to the progress of engineering. In his long and notable career, which began with the construction of his first microscope in 1872, Dr. Bausch has been a constant contributor to engineering progress. At eighty-three years of age, he is still at work, and recently, with other members of the Bausch and Lomb Optical Co., has designed the contour measuring projector. This new instrument is proving itself a valuable inspection device in many types of industry. It is both a microscope and a projection apparatus of the highest quality and great accuracy with which a highly magnified profile of such parts as screw threads, gears, dies, gauges and shapers may be thrown upon a screen or chart for study and comparison.

DR. BAUSCH entered his company's service sixty-two years ago, immediately upon leaving Cornell University. As assistant to his father, John J. Bausch, he is credited with the great expansion of the industry in the United States through the introduction of new technical methods and machine processes to compete with the cheaper hand labour of Europe. Dr. Bausch has for many years been a fellow of the Royal Microscopical Society, and has a wide acquaintance with workers in this field both in Europe and the United States. Not content with his own efforts in building up the optical industry, Dr. Bausch has been conscious of the necessity of educational work to perpetuate his labours. This explains his interest in the establishment of the Institute of Optics, as a part of the Physics Department of the University of Rochester, and the construction of the Bausch and Lomb Physics Building at the University in honour of his father and Captain Henry Lomb, founders of the Bausch and Lomb Optical Co.

Research on Atmospheric Pollution

THIRTY-THREE representatives of local authorities and other organizations co-operating with the Department of Scientific and Industrial Research met at the Fuel Research Station of the Department at East Greenwich on November 30 to discuss the investigation of atmospheric pollution. Dr. G. M. B. Dobson, chairman of the Atmospheric Pollution Research Committee, presented a report on the progress of the investigations carried out under the auspices of the Committee. The Conference noted especially that arrangements are well in hand for the intensive survey of pollution in and around Leicester. After the meeting, the representatives were shown the work of interest to them which is in progress at the Fuel Research Station. Broadly speaking, there are two fundamental and closely related factors involved in the reduction of atmospheric pollution by coal burning—the nature of the fuel and the appliance in which it is burned. The former of these leads to the selection from the varieties available of fuel most suitable for a given purpose. The preparation of coal for the market, by cleaning and grading, assists materially in the reduction of pollution; the cleaning yields a coal of lower ash content, thus decreasing the potential emission of ash in the form of grit, while grading the coal according to size reduces the content of small particles which may be blown from the fuel bed by the draught. The aim in coal-burning appliances is towards greater control over the combustion. This is obtained by uniform air distribution to the fuel and the regulation of air supply, thereby promoting efficient combustion and a reduction of the unburned products passing into the atmosphere. In the domestic field attention has been devoted mainly to the production from coal of a free-burning smokeless fuel, by removing the greater part of the volatile matter which is responsible for most of the smoke nuisance. Appliances have been designed for the burning of such smokeless fuel. Efforts are also being made to test and modify domestic appliances so that raw coal may be burned more efficiently and with a substantial reduction of pollution.

Domestic Cokes

THE Institute of Fuel and the Manchester Association of Gas Engineers held a symposium on domestic cokes in Manchester on November 18. Arnold Marsh examined the question from the point of view of smoke reduction and, discussing the scope of the different smokeless fuels, concluded that all forms of coke would be required. E. C. Evans, on the other hand, fears that an increase in the use of oven coke for domestic purposes would be disadvantageous to the economic production of pig iron. Even now there is a shortage of suitable blast furnace coke. H. J. Hodsman, discussing the relation between the properties of a coke and its behaviour in the grate, emphasized that shallow modern grates cannot be justified on the ground of efficiency on consuming any fuel—whether raw coal or coke. The deeper fuel bed is more rational and this is being recognized by the consumer, for E. W. L. Nicol pointed out that 70,000 such grates convenient for burning coke are sold annually. A. Blackie described two suitable designs of grate which have proved satisfactory. Emphasis was laid on the possibility of activating high-temperature cokes with soda. Prof. J. W. Cobb described how in 1925 it was observed that the reactivity of coke to carbon dioxide is enormously increased by treatment with soda. The chance of industrial use of this has been increased by P. J. Askey's observations that in presence of lime, the addition of even so little as 0·5 per cent sodium carbonate to a coke may produce an adequate increase in the reactivity. R. A. Mott described experiments made with H. H. Thomas in Liverpool Gas Works on alkali activation made under coke oven conditions. These leave little doubt that high-temperature cokes can be made to burn more actively as a result of alkali treatment; but the economic future of the process will depend on other factors. Many existing gas works would find it difficult to introduce a process of pretreating coal into their routine.

Acquisitions at the British Museum (Natural History)

MR. W. FALCONER has recently presented to the Department of Zoology males and females of eighty-four British species of spiders all new to the collection. This valuable gift makes the collection of British spiders in the Museum almost complete. Another interesting accession comprises nine spiders' webs mounted between sheets of glass, the webs being made visible by a black background and the judicious application of baby powder. Prof. G. H. F. Nuttall has presented to the Department of Entomology the whole of the material upon which he based his well-known studies on the human louse. His results, published in *Parasitology* (1917–30), include a very full summary of its relation to typhus, relapsing and trench fever, and other diseases which it carries, and a detailed account of methods of combating lousiness. Among other things Prof. Nuttall demonstrated that the head louse and body louse are not distinct species, but only varieties, possibly showing slight biological differences, of a single species. Recent accessions to the Department of Geology include an extensive series of petrified cones and wood of Araucarian conifers from Patagonia, collected and presented by Dr. F. Mansfield. Many of the specimens have been cut and polished, and the preservation, in chalcedony of various colours, is very good. These fossils were found in the Cerro Alto and Cerro Cuadrado region of Santa Cruz, which has been described as one of the world's most marvellous petrified forests; the material has not yet been fully studied, and the geological age is still uncertain, though it is probably at least as old as early Tertiary. Several hundred invertebrates, mainly corals, from the Palæozoic of Germany and Bohemia, have been collected and presented by Dr. Stanley Smith. The Mineral Department has received by exchange with the Mineralogical Museum, Moscow, an interesting series of specimens from Kola Peninsula and various localities in Central Asia. Lord Ilchester has given a series of pebbles from carefully defined points on the Chesil Beach, which is probably the most remarkable bank of shingle in the world.

Exhibit of the Biology of Water-Supply

A NEW exhibit which has been installed in the Central Hall of the British Museum (Natural History) illustrating the biology of water-supply shows, more fully than its predecessor, the influence of plants and animals on the purification of water for human use. It shows how river-water is purified by storage in reservoirs, followed by filtration through sand. Some of the organisms living in the water of a river find the conditions in waterworks more favourable, and multiply greatly. Thus great swarms of minute plants, and the animals that feed on them, arise in reservoirs. This is sometimes to the advantage of the water engineer, and sometimes greatly to his disadvantage. The beneficial effects include oxygenation of the water by the plants, and the formation of a natural filtering film, more efficient than any artificial film, in stopping the passage of bacteria. This living film, which consists chiefly of microscopic plants, forms on the surface of the sand and gravel of the filter-bed. Trouble arises if the living things in the reservoirs become so numerous as to choke the filters, or are of such a kind as to give an unpleasant flavour to the water. These points are illustrated by specimens, photographs and diagrams. History has shown that, without sand-filtration, mains and supply-pipes are apt to become seriously blocked with animal growths. This is illustrated in the exhibit, which also shows how the excessive growth of microscopic plants can be checked, how wells and springs come to give good or bad water, how sudden and severe outbreaks of iron-bacteria have been known to occur, and the importance of taking drinking water direct from the main, and of keeping household cisterns covered. The Museum is indebted to the staff of the Water Examination Department of the Metropolitan Water Board for help in the preparation of this exhibit.

The Aquarium of the New York Zoological Society

THE fortieth annual report of the New York Zoological Society (June 1936) contains a report on the aquarium, written by the assistant director, Mr. Charles M. Breder, jun. There has been much activity both in improving equipment and collecting fishes and invertebrates for the aquarium. Besides this, many fishes have been hatched, including whitefish, Chinook salmon, rainbow trout and muskallunge, and the young handed over to the New York City Water Department for distribution in public waters. Studies on the nature of electrical energy discharged by such fishes as the electric eel were continued by Mr. Coates. After many experiments, it was found that the electricity discharged by an eel could be made to light a neon tube, and this led to a daily demonstration for the benefit of the public. Mr. Breder himself is studying details of reproductive habits of fishes, including five species of sunfish, the stickleback, *Apeltes quadracus*, and the catfish, *Villarius catus*, and has published several papers on this subject. Besides work by the staff, a number of visitors have made use of the aquarium facilities during the year.

The Parliamentary Science Committee

THE annual general meeting of the Parliamentary Science Committee was held at the House of Commons on November 26, the Earl of Dudley presiding. The officers elected for the ensuing year were : *President*, The Earl of Dudley ; *Chairman*, Sir Arnold Wilson ; *Vice-Chairman*, Prof. B. W. Holman ; and *Hon. Secretary* and *Treasurer*, Mr. H. W. J. Stone. According to the annual report, four more institutions were affiliated to the Committee during 1936, and others have the subject under consideration. The total aggregate membership of the affiliated institutions now exceeds 100,000. During the last session, the Committee was active in approaching Government departments, and in promoting questions in Parliament on a variety of topics. The outstanding feature of the year's work has been the consideration of a memorandum how best to finance and develop scientific and industrial research. The investigations into this subject have not yet been completed. During the past year the following members of parliament have joined the Committee: Lord Melchett, Prof. J. Graham Kerr, Mr. Andrew MacLaren and Sir Philip Dawson.

Bright Fireball of November 14

AT about 8.45 p.m. on November 14, a very bright fireball was seen by a number of people in different parts of Ireland. All the accounts agree in describing it as extremely brilliant, showing lights of various colours—white, blue, and red—and moving fairly slowly earthwards. Some of those who saw it allege that it lighted up the country, a road being visible for half a mile ahead, or the earth being as bright as day. Many people were terrified by the apparition, and one girl collapsed with fright. Most of the accounts come from Dublin and Wicklow, but it was also seen in Co. Tipperary, and a correspondent there describes it in terms almost similar to those used by others in eastern Ireland, namely, "it seemed very close at hand and lighted the whole place up". A report from Co. Armagh, Northern Ireland, asserts that three minutes after its disappearance a dull rumbling noise like distant thunder was heard. No one has given its position at beginning or ending with reference to the stars ; indeed it does not appear that any stars were visible, at least for the observers in eastern Ireland. For this reason it is quite impossible to compute its path. Judging by the vague descriptions of its direction, it was probably falling nearly vertically somewhere about the middle of Ireland, probably a little towards the west.

Three Large Sunspots

A CONSPICUOUS feature of present solar activity is the appearance on the disk at the same time of three large sunspots, each being visible to the naked eye. Foggy weather in London and elsewhere on November 28 provided almost ideal conditions for direct observation without a telescope, and a number of people, who were previously quite unaware of the existence of the spots, discovered them independently for themselves. From a photograph obtained at the Royal Observatory, Greenwich, on November 27, the following data are derived :

Date on Disk	Central Meridian Passage	Latitude	Area
Nov. 23–Dec. 5	Nov. 29·3	17° N.	1400
Nov. 23–Dec. 5	Nov. 29·4	11° S.	1000
Nov. 25–Dec. 8	Dec. 2·2	14° S.	1400

Areas are corrected for foreshortening and are given in millionths of the sun's visible hemisphere.

Under favourable conditions, a single spot of area 500 millionths may be detected without a telescope. Including the three present spots, nineteen naked-eye spots have already been recorded this year. Since the frequency curve of these large spots approximates closely to the more representative curve given by all spots or by their mean daily area, an even greater number of large spots may be expected in 1937–38, the epoch of the anticipated maximum of the present 11-year cycle.

The Night Sky in December

ON December 22^{d} 0^{h} the sun enters, at the winter solstice, the sign Capricornus ; in the latitude of London the nights are then 16¼ hours in duration. The moon is new on December 13 at $23\frac{1}{2}^{\mathrm{h}}$ and full on December 28^{d} 4^{h} U.T. At new moon an annular eclipse of the sun is visible in the antipodes (local time December 14)—the central line, along which the duration of annularity is 5½–7½ min., crossing

Australia and the North Island of New Zealand. Among the seven lunar occultations visible at Greenwich, the disappearance of *A* Tauri (mag. 4·5) may be noted on December 25 at $20^h\ 0{\cdot}9^m$ at 120° from the north point of the moon's disk. Of the planets visible, Venus is a conspicuous object (mag. $-3{\cdot}6$ to $-3{\cdot}7$) setting about $19^h\ 0^m$ in mid-December. On December $17^d\ 17^h$ the planet is in conjunction with the moon, below which it will be situated 6°. Mercury is not very accessible to observation, but may be seen during the last week of the year near the south-west horizon at 17^h. Mars rising after midnight is in Virgo; on December 21 it passes 3° north of the bright star, Spica. Saturn, in Aquarius, sets about 23^h in mid-December; on Dec. $20^d\ 19^h$ the planet is in conjunction with the moon, and on December 28 the sun will be in the plane of the rings, the minor axis of which is now about 2″. In addition to the planets, the skies offer at any time during a fine night in December an attractive field for observation. At 22^h in the middle of the month, the constellations of Cassiopeia, Perseus, Andromeda, Taurus and Aries are near the meridian, whilst the stars of Orion, Sirius, Procyon, Castor and Pollux are south-east and eastwards. The Geminid meteor shower should be looked for on or about December 11, the radiant point being at R.A. $7^h\ 12^m$: Dec. 33° N. The light variations of Algol may be observed at about December $1^d\ 0^h$: $3^d\ 21^h$: $6^d\ 18^h$: $18^d\ 5^h$: $21^d\ 2^h$: $23^d\ 23^h$: $26^d\ 20^h$ and $29^d\ 17^h$.

Announcements

THE Buchan Prize of the Royal Meteorological Society for 1937 has been awarded to Mr. C. S. Durst, for papers contributed to the *Quarterly Journal* of the Society during the years 1931–35.

THE Mozelle Sassoon High Voltage X-Ray Therapy Department of St. Bartholomew's Hospital, London, will be opened by Mrs. Meyer Sassoon on December 10 at 2.30 p.m., when Lord Rutherford and Lord Horder will speak. A memorial plaque to Dr. R. G. Canti, late clinical pathologist to the Hospital, will be unveiled by Dr. Malcolm Donaldson, director of the Cancer Department.

MESSRS. W. WATSON & SONS, LTD., of 313 High Holborn, London, W.C., are holding their fourth Annual Exhibition of Microscopes in the Central Hall, Westminster, on December 7–11. In connexion with the Exhibition, several cinematograph films will be shown, and the following lectures will be given: "Science and Vinegar Brewing" (Mr. Sarson); "The Romance of Shell Life" (Mr. F. Martin Duncan); "Old Instrument-makers" (Mr. R. S. Whipple).

DR. FRICK, the German Home Office Minister, has ordered that specimens of blood should be examined for the presence of alcohol according to Widmark's method in the case of persons apparently under the influence of drink when involved in motor accidents.

ACCORDING to the Soviet Union Year Book Press Service, the large Soviet Medical Encyclopædia has now been completed. It consists of 35 volumes, containing 6,396 articles and 80,000 terms used in medicine and allied sciences; 20 academicians, 692 professors and 1,006 other scientific workers have taken part in the production of the Encyclopædia under the editorship of Prof. N. A. Semashko.

THE Leningrad branch of the All-Union Institute of Experimental Medicine is collecting documents relating to the life and work of the late Prof. I. P. Pavlov. The documents are to be added to the collection already in existence at the Pavlov Museum founded by the Leningrad branch. A commission is approaching men of science and scientific institutions abroad for gifts of any material they may have in their possession relating to Pavlov.

WE are informed that the price of Osborn's "Monograph of the Proboscidea" is 20 dollars (NATURE, Oct. 31, Supp. p. viii, and Nov. 21, p. 860).

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

Lecturer in mechanical engineering in the St. Helens Municipal Technical School—The Director of Education, Education Office, St. Helens (December 8).

Lecturer in mechanical engineering and lecturer in electrical engineering in the Norwich Technical College—The Principal (December 9).

Lecturer in mechanical engineering in the West Hartlepool Technical College—The Secretary for Education, Education Offices, West Hartlepool (December 9).

Temporary assistant engineers, engineering assistants and junior engineering assistants to the Ministry of Transport—The Establishment Officer, Ministry of Transport, Whitehall Gardens, S.W.1 (December 11).

Junior research chemist for work on fuel problems at the Bone Research and Development Association, Ltd.—Prof. W. A. Bone, Imperial College of Science, S.W.7 (December 11).

Research physicist to the Printing and Allied Trades Research Association—The Director of Research, 10 Robin Hood Court, Shoe Lane, London, E.C.4 (December 21).

Chief mining engineer to the Safety in Mines Research Board—The Establishment Officer, Mines Department, Dean Stanley Street, S.W.1 (December 31).

Imperial economic botanist at the Imperial Agricultural Research Institute, New Delhi—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (January 2).

Professor of animal pathology in the University of Cambridge—The Vice-Chancellor (January 12).

Research physicist to the British Cotton Industry Research Association—The Director of Research, Shirley Institute, Didsbury, Manchester.

Principal of the Kadoorie Agricultural School, Mount Tabor, Palestine—The Chief Secretary to the Government of Palestine, Jerusalem.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 976.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Mechanism of Thermal Change in Gaseous Organic Compounds

INVESTIGATIONS in this laboratory have shown that thermal change in gaseous organic compounds commonly leads to the formation of paired products through a single chemical process, so that, although the rate of change in the reactant is determined solely by initial concentration and temperature, the relative rates of formation of the products may be determined by other conditions. In such cases the initial rates of reaction show acceleration, the $x - t$ graphs being linear, or curved towards the x-axis; but after a relatively short period the slopes of the graphs suddenly diminish. Further, the main process seems generally to be associated with a primary or *background process*, represented by,

$$A \rightleftharpoons B\ (+C),$$

leading to equilibrium in the system A, B, (C).

The main process seems to be initiated by binary collisions AB, collisions AA, and generally also BB, leading only to change in the equilibrium system. The main process may be represented by,

$$\begin{array}{ccccc} a & b & c & d & e \\ A + B \rightarrow & A'B' \rightarrow & A'B' \rightarrow & A'B' & \begin{smallmatrix} \nearrow C \\ \searrow D \end{smallmatrix} \\ \text{Molecules} & \text{activated complex state} & & \text{unstable intermediate} & \text{paired products} \end{array}$$

The change $c \rightarrow d$ is such that the probability of reversal is very small, and it is the rate of this process which we generally measure. Since the products which are formed simultaneously may be, on one hand, products of condensation, and on the other, products of disruption of the reacting molecules, it is suggested that these survive as entities to the *unstable intermediate* stage, and that free radicals are not accountable for the processes involved.

Re-investigation of the data obtained by Dr. Hockin, Dr. Pearce and myself from the study of the thermal decomposition (550°–630°) of ethane, and of ethane – ethylene – hydrogen equilibrium mixtures, has thrown some light on the whole problem of the thermal changes in simple organic compounds. In both cases methane and condensation products are formed, but in the background of the processes which give rise to these products is the equilibrium reaction represented by,

$$C_2H_6 \rightleftharpoons C_2H_4 + H_2.$$

However, in this case the background reaction can be studied independently, and a great deal is known about it. Also, by working with ethane – ethylene – hydrogen equilibrium mixtures, we can virtually eliminate the disturbing effect introduced by the operation of the background reaction when working with pure ethane. It is possible to make up an unlimited number of mixtures in which the ratio $(C_2H_4)(H_2)/(C_2H_6)$ corresponds to equilibrium conditions at the temperature of the experiment, and using the computative method described in one of our papers[1], I have found that the rate of formation of the products, expressed in terms of the rate of disappearance of 2-carbon hydrocarbon, conforms to the expression,

$$d(CH_4 + R)/dt = K(C_2H_6)(C_2H_4),$$

with reasonable exactitude in the case of about a hundred experiments.

Starting with pure ethane, it is found that the initial rate of reaction is accelerated. This may be accounted for qualitatively by the fact that the ethylene concentration is increasing from the commencement. However, the acceleration is greater than can be accounted for in this way, and the fact that the break does not occur in the $x - t$ graph until some little time after the ethylene concentration has reached a maximum suggests that the acceleration may be partially due to some chain mechanism arising from the background reaction. After the break, the rate of reaction seems to conform to the bimolecular equation. The ratio $(CH_4)/(CH_4 + R)$ seems to vary between limits 0·5 and unity with the hydrogen concentration, but no quantitative relationship has been worked out. The bimolecular reaction involving ethane alone results only in the formation of ethylene and hydrogen, and the bimolecular condensation of ethylene, as studied by Pearce, seems to be a heterogeneous process.

The work carried out by Dr. Seddon and myself on acetaldehyde was that in which it was shown originally that the *paired products* may result from a single chemical process. They are methane and carbon monoxide, which constitute the main product when the reaction is conducted in an empty tube, and propylene, carbon monoxide, and water, which may constitute the main product when the tube is packed. The thermal decomposition process is accelerated initially; and, from analogy with the case just considered, it seems fair to associate this process with the development of a system represented by,

$$CH_3.CHO \rightleftharpoons CH_2{:}CHOH,$$

in the background. The constituents of the system are known, though nothing is known about their equilibrium relations.

The thermal decomposition of methyl nitrite has been studied by Mr. A. G. Carter and myself. Contrary to the conclusion of Steacie and Shaw, we find that the decomposition process shows strong initial acceleration, and that paired products result, the processes being represented by,

$$\begin{aligned} 2\,CH_3NO_2 &= 2\,NO + CH_2O + CH_4O, \text{ or} \\ &\ N_2O + 2\,CH_2O + H_2O. \end{aligned}$$

There is evidence here that the process must be bimolecular. However, though there is plenty of evidence to show that methyl nitrite does not behave like a normal ester, there is no evidence as to the nature of a background process, should such exist. The thermal decomposition of methylamine has been studied by Messrs. Bosanquet, Carter, Wilshire and myself, in continuation of the work of Emeléus and Jolley. Their work suggested that the two methods of decomposition represented by,

$$CH_3NH_2 = HCN + 2\,H_2, \quad \text{and}$$
$$CH_3NH_2 + H_2 = CH_4 + NH_3,$$

are related. We find further evidence in support of this view, and also that the processes are initially accelerated. The process represented by the first equation is definitely reversible, and it can be supposed that a background reaction operates in this case, though its nature is again unknown.

A similar mechanism must operate in the case of other gaseous reactions to which I have made reference in recent letters to NATURE.

We have also studied the thermal decomposition of certain 3-carbon compounds, but detailed analysis shows that the processes are extremely complex. One can, in such cases, express the rates of decomposition, if measured by observing increase in pressure at constant volume, by means of an equation analogous to that representing unimolecular change. Taking the two sets of results together, however, it seems to me that such procedure is likely to be much more misleading than helpful.

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Action of Co-zymase as the Specific Co-enzyme of Lactic Dehydrogenase from Heart Muscle

EARLIER work on the mechanism of enzymatic dehydrogenation has shown that, in presence of a thermolabile apo-dehydrogenase of protein character, co-zymase takes up hydrogen from a substrate and is thereby reduced to a dihydro-form[1]; the dehydrogenation of alcohol may be represented by the equation

$$\text{alcohol} + D^A\text{-}Co^{I} \rightleftharpoons \text{aldehyde} + D^A\text{-}Co_{I}H_2 \qquad (1)$$

where D^A is the specific alcohol apo-dehydrogenase and Co^I co-zymase. The apo-dehydrogenases are specific with respect to substrates and to one or other of the two known co-dehydrogenases, co-zymase (Co^I) or Warburg's co-ferment (Co^{II})[2]. Recently, we showed that lactic apo-dehydrogenase from heart muscle and alcohol apo-dehydrogenase from yeast are not identical, but both form active holo-dehydrogenases only with Co^I and not with Co^{II}[3].

Green and Brosteaux[4] have just confirmed our result that lactic dehydrogenase is not activated by Co^{II}, but have not decided whether the necessary co-dehydrogenase is identical with Co^I. Our earlier proof of the identity of lactic co-dehydrogenase with co-zymase, based on parallelism between fermentative and co-dehydrogenase activity, is confirmed conclusively by the following experiments, which show that alcohol co-dehydrogenase and lactic co-dehydrogenase are completely interchangeable. The identity of the former with co-zymase is quite certain.

(1) 2·0 ml. $M/2$ sodium lactate, 1·4 ml. $M/2$ disodium hydrogen phosphate and 0·1 ml. lactic dehydrogenase (D^L) from heart muscle (clear solution) were mixed in an absorption cell and the extinction (ε) at $\lambda = 334$ mμ was measured photo-electrically. After addition of 0·4 mgm. co-zymase, the extinction increased rapidly, corresponding with the formation of reduced co-enzyme (Fig. 1). Equilibrium was reached after 10 minutes. After a further 15 minutes, 0·1 ml. $M/10$ sodium pyruvate was added (*a*) which caused the extinction to fall rapidly to a value representing the absorption of the excess of pyruvic acid. This experiment indicates the reversibility of the process

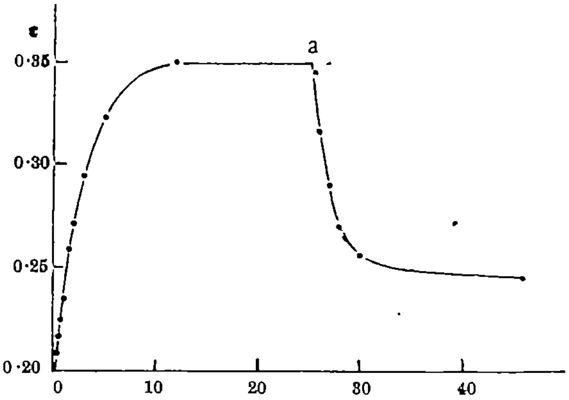

FIG. 1.

$$CH_3.CHOH.COOH + D^L\text{-}Co \rightleftharpoons CH_3.CO.COOH + D^L\text{-}CoH_2 \quad . \ . \ . \ . \quad (2)$$

The effect of pH and temperature on this equilibrium is being further investigated.

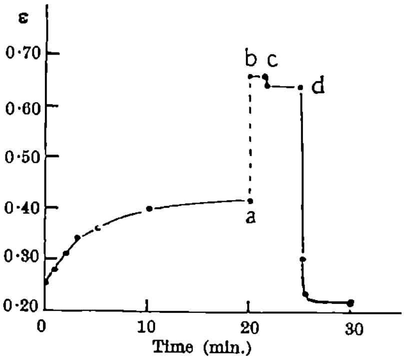

FIG. 2.

(2) In a similar experiment (Fig. 2), after production of the reduced co-enzyme, the mixture was heated (*a*) for 5 minutes at 75°, thus destroying the lactic apo-dehydrogenase. After filtration, the extinction of the clear filtrate was again measured (*b*). The increase is due to a displacement of the equilibrium by rise of temperature in favour of the reduced co-enzyme prior to destruction of the enzyme. No reaction occurred on addition of 0·1 ml. $M/100$ acetaldehyde (*c*), but on subsequent addition of 0·1 ml. alcohol apo-dehydrogenase from yeast (*d*),

the extinction fell immediately to the initial value. This action of acetaldehyde in presence of alcohol apo-dehydrogenase indicates that the reduced co-enzyme was identical with dihydro-co-zymase.

(3) In a mixture of 0·2 mgm. co-zymase, 0·3 ml. $M/2$ phosphate buffer $pH=7\cdot6$, 0·1 ml. alcohol apo-dehydrogenase, 0·2 ml. absolute alcohol and 3·5 ml. water, dihydro-co-zymase was produced and recognized by its characteristic absorption at 334 mμ (Fig. 3). After attainment of equilibrium, the apo-dehydrogenase was destroyed by heating (*a*); the extinction rose to (*b*) owing to a slight turbidity. Addition of 0·1 ml. $M/10$ pyruvate caused an immediate increase to (*c*), due to the pyruvate itself, but on further addition of 0·1 ml. lactic apo-dehydrogenase (*d*), the extinction fell by an amount representing the reoxidation of the dihydro-co-zymase. It follows that dihydro-co-zymase can act as the prosthetic group of lactic dehydrogenase in the reduction of pyruvic acid to lactic acid.

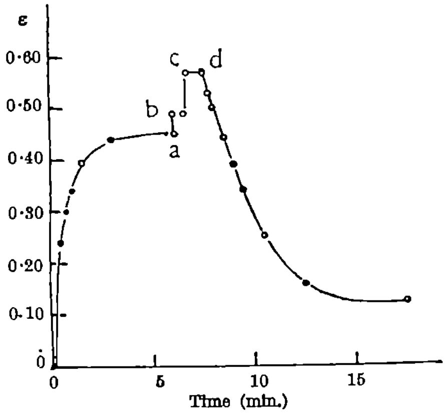

FIG. 3.

These three experiments show that the co-enzyme of lactic dehydrogenase is identical with that of alcohol dehydrogenase and therefore with co-zymase. The reduction of pyruvic acid to lactic acid in muscle glycolysis probably involves dihydro-co-zymase. Further details will be given elsewhere.

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The Sterckfontein Ape

IN NATURE of September 19, Dr. R. Broom, of Pretoria, has given an account of the important discovery of a Pleistocene anthropoid skull at Sterckfontein, near Johannesburg, Transvaal, and has supplemented it simultaneously by a series of excellent photographs both of the site and specimen which have appeared in the *Illustrated London News*. In NATURE of October 24, p. 719, he has given a figure and description of the teeth. He maintains that the Sterckfontein specimen belongs to the same genus *Australopithecus*, although to another species, as the Taungs ape, and that both are hominoid, and not nearly related to any of the existing species of anthropoids.

In examining the cast of the Taungs specimen in the British Museum, and the photographs of the teeth published by various authors, notably by W. Abel[1], the conclusion could not be avoided that these teeth are not human at all but are more like those of the gorilla. As regards the skull of the baby specimen from Taungs, it shows features which are decidedly gorilloid. The concave profile of the face (taken to be chimpanzoid by Dart) can easily be explained by deformation, proof of which is the crack at the root of the nasals. The nasals themselves are fairly big, but appear smaller than they really are, because the lower end is broken off, and the nasal aperture therefore distorted. Other features which the skull has in common with the gorilla are the length of the brain case, and the fact that the suture between the maxillary and the zygomatic runs medially to the masseteric knob, whereas in the chimpanzee, for example, it runs laterally. The size of the Taungs ape is smaller than that of any recent gorilla of corresponding age. The Sterckfontein skull is that of an adult animal. Its size again is smaller than that of the existing gorilla. But this reduction in size is on about the same level as in the Taungs ape. The teeth figured by Dr. Broom are quite unlike those of man or of the chimpanzee. In both of these they are roundish in outline, and the heel of the last molar is shortened and the individual cusps more or less fused into a ridge. In the Sterckfontein skull, and in the gorilla, the cheek teeth are more rectangular in cross-section, and the last molar has a well-developed heel with two distinct cusps (and a postero-external style). The structure of this tooth in Dr. Broom's specimen can be matched by that found in a female gorilla from the Okuni district, South Nigeria (Brit. Mus. No. 7.1.8.4).

Dr. Broom has maintained that one of the most important features proving the affinity of *Australopithecus* and man was the fact that the lateral incisors of the upper jaw and the canines meet, a feature which he thinks does not occur in apes. This may be true in normal chimpanzees and gorillas. But it is not quite true in the pigmy chimpanzee (*Pan satyrus paniscus*) found south of the Congo, where the space between these two teeth has become very small indeed. This animal, as has been pointed out before, presents a case homologous to *Australopithecus*[2]. The small size, the dome-shaped forehead, the shortness of the face which is responsible for the crowding together of the teeth, are the same in both. It is, therefore, very probable that *Australopithecus* was a pigmy gorilla. From the relative size of the two specimens known and the smallness of the canine teeth, it appears that both were females.

The fact that Dr. Broom's specimen does not represent an ancestral form of the hominoid line does not detract from the extreme value of the discovery. It is to be hoped that he will be able to continue his researches, and to elucidate the history of anthropoids in Africa, an undertaking quite as important and interesting as that of the ancestors of man himself.

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Enamel Protein

HUMAN dental enamel contains about one per cent organic matter[1], and it is well established on histological evidence that the structure of enamel consists of a mesh-work of organic matter in which inorganic salts (mainly calcium phosphate) are deposited in an orderly arrangement, resembling prisms. It is to be noted that newly formed enamel is covered with a layer of organic matter (Nasmyth's membrane), and also[2] that there is more organic matter in enamel near the junction with the underlying tissue, the dentine, than in that portion equidistant from the dentine and the surface of the tooth.

Fifty years ago Thompson[3], in describing human dental enamel, referred to "an organic matrix of horny matter, keratine", and it may be said that the organic matter associated with enamel has always been regarded as keratin. Most authorities agree in referring to keratins as proteins with a high sulphur content, although Block and Vickery[4] do not regard "a high proportion of cystine as necessarily characteristic of keratins". It has been stated that "the linkages binding sulphur into the protein molecule are uncertain"[5]; this uncertainty may be said to extend to organic substances containing sulphur, of which two new examples have recently been described by Mueller[6] and Baernstein[7]. It will be seen below that the presence of sulphur can readily be demonstrated in some keratins, but it may be said that the demonstration is incomplete so far as enamel protein is concerned. Rosebury[8], who recently published a detailed study of enamel protein, described it as "showing the chemical characteristics of keratin". In this work he used the lead test for labile sulphur, which, he says, "at best is not a delicate reaction".

In separating the organic material in enamel from the inorganic part, one of the difficulties with which I met was the scarcity of suitable human material. It was considered that biochemical methods of examination into the nature of this protein offered advantages over methods involving the use of stains and microscopy. One method of separation of the inorganic matter from the organic consists of reducing whole teeth to powder, then suspending the mass in a liquid of which the relative density is midway between that of the inorganic and the organic portions. This method was not continued as it was found that the density of the organic matter in dentine was too near that of the organic matter in enamel.

I took advantage of the fact that the inorganic salts of enamel are soluble in acetic acid, while the organic part appears to be insoluble. While this means of separating organic matter from inorganic has been found convenient, it is realized that the acid may have some action on the protein. For the purposes of the present work, it has been assumed that acetic acid does not dissolve organic matter from the dentine. This assumption is supported by histological evidence.

In an attempt to elucidate the nature of enamel protein, the following method was used: sound (non-carious) human teeth were scraped clean, dipped in 20 per cent nitric acid for a few seconds to remove surface contamination, and washed in distilled water. The roots were cut off and discarded, and any remaining pulp-tissue removed. The crowns were next exposed to the action of 10 per cent acetic acid as a decalcifying agent and agitated mechanically for twelve days. In this way the greater part of the enamel was removed from the dentine and appeared in the acid as a white powder, separation being aided by shaking with glass beads. The pieces of dentine were removed, and the white powder allowed to settle for 24 hours, when the bulk of the fluid was poured off and tested for protein with picric acid and with sulpho-salicylic acid, both with negative results. The powdery mass was next shaken up with distilled water and a few drops of nitric acid added. The enamel protein was thrown out by centrifuging, then washed and centrifuged several times until the washings appeared neutral to B.D.H. universal indicator.

The application of this method resulted in the separation of the protein as a flocculent, yellowish-brown mass, with a density near that of water. Nitrogen determination gave a positive result, but the percentage figure arrived at (9·2) is of doubtful value on account of uncertainty as to the freedom from contamination of the protein. Heated on platinum foil to redness, the protein disappeared leaving only the faintest of marks. It appeared unchanged after exposure for one hour to boiling strong potassium hydroxide. With Millon's reagent the protein gave a marked red colour. Negative results were seen when the sodium nitro-prusside test for sulphur as given by Cole[9] was applied. The procedure was varied by exposing the protein to 1 per cent potassium hydroxide at 37° C. for twenty-four hours, and also by boiling it with 25 per cent potassium hydroxide for one hour. The sodium nitroprusside test gave a negative result after both these forms of treatment. As controls, fragments of human nail, sheep's wool and horse hoof were exposed to acetic acid for ten days and then tested for sulphur by the nitro-prusside method, with a positive result in each case. Other reducing agents were used in attempts to reduce any cystine present to cysteine: tin exposed to hydrochloric acid, also zinc exposed to cadmium chloride then to hydrochloric acid. Both these reducing agents were used in place of potassium cyanide, but gave negative results. It was noticed, however, that when potassium cyanide was used as a reducing agent, the protein went into solution.

It is thought that it should be possible to get the protein in a pure form by the use of potassium cyanide followed by the use of dialysis. The observation that the action of potassium cyanide is to dissolve this protein may be contrasted with the negative results observed with the nitro-prusside method. It is thought that neither the acetic acid used to decalcify the teeth, nor the presence of calcium salts from the enamel or the dentine affected the result. Preliminary examination of the protein by Mr. W. T. Astbury using X-ray spectrography has suggested that the X-ray picture differs from that given by some keratins.

The organic material appears to be a protein containing tyrosin and resembling reticulin, and further work to determine its nature is in progress.

The work was carried out with the aid of a grant from the Medical Research Council, for which grateful acknowledgement is made.

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Thermal Stratification in Lakes

EARLY in this century, Thienemann[1] and Naumann[2] described the physical conditions in deep freshwater lakes in the temperate zone. They found a yearly cycle of events which depended on the thermal stratification of the water. Their findings, and the conclusions they drew from them, can be summarized briefly, as follows. In winter and early spring, the temperature and density of the water mass is almost uniform from the surface of the lake to the bottom, so that the viscosity of the water is the only hindrance to mixing by wind. In late spring and early summer this state of affairs changes because the surface layers become warmed up by increased radiation from the sun and conduction from a warmer atmosphere, and by the inflow of warmer rivers. The result of this warming is that, in summer, a warm upper layer of less dense water, the epilimnion, comes to lie over a cold deeper water mass, the hypolimnion. The two are separated by a region of very steep vertical temperature gradient, the thermocline, with the result that mixing by wind is impossible.

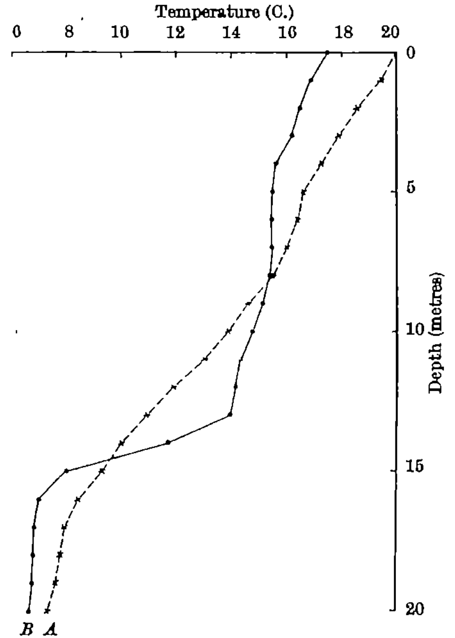

FIG. 1.

Since photosynthesis can only take place in the upper layers of the water, that is to say in the epilimnion, the available supply of salts for the planktonic algæ must be that which is dissolved in the water above the thermocline. Thus the continuous existence of the thermocline, with the consequent separation of the epilimnion from the hypolimnion, has important biological consequences, namely, the restriction of algal growth by limiting the salt supply. Thienemann and Naumann suppose that this state of separation exists continuously for the whole summer and well into the autumn, in fact throughout the period of maximal solar radiation. Consequently, the salt supply of the upper layers of water can first be renewed in late autumn, when the thermocline breaks down owing to the cooling of the epilimnion. Then free circulation is again possible, and water richer in salts from greater depths can reach the surface.

We have taken regular temperature observations in the north basin of Windermere extending over several months during the spring and summer of 1936. Our findings do not agree with those of the Continental workers, for the thermocline in Windermere, in this year at any rate, can be very unstable. It can appear and disappear in the course of a few days. Sometimes the state of affairs postulated as permanent by Thienemann and Naumann was found, but at other times there was a uniform temperature gradient from the surface to a depth of 20 metres without any trace of a thermocline. The presence or absence of a thermocline can be correlated with the weather. When it is calm there is no thermocline at all, but windy weather is always followed by the appearance of a region of sharp temperature gradient. The depth at which the thermocline appears depends on the strength of the wind; the stronger the wind the greater the depth. It can occur at any depth in Windermere from just below the surface down to 15 metres. After a thermocline has been formed during a period of active mixing by wind, it disappears again within two days if the weather becomes quiet.

In Fig. 1 the curve *A* represents the state of affairs during the period August 25–29, 1936, when the weather was uniformly fine and windless. Curve *B* obtained on August 31, 1936, at the same place, shows that a thermocline had been formed at a depth of 13–15 metres by a strong wind blowing on the intervening day, August 30.

Some of the factors which lead to the formation of the thermocline are not yet clear, and nearly all those concerned with its disappearance are still obscure. But the biologically important fact remains, that the thermocline is not a continuous feature of the summer conditions in temperate lakes. Sometimes it is not there at all, and when it appears the depth at which it occurs varies greatly. This must lead inevitably to a re-orientation of ideas about the biological productivity and the heat budgets of temperate lakes.

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The Half-Drill Strip System Agricultural Experiments

PROF. R. A. FISHER and Dr. Barbacki have recently published a paper in the *Annals of Eugenics* entitled "A Test of the Supposed Precision of Systematic Arrangements"[1]. There is a good deal in the paper with which I am not in agreement and with which I hope to deal elsewhere, but a letter from a friend of mine in Australia, who had heard at second-hand that Fisher's "results showed not only that the half-drill strip failed to give a valid estimate of error but was less accurate", shows that it would be better not to let such rumours get a start, for they are quite unfounded.

In the paper, the crop on a uniformly treated field was assigned to two imagined treatments *A* and *B* on a systematic plan in which eight strips of the width of a half-drill were assigned to *A*, and eight to *B*, in the usual arrangement of an eight comparison half-drill strip experiment. Apart from the fact that one should have at least ten comparisons—in Beaven's original paper[2] there were 26—the representation is a fair one.

The authors, for the purpose of ascertaining the degree of precision which is obtainable from the systematic arrangement in question, have taken the weights of grain, not from the total area of each of the 16 strips, but from 12 sections of each strip, and have treated these 192 sections as if they were independent half-drill strips—in fact they have called them half-drill strips—and from the 96 comparisons they have calculated a standard error to represent the precision which they suppose an advocate of systematic arrangements would attribute to the method. But, of course, the sections of a half-drill strip are not in fact independent, and in this case are markedly correlated, so that the figure which they obtain is much too small to account for the observed difference between the *A*'s and the *B*'s—and they draw conclusions adverse to the systematic arrangement and not to their own method of calculation.

The procedure adopted, of dividing up the long strips, is that which Dr. Beaven[2] originally proposed in 1922, namely, weighing the sheaves off equal segments of his half-drill strips and calculating the error from these weights; but so early as 1923, I pointed out[3] that this method would probably give a fallaciously small value, and since then it has been customary to regard the whole length of the strip as the unit in the calculation.

Had Prof. Fisher and Dr. Barbacki calculated the error on that basis[4,5], they would have found a standard error of 2·37 per cent of the average yield, while the actual difference between the *A*'s and *B*'s amounts to 1·75 per cent; that is, the difference between two things which should be the same within the error of random sampling is in fact no more than 0·75 times the standard error.

The authors' practical demonstration of the correctness of my *a priori* reasoning is, of course, very gratifying to me, but I must nevertheless insist that their paper has no bearing whatever on the error of present-day half-drill strip experiments.

"STUDENT."

---

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Genetics in the Universities

THERE are two technically distinct branches of experimental biology: physiology and genetics. The first is concerned with the processes by which life is maintained and developed, the second with the determinants of these processes which are identifiable in heredity. The distinction between the two methods of analysis is convenient, but not of course rigorous; experimental embryology attempts to connect them. Across this subdivision cuts the much older one between botany and zoology. However difficult it may be to draw the line between plants and animals, in descriptive work it is clearly necessary to draw a line somewhere. But in experimental analysis it is not merely unnecessary; it is often destructive. This is perhaps not so true in physiology as in genetics, since there is a bifurcation in the method of development of plants and animals and even in the molecular structures used in their development. But this bifurcation begins outside the cell nucleus. Within the nucleus the distinction between plants and animals in structures both molecular and super-molecular to a great extent breaks down. Nuclear division and sexual heredity are the same in principle in the fly and the flowering plant.

This view of the unity of living things in their genetical aspects is so clear and important that it has been recognized by the British Association through the appointment of a committee to co-ordinate genetics and cytology in the different sections, and it is to be hoped that the confusion of the past will be remedied in this way. But it is in teaching that failure to recognize the unity of biology leads to the most serious confusion and failure of adjustment to modern changes. The universities present a surprising spectacle of variation in their methods of teaching genetics and cytology. In a few, the processes of heredity and their underlying mechanism are described as one integrated whole; they are described together to the botany and zoology students; the syllabus is revised to bring it into line with recent research; and questions are regularly asked on the subject in examination papers. In other universities, any or all of these conditions may be omitted. In one, a student may hear four descriptions of chromosome behaviour, in morphological, genetical, physiological, agricultural or medical courses; and these descriptions may or may not be required by his syllabus or by his examiners. In another, a student may hear a morphological account of the cell which he has to relate as best he can with an entirely unco-ordinated account of heredity, if indeed he has received any account of it at all.

In our opinion, whatever the object of training in botany or zoology, such a method defeats that object. The physiologist who does not understand what part genetic differences may play in his experimental material, the taxonomist who can distinguish his species but does not know what different mechanisms of heredity perpetuate them or what sterility barriers separate them, alike seem to be in danger of wasting their time. The teacher who describes the types of organism (sometimes very numerous types) and does not show how each varies, or who explains the structure of everything and the mechanism of nothing, seems to be in danger of wasting his students' time. Above all, he is likely to deter the most intelligent students from continuing their studies in what may appear to be a purely scholastic inquiry.

Teaching how meiosis works without ever arriving at its results in crossing-over and segregation, teaching *Drosophila* genetics without mentioning how the spores of fungi show the properties inferred in the sperm of *Drosophila*: throwing away, in a word, the glorious opportunity that genetics now offers us of uniting the sciences, seems to be the consequence merely of lack of co-ordination. Departmental independence in the universities should be accompanied by departmental co-operation. Uniformity between the universities is the last thing we want, but the student surely has a right to expect internal consistency. Is it too much to hope that the Boards of Studies which all over Great Britain will soon be considering their university courses should ask themselves, first whether their syllabuses represent the fundamentals that recent research can offer to the intelligent student; secondly, whether the teaching of genetics and cytology is satisfactorily co-ordinated between the botanical and zoological sides; and thirdly, whether the questions set in examinations adequately cover the newer parts of the syllabus.

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E. J. SALISBURY, London.
W. B. TURRILL, Kew.
C. H. WADDINGTON, Cambridge.

Nov. 9.

Vernalization of Winter Rye during Ripening

VERNALIZATION of winter rye by chilling, which normally is carried out during the germination of ripe grain, has been successfully applied during ripening while the ears remained attached to the parent plant. To this end each ear was placed in a boiling tube inserted in the neck of a vacuum flask containing ice. Thus the ear was not in direct contact with the ice and a fairly even temperature of 1°–1·5° C. was maintained within the tube. The ears were selected for treatment at various times after anthesis, and, after being kept for twenty-four days at a low temperature, allowed to finish ripening normally. Ears which were selected from the middle period of ripening alone produced grain which on spring planting proved to be vernalized. The control grain came from ears kept for a similar period in vacuum flasks without ice.

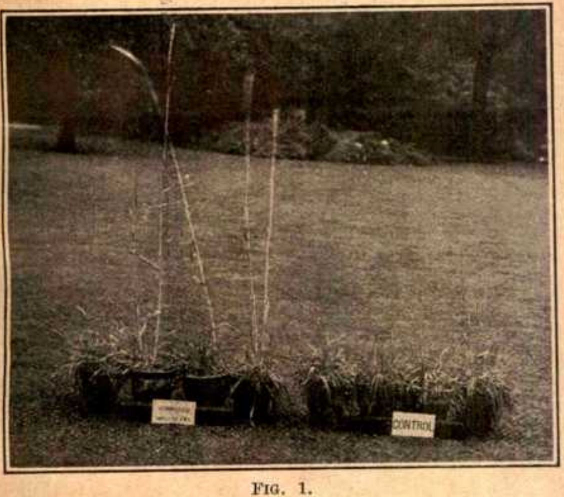

FIG. 1.

Ripening ears with stems and green leaves were also successfully vernalized after being detached from the plant. They were placed in water, and chilling carried out in a refrigerator at 1° C. for a period of six weeks. Control ears were ripened in a dark room at 17°–18° C. A photograph of plants grown from grain of chilled and unchilled ears is shown (Fig. 1).

Experiments are now in progress to find at which stage in the development of the embryo the application of cold is most effective.

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Sparking Potential of Mercury Vapour

THE sparking potential of mercury vapour between parallel electrodes previously degassed at about 750° C. has recently been measured in this laboratory throughout a large range of vapour densities, and the influence of the material of the cathode on the sparking potential has also been examined.

When the density of the vapour is expressed in terms of the corresponding pressure, p mm. of mercury, of a permanent gas at 17° C., and d is the distance in cm. between the electrodes, the sparking potential was found to be almost a linear function of the spark parameter pd from about 500 to 5,000 volts. The value of pd at the minimum sparking potential was 1, while at the highest vapour density used pd was 85 and the sparking potential was 5,000 volts.

The minimum sparking potential V_m was measured for a number of different cathode surfaces, and the values obtained are given in the accompanying table, where φ is, approximately, the work function of the cathode.

Cathode.	φ	V_m in volts.
Clean nickel	5	400
Clean 'Staybrite' steel	4·7	380
Nickel coated with a mercury film	4·4	305
Steel " " " "	4·4	305

It is seen that large changes in the value of V_m were produced by small changes in the work function of the cathode surface.

A corresponding variation of the normal cathode fall with the work function of the cathode material has previously been noted[1]. With the highest values of pd, however, the sparking potential was practically independent of the nature of the cathode surface, and this result is in accordance with the general theory of the spark discharge[2]. At these high vapour densities, also, the spark time lag was very pronounced.

The large variation of V_m with the nature of the cathode surface affords strong evidence in support of the view that the cathode plays an important part as a source of electrons under the impact of positive ions; and that in mercury vapour this mechanism is of predominating importance in the production of the spark and in the maintenance of the discharge. In this respect mercury vapour differs from a typical diatomic gas like hydrogen[3]. However, this result does not necessarily exclude the possibility of the existence of the process of ionization by positive ions in collision with the molecules of mercury vapour which in fact has been detected[4] with ions of energies of about 700 electron volts, but it would appear that this process does not predominate over the electrode effect, especially at those densities which correspond to the minimum sparking potential.

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[1] F. Köppen, *Z. Phys.*, **75**, 650 (1932).

[2] J. S. Townsend, "Electricity in Gases", Chap. ix and xi (1915); also L. B. Loeb, *Rev. Mod. Phys.*, **8**, 267 (1936).

[3] J. S. Townsend and F. Llewellyn Jones, NATURE, **130**, 397 (1932); and *Phil. Mag.*, **15**, 282 (1933).

[4] R. M. Chaudhri, *Proc. Roy. Soc.*, A, **141**, 389 (1933).

Auroral Phenomena and the Behaviour of the Ionosphere during a Total Solar Eclipse

FROM the appearance of very long auroral rays in the middle of the night, as described for the auroral display at Oslo of October 16 [see NATURE, Nov. 28, p. 930], it follows that the density of matter also during the night may decrease very slowly upwards.

This state is essentially due to the large number of free electrons present. On account of the high mobility of the electrons, the coronal structure of the upper atmosphere[1] produced on the day side will spread (diffuse) into the night region. This spreading process will counteract the night contraction and support the maintenance of 'a coronal distribution' on the night side of the earth.

In this way we may also account for the fact, shown by radio-echo measurements, that the reflecting layers maintain their conductivity and reflecting power during a total solar eclipse[2].

Thus the distribution of matter and the corresponding electrical state on the night side of the upper atmosphere which is revealed by auroral investigations enable us to understand certain essential features regarding the behaviour of the ionosphere during a total solar eclipse.

The spreading or diffusion process essentially effected by free electrons has also to be taken into account in any estimate of the rate of recombination from changes of ion concentration derived from radio-echo measurements.

L. VEGARD.

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Oct. 28.

[1] L. Vegard, "Die Korona der Erde und Sonne, etc.", *Gerlands Beiträge zur Geophys.*, **32**, 288 (1931).

[2] Cf. L. V. Berkner and H. W. Wells, "Report on Ionospheric Observations during Solar Eclipse of June 19, 1936". Presented to the Edinburgh Congress of the International Union of Geodesy and Geophysics.

Demonstration of Phosphorescence

THIS letter describes an interesting lecture experiment in connexion with phosphorescence. It provides a striking demonstration with apparatus of a simple character, and makes available a 'permanent' source of 'cold' light.

It is well known that most, if not all, materials that phosphoresce as a result of exposure to light are also fluorescent. This fact, coupled with the initial rapid decay of phosphorescence characteristic of phosphors, renders it difficult to appreciate visually the extent to which phosphorescence may be excited. Luminescent powders are commercially available which exhibit marked phosphorescence when illuminated by wave-lengths of three thousand to four thousand Ångström units, and the modern electric discharge lamp, in which a discharge passes through mercury vapour at approximately atmospheric pressure, provides a convenient source of these wave-lengths.

Phosphorescence resulting from irradiating the selected powder can be observed at a constant value, if it is continually re-excited and viewed for a short period while the radiation is discontinued. If it is observed immediately after irradiation, then the phosphorescence will have suffered little decay and will be near a maximum.

This effect can be secured very conveniently by rotating an opaque cylinder coated with phosphorescent material in front of a lamp radiating suitable wave-lengths. The side of the cylinder remote from the lamp is then a source of 'cold' light of quite high brilliancy.

The apparatus that has been constructed is illustrated in Fig. 1, and it consists of a Mercra 400 watt lamp provided with a special outer bulb functioning as a filter to pass only ultra-violet radiation between 3,000 A. and 4,000 A. Chances No. 14 is a good example of a suitable filter. The cylinder may be rotated at various speeds and may have a surface brightness of 10 equivalent foot-candles, and a total luminous output equivalent to that of a 1–1/2 watt tungsten filament lamp. In this connexion it is of interest to note that a road surface with a brightness of 0·5 equivalent foot-candles is considered to be illuminated to a fairly high standard, and one once again realizes the attractiveness of the (at present) impracticable suggestion to employ phosphorescent materials, excited during the daytime, on our road surfaces or surroundings.

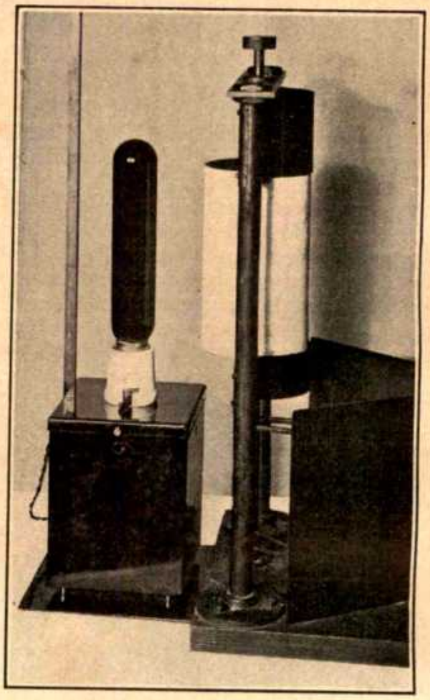

FIG. 1.

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Diamagnetism of Mixtures of Organic Liquids

CERTAIN measurements of the magnetic susceptibility of binary mixtures of organic liquids made by us[1], which are at variance with the determinations of several investigators and which we have agreed are in error for reasons stated[2], are still being quoted in text-books and the literature.

We have now completed the remeasurement of the susceptibility of the binary mixtures under discussion, namely, acetone-chloroform, acetone-trichloroethylene, chloroform-ether, by the Gouy method[3] and find that the deviations of these mixtures from the mixture law do not exceed 2–3 per cent except in the case of acetone-chloroform, where a maximum deviation of about 4 per cent is obtained: results which are substantially in agreement with those of our critics.

Since our new apparatus came into use, full details have been published for the mixtures of acetone and trichloroethylene[4]. Details of other binary mixtures of organic liquids are to be found in the same paper and in a further paper[5]. The general conclusions to be drawn from the values obtained for about fifteen series of binary organic mixtures of substances of varying chemical type are that, in common with other physical properties, (i) the magnetic susceptibility exhibits slight deviations from the mixture law for most binary mixtures of organic substances; (ii) where the constitution and molecular weight of the constituents of the mixtures are similar the deviations are very small, rarely exceeding 0·5 per cent; and (iii) where there is considerable difference in chemical constitution or mass the deviations are slightly larger, about 1–4 per cent. When, however, molecular susceptibilities are compared, the deviations are much smaller, rarely exceeding 0·1 per cent, and thus come into line with the deviations of other physical properties from the mixture law.

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Oct. 31.

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[1] *Proc. Roy. Soc.*, A, 131, 209 (1931).
[2] NATURE, (Jan 16, 1932).
[3] Trew and Watkins, *Trans. Far. Soc*, 30, 1310 (1933).
[4] Trew and Watkins, *loc. cit.*
[5] Trew and Spencer, *Trans. Far. Soc*, 32, 701 (1936).

Centrifuging in Rotating Hollow Cylinders

PROBLEMS in particle size analysis in disperse systems may be divided in general into two classes, namely, those involving the determination of the size or molecular weight of particles comprising the disperse phase of a monodisperse system, and those involving the determination of the particle size distribution function for the disperse phase of a polydisperse system.

Dr. M Schlesinger has described[1] a most ingenious method for determining the molecular weight of units of the disperse phase in presumably monodisperse systems. The method employs the Sharples super-centrifuge run with a 'closed bowl'. Using the Sharples super-centrifuge with a continuous flow or separator bowl, we have been able to obtain sufficient data for the calculation of the particle size distribution curve in such polydisperse systems as colloidal clays, all particles of which have equivalent spherical diameters substantially below 500 mμ.

Our method, which was presented before the thirteenth Annual Colloid Symposium in St. Louis, on June 11, 1936, involves feeding at a constant rate a suspension of known concentration and temperature into the centrifuge bowl, which rotates at constant speed. As the suspension flows through the bowl, there is a partial sedimentation of the particles of the disperse phase on to a removable celluloid liner flush with the walls of the bowl. After a suitable amount of suspension has flowed through the bowl, the operation is discontinued and the liner containing the sediment withdrawn. At definite distances along the liner, the sediment is quantitatively removed and weighed. From this data the particle size distribution curve may be calculated. As it is unnecessary to settle out the disperse phase completely, the effluent liquid, while reduced in concentration in disperse phase, may still contain some disperse phase, depending on the rate at which the suspension is fed into the bowl during the run.

This method, which will be published in detail in the volume reporting papers at the 1936 Colloid Symposium, as well as in a forthcoming issue of the *Journal of Physical Chemistry*, is particularly useful when it is desired to make a particle size fractionation of some polydisperse system; for example, when it is contemplated studying the influence of the particle size variable upon other properties of the colloidal sol. We have developed it in particular for use in determining the influence of particle size on thixotropy and rheopexy of suspensions of the colloidal clay bentonite.

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Oct. 20.

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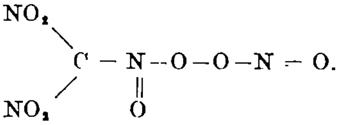
[1] NATURE, 137, 549 (Sept 26, 1936).

Constitution of Tetranitromethane

IN a "Research Item" in NATURE of November 7, p. 807, attention is directed to the question of the constitution of tetranitromethane. Instead of the usual symmetrical formula, it is suggested that the substance is to be represented by the expression:



$$(\mathrm{NO_2})_2\mathrm{C}-\underset{\underset{\textstyle\mathrm{O}}{\|}}{\mathrm{N}}-\mathrm{O}-\mathrm{O}-\mathrm{N}=\mathrm{O}.$$

The arguments[1] have been reproduced so recently in NATURE that it is unnecessary to repeat them, but they appear to be fallacious for the following reasons: It is said that the symmetrical formula does not explain the oxidizing properties of the substance, but this statement fails to take into account the strong inductive effect of the nitroxyl groups. The molecule as a whole must be powerfully cationoid and electron-accepting, as indeed is shown by the colorations produced when tetranitromethane is dissolved in anionoid solvents without decomposition. But furthermore, the $C(NO_2)_3$ group must be that substituted methyl group with the greatest general electrical effect (electron-attracting) and it will excel in this respect even the groups CF_3 and CCl_3. It is therefore not at all surprising that the compound $C(NO_2)_3.NO_2$ simulates peroxidic character and is very readily reduced.

A perfectly analogous case is that of carbon tetraiodide, which is very readily reduced to iodoform, and in this case a special constitution would be difficult to devise. Again, it is said that one of the nitro groups of tetranitromethane is markedly different from the others in its reactions, but it should be remembered that when this first nitro group has been removed, the substance is no longer tetranitromethane. It has acquired the hydrogen atom necessary for transition into the *iso*nitro form. The final and conclusive argument in favour of the formula $C(NO_2)_4$ and against the proposed revision is provided by the fact that tetranitromethane has a very small dipole moment[2].

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[1] C. Krauz and J. N. Štěpánek, *Chem. Obzor.*, 11, 153 and 177 (1936).

[2] J. W. Williams, *Phys. Z.*, 29, 204 (1928); E. Bretscher, *Helv. phys. Acta*, 1, 355 (1928); A. Weissberger and R. Sangewald, *Ber.*, 65, 701 (1932).

Nicotine Inhibition of Oxidation and Fermentation

IN a recent letter to NATURE[1], I have reported some observations on the more powerful inhibition of various oxidations in micro-organisms by *dl*-nicotine as compared with the *l*-form. Such results are regularly obtained when *dl*-nicotine prepared according to the method of Pictet and Rotschy is used; this preparation is relatively more efficient than the natural form. But optically pure *d*-nicotine later prepared by us lacked these properties. It was therefore concluded that some active principle always present in the racemic preparation is responsible for the observed effect. This principle has been isolated and identified as hydronicotine. Further, when we hydrogenized nicotine in two different ways and tested these preparations, we actually observed much stronger inhibition of oxidation in micro-organisms, as compared with nicotine, but no specific effect on fermentation processes. It is therefore concluded that hydronicotine and not the *d*-form is responsible for the biological effects described in my previous communication. Investigations along this line are in progress.

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University, Moscow.
Oct. 28.

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[1] NATURE, 138, 245 (1936).

Points from Foregoing Letters

To explain the mechanism of certain thermal reactions in gaseous organic compounds, Prof. M. W. Travers assumes a series of transformations: molecules → activated state → complex → unstable intermediates → paired products, and states that the rate of reaction usually measured is determined by the transformation complex → unstable intermediates. He discusses the thermal decomposition of ethane and of ethane-ethylene-hydrogen equilibrium mixtures, and refers to the thermal decomposition of acetaldehyde, methyl nitrite and methylamine.

From the interchangeability of lactic dehydrogenase from heart muscle with alcohol dehydrogenase from yeast, in reactions involving reduction of pyruvic to lactic acid and of acetaldehyde to alcohol *in the presence of co-zymase*, E. Adler, Prof. H. v. Euler and H. Hellstrom conclude that co-zymase is the active co-enzyme for both those specific oxidation-reduction agents.

From an examination of the cast of the Taungs ape in the British Museum (Natural History) and of the photographs of the skull and diagrams of the teeth of the Sterckfontein ape recently described by Dr. R. Broom, Dr. E. Schwarz concludes that the animals to which they belonged were not in the direct ancestral line of man but were more nearly related to the gorilla.

Preliminary results of an investigation into the nature of the protein by Dr. Geo. Pincus in the enamel of teeth indicate that it contains no sulphur, though it has hitherto been believed to be a keratin. Its X-ray picture also differs from that of some keratins, and it appears to contain tyrosin.

Graphs showing temperature gradients in the north basin of Windermere during calm and in windy weather, in spring and summer, are submitted by P. Ullyott and P. Holmes. Unlike the conditions described by other investigators for lakes in the temperate zone, the authors find no *permanent* region of sharp temperature change (thermocline) separating an upper warm layer from a lower cool one; they find the thermocline only during windy weather, and then it may occur at any depth down to 15 metres.

Following an inquiry into the split-drill method of testing cereal varieties applied to data obtained by Wiebe on the yields of wheat, Barbacki and Fisher concluded that "the arrangements randomizing either pairs or sandwiches of half-drill strips give smaller errors than the systematic arrangement" advocated by "Student". Commenting upon this, "Student" considers the criticism unwarranted and states that although Barbacki and Fisher's arrangement is a fair example of half-drill experiment, their method of calculating the error was one which he had expressly rejected in 1923.

A group of leading workers in experimental biology discusses the teaching of genetics in the universities, and advocates greater co-ordination of genetics and cytology on the botanical and zoological sides than at present exists.

Prof. F. G. Gregory and O. N. Purvis report that they have successfully 'vernalized' winter rye by keeping the ears of the rye at a low temperature (1°–1·5° C.) for twenty-four days during the ripening of the parent plants.

The sparking potential of mercury vapour is found by Dr. F. Llewellyn Jones and W. R. Galloway to be almost directly proportional to the 'spark parameter' (pressure × distance), over a wide range of vapour densities. The authors give the minimum sparking potential at different cathode surfaces (nickel and steel, clean and mercury coated) and discuss the process of formation of ions.

A simple apparatus for the demonstration of phosphorescence is described by H. Warren. It consists of a rotating cylinder coated with the phosphorescent substance and exposed on one side to exciting radiation.

As a correction to some of their previous findings, Prof. J. F. Spencer and Dr. V. C. G. Trew state that they have redetermined the magnetic susceptibilities of mixtures of acetone-chloroform, acetone-trichloroethylene, and chloroform ether and find that the maximum deviations from the mixture law is about 4 per cent.

Research Items

Origins of Speech and the Orang-Utan

DR. CORNELIUS J. CONNOLLY, professor of physical anthropology in the Catholic University of America, as the result of a study of the brains of fifty species of primates from the lemur to man in the primate brain collection of the Smithsonian Institution, Washington, D.C., claims to have found in the cerebral cortex of the orang-utan the first rudiments of the brain structures of speech (*J. Physical Anthrop.*, Oct. 1936). It is believed by neurologists that the associative process, which with the power of making articulate sounds constitutes the essential element in human speech, is centred in that part of the cerebral cortex known as Broca's area, found in both frontal lobes of the brain, and set off from the rest of the brain by well-marked depressions, the inferior frontal sulci. This area is now found to appear first among the primates in the orang. Absent in the gibbon, it is more emphatically marked in chimpanzee and gorilla. The sulcus subdividing the inferior frontal region, on the other hand, is exclusively and constantly human, never appearing in the anthropoids; but there is evidence of it in *Pithecanthropus* and Neanderthal man. It is possible that the exclusively human *V*-shaped area of the cortex enclosed by this sulcus may be that in which the association between sound and objects, making symbolism possible, takes place. So far as surface pattern of the cortex is concerned, the orang and two higher apes appear to have stopped on the threshold of speech. A second point emerges from the study of thirty-five orang brains of both sexes and various ages. This shows that while the principal sulci are present in all from birth and are standardized, there is greater variability in the pattern of the secondary channels in the orang than there is in either of the other great apes. As the sulci divide functional areas of the cortex, it would seem that the brain of the orang is possibly capable of further development.

Roding of the Woodcock

THE habit of the woodcock of flying over definite tracks at dusk and in the morning during the breeding season has been investigated by T. Warwick and V. D. van Someren (*Scot. Nat.*, 1936, p. 165). A particular pair of birds developed four roding circuits, varying in length from one to three miles and used with different frequencies. The flights, which took place irrespective of the kind of weather, lasted for almost an hour beginning about 9 p.m. and might include so many as thirteen circuits. Both birds occasionally flew together, but most often the male was unaccompanied. The rate of flight was approximately twenty miles an hour, and it was noticeable that as darkness fell the length of time taken to complete a particular circuit increased. The purpose of the roding habit is obscure: each circuit followed a line on which one or more marshy feeding places occurred, and when another woodcock was encountered the roding flight was interrupted while the interloper was driven off. The authors accordingly regard roding, since the woodcock is not a song-bird, as having an aggressive basis and as delimiting the territory by regular patrolling. It is unfortunate that the position of the nest relative to the system of roding flights was not definitely determined.

Resistance of Fish to Supercooling

EXPERIMENTS on the effect of low temperatures on live fish have so far shown that death follows cooling to about − 1° C. It was not clear whether death was due to the conversion of body fluids into a solid state, or whether the low temperature by itself had a fatal effect on living cells. To decide this question, P. J. Schmidt and his collaborators have investigated the result of keeping fish in supercooled water (*C.R. Acad. Sci., U.S.S.R.*, 3, No. 6; 1936). The authors succeeded in supercooling the body fluids, for a prolonged period, to a temperature more than 2° below their normal freezing point. The experiments proved that fish can stand supercooling even to − 3·06° C. if no crystallization of the surrounding water or of the body fluid occurs. This suggests that fish perish mainly from the effects of ice forming within the body, and not from the effects of low temperature. Such powers of resistance to supercooling should be of biological significance for fishes, since cases of supercooling of water occur in natural conditions. The phenomenon can be interpreted as a true anabiosis, if the latter is defined as a depression of life by the elimination of water from living matter, so that a complete cessation of life-processes results.

Standard Errors of Mendelian Ratios

TABLES of standard errors of Mendelian ratios have been worked out by Messrs. S. S. Purewal and P. K. Rao (Misc. Bull. No. 11, Imperial Council of Agric. Research, 1936. Delhi: Manager of Publications; London: High Commissioner for India. 12 annas or 1*s.* 3*d.*) The standard errors expressed in numbers of individuals have been prepared for the ratios 1 : 1, 3 : 1, 9 : 7, 15 : 1, 13 : 3, 27 : 37 and 63 : 1, and standard errors expressed in percentages for the 1 : 1 ratio. The tables give the standard errors for values of *n* from 5 to 1,000 and can be used for numbers up to 100,000. A deviation greater than twice the standard error is considered significant. These tables should be useful for geneticists and plant breeders.

The Temperature Scale

WHILE the final standard scale of temperature is Kelvin's thermodynamic scale, independent of the properties of any particular substance, it is on the properties of gases that we have to depend for the practical realization of the scale in certain low and certain high temperature ranges. An examination of the properties of hydrogen, nitrogen and carbonic acid then available led Daniel Berthelot in 1907 to conclude that the coefficients of expansion and of pressure of a perfect gas and of actual gases at very small densities were 0·0036618, from which it follows that the temperature of freezing water on the Kelvin scale is 273·09° K. Much accurate work on helium and the above gases has been done in the last thirty years, and from a consideration of it Prof. Keesom and Dr. W. Tuyn, in a communication from the Kamerlingh Laboratory of Leyden (Supplement No. 78), come to the conclusion that a more accurate value of the coefficient is 0·0036611, from which it follows that the freezing point of water is 273·14° K.

Velocity of Radio Waves

MOST of the measurements being made at the present time on the ionosphere are based on the assumption that radio waves travel with the velocity of light. The paper by R. C. Colwell, N. L. Hall and L. R. Hill, which appears in the *Journal of the Franklin Institute* of November, on the experimental determination of the velocity of radio waves, is therefore a timely one. The experiments were made between West Virginia University and Fairmont State College, which are 20 kilometres apart. A continuous train of very short radio pulses from the sending station travel to a receiving station, where their phase is adjusted so that a pulse starts back the instant it is received. Synchronization between the transmitting and sending station is automatically obtained, as they are both supplied from the same 60-cycle power network. The observations so far obtained indicate that the velocity of the ground waves varies between one half and two thirds the velocity of light. The experiments give no indication of the velocity of sky waves. To obtain measurements of these, it would have been necessary to have a second radio station on a stratosphere balloon. It is concluded that the velocity with which radio waves travel along the ground is considerably less than that of light. This reduction in the velocity is attributed to the influence of the conductivity and dielectric constant of the earth and to the ionization of a certain layer of the atmosphere. The authors also conclude that the velocity of ground waves is not constant, and that the strength of ground waves varies during periods of atmospheric disturbance. On one occasion, the received signal was four times normal strength, and during this period the measured velocity was a minimum.

'Lumophor' Glass for Tubes containing Luminous Gases

RECENT researches on 'lumophor' glass, that is, glass for use in making the tubes containing luminous gases, has led to the discovery of much more effective materials for making these tubes. A brochure recently published by Glaswerk Gust. Fischer, Ilmenau, Thuringia, gives many technical calculations and measurements on the efficiency of various types of lumophor glasses. An abstract of it is given in the November number of *Helios*, the electrical export trade journal published in Leipzig. It is found that the brightness of the tube increases very appreciably with the current taken by it, but the luminosity in lumens per watt shows its maximum value with a small tube current. The characteristics shown by the various types of lumophor glasses are all of a similar nature. Interesting data are given on the influence of external temperatures from − 60° to + 220° C. on the light intensity. It is known that luminous tubes for blue light burn differently according to the external temperature even when filled with a mixture of rarefied gases having high resistance powers against cold. This dependence is more pronounced when lumophor glasses are used. In this case, the luminous colour results from the radiation from the mercury vapour and the radiation of the luminescence of the glass walls. The experiments made with a photo-cell and the measurements show that the light intensity throughout the medium temperature range, which coincides with the surface temperature range, has the maximum value. At temperatures exceeding 220° C., No. 1 lumophor glass loses its pure white colour and assumes a greyish-white tint. At 0° C. the colour becomes duller as the pressure of the mercury vapour decreases. The light blue tube No. 2 shows a violet colour at − 40° and above 135° becomes a greyish-white. Owing to 'fatigue' of the glass, the light emitted falls 30 per cent in the first two hours and then remains constant, even after the lapse of 3,400 hours. Switching the tubes off invariably leads, on relighting, to an increase in luminescence.

A Co-ordinated Cuprous Complex

IN the most stable derivatives of cuprous copper, the co-ordination number appears to be 4, for example, in $K_3[Cu(CN)_4]$. It is found (F. G. Mann, D. Purdie and A. F. Wells, *J. Chem. Soc.*, 1503 ; 1936) that cuprous and silver iodides form compounds with tertiary phosphines and arsines analogous to the well-known non-ionic aurous chloride derivatives $[R_3P(As) \rightarrow AuCl]$. The cuprous compound would be expected (for 4-co-ordinate copper) to be $[(PR_3)_3CuI]$, analogous with $K_3[CuI_4]$. In this compound the copper is joined by three co-ordinate and one covalent link, giving the 7 electrons which the copper requires to attain the electronic structure of krypton. This suggests that the 2-co-ordination compound, $[R_3P \rightarrow CuI]$, should be very unstable, whilst actually many members of the phosphine and arsine series are very stable. X-ray analysis of the arsine compound shows that the true molecule actually consists of four simple units, $[Et_3As \rightarrow CuI]_4$. In this molecule, the four cuprous atoms are arranged at the apices of a regular tetrahedron: the four iodine atoms lie each at the centre, but above the plane of, one face of the tetrahedron. Beyond each cuprous atom is an arsenic atom lying on the elongation of the axis joining the centre of the tetrahedron to the copper: the three ethyl groups are then joined to each arsenic atom so that the tetrahedral angle is subtended both at the arsenic and at the first carbon atom of the ethyl groups. The stability is conferred by each iodine atom, in addition to being covalently linked to its original copper atom, also becoming joined by co-ordinate links to the other two copper atoms of the same tetrahedral face. Each copper atom acquires 7 electrons and is identical, in both co-ordination number and electronic structure, with that in $K_3[Cu(CN)_4]$. Interesting derivatives with αα'-dipyridyl were also prepared.

Orionid Meteors

MOHD A. R. KHAN, of the Osmania University, Hyderabad, Deccan, observed the Orionids from October 18 until 21, a total of 124 being recorded in the four nights. He has deduced a radiant at 93·7° + 14° by combining the observations over the period. It would have been better, if possible, to have used the results for each night separately, as the radiant moves eastward from night to night. Mr. J. P. M. Prentice discusses this matter in *Memoirs of the British Astronomical Association* (Report of the Meteor Section), May 1936. He concludes, after careful study of this shower, that the radiation comes from three sharply defined centres situated at close intervals in declination + 15°, and that these three centres move approximately 1·3° (small circle) each day.

Anniversary Meeting of the Royal Society

SIR WILLIAM BRAGG delivered his presidential address to the Royal Society on November 30, opening with the customary record of the losses by death of the Society during the past year. These have been unusually heavy, for they have included the Society's patron, H.M. King George V, two foreign members and no less than twenty-one fellows. Reference was made to recent gifts for research to the Universities of Oxford and Cambridge, and to the fact that the Society has undertaken a principal share in the administration of £200,000 bequeathed by the late Mr. H. B. Gordon Warren, the interest of which is to be applied to the encouragement of research in metallurgy, engineering, physics and chemistry. The capital value of the funds administered by the Society, including the Warren bequest and also the bequest of about £40,000 by the late Sir Joseph Petavel, is now approximately a million sterling. Surveying some developments of the past few years in the light of the research which has made them possible, Sir William said: "From this point of view the suggestion sometimes made that scientific workers might take a holiday looks more ridiculous than ever. No nation could afford such an intellectual disarmament in the face of the world; nor could the world itself in face of the evils that are to be overcome." There is the danger, however, that research funds may inadvertently lead a man into a blind alley so far as useful occupation is concerned; it should be the business of bodies administering such trusts to see that the highly qualified men they utilize are not wasted when their active research has ended. The address concluded with a discussion of recent developments in the field of the X-ray analysis of crystalline structure (see p. 953).

Sir William Bragg then presented the medals for 1936; extracts from his remarks are printed below.

PRESENTATION OF MEDALS

Copley Medal: Sir Arthur Evans, F.R.S.

Sir Arthur Evans is awarded the Copley Medal. He is the leading British authority in classical archæological studies: from his father he inherited a predilection for numismatics, a subject to which, in his earlier years, he made contributions of outstanding importance. His researches in Crete from 1893 onwards resulted in the discovery of the remains of a civilization which he named Minoan after the sea-king, Minos. He traced the development of the Minoan civilization from approximately 3200 to 1400 B.C., from the late Neolithic through the Bronze Age. His Cretan work, published in six volumes, "The Palace of Minos", has revolutionized our knowledge of the ancient history of the Near East.

Rumford Medal: Prof. E. G. Coker, F.R.S.

The Rumford Medal is awarded to Prof. Ernest George Coker, who has devoted a lifetime to the investigation of stresses in solids by means of polarized light. The original effect was discovered by Brewster in 1815, and Brewster himself suggested that the effect might be used for the direct exploration of stress. But although many physicists since Brewster's time investigated the effect, no one, until Coker came, developed a practical method enabling stresses in a model to be actually traced. Coker not only applied to such researches a material, celluloid, not hitherto employed, and capable of being cut to any shape, but he was also the first to devise a reliable instrument (the lateral extensometer) for measuring at any point the sum of the principal stresses, which is not directly given by the optical results. In many other ways, he made very important improvements in methods of observation, and he has, in fact, created a new technique and given the engineer a new instrument of discovery. His work is only now beginning to be recognized and taken up by the engineer.

Coker's first paper on this subject dates from 1910; since then he has published, either alone or with pupils and colleagues, some fifty or sixty papers, in which he has applied the method to almost every important engineering problem which can be approximated to on two-dimensional lines. In the course of his work, not only has he cleared up a vast number of problems and difficulties, but he has also rendered a great service to applied mathematics, by demonstrating to the engineer the substantial accuracy of the results of the mathematical theory of elasticity.

Coker's work fulfils admirably the condition laid down for the Rumford Medal which says that the discoveries for which it is awarded should be such as "tend most to promote the good of mankind". The results obtained by photo-elasticity in such subjects as the stability of dams and the strength of aeroplane frameworks will certainly be the means of saving many lives. Moreover, Coker has created a world-wide school: to his inspiration is largely due the modern development of photo-elastic laboratories in Japan, the United States, Belgium, Switzerland and Russia.

A Royal Medal: Prof. R. H. Fowler, O.B.E., F.R.S.

A Royal Medal is awarded to Prof. Ralph Howard Fowler. His general theory of statistical mechanics, his later applications of it to the equilibrium of mixed crystals and to a theory of semi-conductors, are of outstanding importance. His paper on dense stellar matter contains the first working out of the properties of a degenerate electron gas, and those on the internal conversion of γ-rays and on thermionic emission and stray field emission of electrons from metals were fundamental. His work on the theory of the photo-electric effect, especially as a function of temperature, led to a rational means of analysing emission frequency curves, which enables one to determine the true threshold frequencies. His work on the quantum theory of energy exchange between gases and solids broke new ground. Further, he has made notable contributions to the theory of the photo-electric current in semi-conductors, and has made notable contributions in recent years by his adaptation of wave mechanics, as it has been developed, to the solution of problems actually under investigation by groups of experimentalists working in close association with him.

A Royal Medal: Prof. E. S. Goodrich, F.R.S.

A Royal Medal is awarded to Prof. Edwin Stephen Goodrich. He is distinguished for his long series of researches on the comparative anatomy, embryology and palæontology of invertebrates and vertebrates, which have thrown light on some of the most fundamental problems of animal morphology. His work on the excretory organs of annelids and of *Amphioxus* resulted in a new conception of the nephridia and their relation to the cœlom and cœlomoducts. His memoirs on scales of fishes and on the median and paired fins threw fresh light on the classification and phylogeny of fishes and on the evolution of the vertebrate skeleton. His contributions to our knowledge of the segmentation of the vertebrate head are recognized as of the first importance. His volume on cyclostomes and fishes in Ray Lankester's "Treatise on Zoology" and his more recent book, "Studies on the Structure and Development of Vertebrates", are masterly and original contributions to the subject of comparative anatomy. In the opinion of many he is the outstanding morphologist of our time.

Davy Medal: Prof. W. A. Bone, F.R.S.

The Davy Medal is awarded to Prof. William Arthur Bone, who has had a wide and varied experience in the main branches of chemical science. His early work on the alkyl substituted succinic acids and allied substances, which furnished a valuable chapter in synthetic organic chemistry, was speedily followed by more fundamental researches on the thermal decomposition of hydrocarbons and their oxidation products and by quantitative studies of hydrocarbon combustion. The evidence collected during these prolonged and systematic investigations, devised to include a great variety of experimental conditions of slow combustion and detonation, was overwhelmingly in favour of the hydroxylation theory of the combustion of hydrocarbons. His study of the direct union of carbon and hydrogen led to a synthesis of methane from its elements.

The closely related problem of flame movements in mixtures of burning or exploding gas has been submitted by him to exhaustive examination with improved methods, which made it possible to observe for the first time some striking characteristics of this phenomenon.

On the subject of catalysis, Prof. Bone's contributions are of especial interest and importance. Thus he has recently demonstrated by a variety of convincing experiments that carbonic oxide and oxygen will unite in the gaseous phase in the absence of moisture.

In collaboration with many colleagues and students, Bone has investigated the difficult problem of the chemistry of coal and has applied new physical and chemical methods of identifying the constituents of this complex material. The benzenoid constitution of coals of widely different geological ages and maturity was demonstrated by oxidation experiments which furnished a complete series of the polycarboxylic acids of benzene. In this field of chemical research, Bone will always be regarded as a pioneer.

Darwin Medal: Dr. E. J. Allen, F.R.S.

The Darwin Medal is awarded to Dr. Edgar James Allen, who for the past forty-two years has been director of the Laboratory of the Marine Biological Association at Plymouth.

Allen has made many notable additions to our knowledge of marine biology, dealing with such diverse subjects as the nervous system of the lobster, faunistic studies of estuarine and other areas, systematic work on the Polychæta, the genetics of *Gammarus*, and contributions to fishery science. He initiated exact work on the association of bottom faunas with the nature of the deposits and has published valuable papers on the artificial culture of phytoplankton, in which he was one of the earliest to obtain successful results. Many years ago he followed the chain of events leading from sunshine and inorganic constituents of sea-water, through phytoplankton and zooplankton to food fishes, making some of the first contributions to a subject which has since shown striking developments.

When the international fishery investigations began, Allen undertook the English share of the work, which was then based on laboratories at Plymouth and Lowestoft: after the Great War the Lowestoft laboratory branched off and became the Government centre for economic fisheries investigations. He has been closely associated with the International Council for the Exploration of the Sea from its earliest beginnings. The organization of the work on water pollution, carried out by the River Tees Survey Committee, owes much to his initiative, and he is a member of the Committee dealing with similar problems in the River Mersey.

Much of Allen's work has been directed to the study of evolution The Hooker lecture, which he delivered to the Linnean Society in 1929, deals with the origin of adaptations, and his presidential address to Section D (Zoology) of the British Association in 1922 is again concerned with the evolution of life in the sea.

Throughout his long term of office at Plymouth, Allen has been the inspiration of the workers at the Laboratory, and the success of his labours is shown by the high quality of the research which has been carried out under his direction.

Hughes Medal: Dr. W. Schottky

The Hughes Medal is awarded to Dr. Walter Schottky of the Central Laboratory of Siemens and Halske, Berlin. He is best known by his contributions to the fundamental theory of thermionic emission. One of his investigations led in 1914 to the formulation of a theory of the effect of an electric field at the surface of a hot conductor upon the emission of electrons; another led to the discovery of the "Schrot" effect, which attributes certain variations in a thermionic discharge to random emission of individual electrons. He also discovered the so-called 'temperature effect' in ordinary conductors of electricity, which he traced to the thermal agitation of the molecules. Further, he made valuable contributions to the theory of space charge in vacuum tubes in the early days of the subject.

Apart from these mathematical contributions to our knowledge of principles, Schottky has added very greatly to engineering progress in wireless telegraphy. In particular, he invented the screening grid valve which has everywhere superseded the triode valve in the high-frequency amplifiers employed in receiving broadcast signals. He is also the inventor of the method of super-heterodyne reception wherein the currents of intermediate frequency are amplified. These are two of the most important wireless inventions of the past twenty years.

The Indian Institute of Science

QUINQUENNIAL REVIEWING COMMITTEE

THE report of the second quinquennial reviewing committee of the Indian Institute of Science, Bangalore, presented to the secretary of the Government of India toward the end of March last, has now been published (Bangalore : Mysore Residency Press). The committee was appointed by H.E. the Viceroy of India two months earlier, and its members were : Sir James Irvine, principal and vice-chancellor, University of St. Andrews (chairman) ; the late Dr. A. H. Mackenzie, pro-vice-chancellor, Osmania University, Hyderabad ; and Dr. S. S. Bhatnagar, professor of chemistry in the Punjab University, with Mr. F. F. C. Edmonds, inspector of schools, Coorg and Bangalore (secretary).

The terms of reference to the Committee were :

"To review the working of the Institute with special reference to the purposes for which it was founded and, if any changes are considered desirable in the organization or activities of the Institute for the better achievement of these purposes, to make recommendations accordingly, but with due regard to the Institute's actual or reasonably augmentable financial resources."

The subjoined extracts are from the report of the Committee :

We have felt compelled to consider the whole question of the aims and objects of the Institute as, during a period of unusually rapid change, it is more than ever necessary to secure that the policy pursued is consistent with the wishes of the Founder and of the contributing bodies. We may at once express the view that, as a first consideration, the province and purpose of the Institute must be defined in more precise terms than at present, and that such a definition should be adopted officially both by the Council of the Institute and by the Government of India. Only in this way can the aims and objects of the Institute be placed beyond individual and fluctuating interpretations ; in the absence of such definition, no continuous policy can be developed.

It may be admitted that the purposes for which the Institute was created have never been clearly defined, but this is in no sense a reflection on those who founded it or who have since administered its affairs. The Founder, the late Mr. J. N. Tata, was a public-spirited and enlightened benefactor who initially envisaged a scheme for creating an Imperial Teaching University the activities of which were to be focused in three main departments, viz., a Scientific and Technical Department, a Medical Department, and a Philosophical and Educational Department. Even with the generous support offered by Mr. Tata, so comprehensive a project was beyond realization, and the idea eventually took shape that the new foundation should be a Research Institute rather than a University.

Later the Government of India, with the concurrence of the heirs and executors of Mr. J. N. Tata, defined the Scheme for the Administration of the Institute as follows :

"The object of the Institute shall be to establish Chairs and Lectureships in Science and Arts especially with a view to the promotion of original investigations in all branches of knowledge and their utilization for the benefit of India, and to provide and to assist in the provision of suitable libraries, laboratories, and all necessary appliances."

No doubt with the laudable intention of securing a measure of elasticity and reasonable freedom to meet changing conditions, the above statement of purposes was drawn up in general terms, but nevertheless the intention is clearly revealed. According to the scheme as approved, the main objective of the Institute is to promote original scientific investigations and to facilitate the utilization of knowledge "for the benefit of India". Professorships and lectureships, offices traditionally associated with University teaching, are certainly envisaged, but in this case these offices are provided for a specific purpose, viz., the equipping of students for research.

In our opinion, the phrase "the benefit of India" strikes the keynote of the policy to be followed by the Institute. Admittedly there are many ways in which a research institution may operate for the benefit of a country and it is owing to the varying interpretations placed on this critical phrase that differences of opinion have since arisen. It may be argued with good reason that the prosecution in India of research of high merit is a benefit to the country through the prestige it confers ; similarly the provision of a steady succession of young men whose minds have been developed through the discipline of research in pure science is another result which comes within the compass of the phrase "the benefit of India". But, whilst in full agreement with such arguments, we believe that the initial conception of the founder was that the activities of the Institute should be devoted primarily to securing for India the material benefits expected to follow from the close association of scientific research with the industries of the country.

We are fully alive to the advantages and the cultural and material benefits which accrue from fundamental scientific work ; equally we recognize that there is no conflict between pure and applied research which can be, and ought to be, prosecuted side by side to their mutual advantage. We are chiefly concerned with the problem as to which of these complementary activities should carry the greater emphasis, and we hold strongly the opinion that, in accordance with the wishes of the Founder, this emphasis should be laid on the applications of scientific research to industry. Accordingly, our first recommendation is that Clause 3 in the Regulations be amended to read as follows :

"The object of the Institute shall be to establish Chairs in Science and Arts for the purpose of providing advanced instruction and conducting original investigations in all branches of knowledge and particularly in such branches of knowledge as are likely to promote the material and industrial welfare of India ; to provide suitable libraries, laboratories, and equipment ; and to co-operate as far as possible with such recognized institutions as exist or are founded in future for cognate objects in India."

The adoption of the above regulation will remove ambiguity as to the purposes of the Institute, will enable a continuous policy to be followed, and will inspire confidence in the bodies which assist its finances. As will appear later in this Report, we do not recommend the curtailment of fundamental scientific research or the abolition of teaching; but in terms of the regulation now proposed, teaching (except in the case of electrical technology which stands in a special position) should be confined to preparing workers as investigators, and, while research in pure science should continue to be an approved purpose, the major part of the resources of the Institute should be applied to those investigations which are likely to be of direct benefit to industry in India.

The evidence before us shows that in some quarters it is tacitly assumed that the Institute should be capable of searching for and selecting industrial problems, of solving these problems in the laboratory, and finally of applying the results on a technical scale. Such an attitude of mind is by no means confined to India, and so long as it is maintained, the Institute will remain the target of uninformed criticism. It must be remembered that, judged by the standards of modern research organizations in Europe and America, the Institute is small and has to work within a comparatively narrow income. But even the largest and best endowed research organizations can provide only a limited service to industry, in the sense that while they may succeed in winning the new knowledge necessary to solve an industrial problem, they are rarely capable of translating laboratory results into terms of technical practice. Different types of mind and experience as well as different equipment are necessary to bridge the gap between theory and practice. In short, the correlation of science and industry demands, as a rule, three types of men, viz., (a) those who find the problem, (b) those who unfold the new knowledge necessary to solve it, and (c) those who apply the results. The corresponding qualities and knowledge are rarely combined in the same types of individual or in the same institution.

Taking into account the restrictions imposed on the Institute by its size, its income, and its geographical situation, it is essential to relieve the staff of the sole responsibility for finding industrial problems for investigation. These problems should be submitted to the Institute by some responsible body capable of collecting proposals from India as a whole, and of sifting them so as to exclude merely routine inquiries (for which other agencies are available) and suggestions which are too unwieldy to be handled by the comparatively small number of workers available at Bangalore. The initiation of problems might well be undertaken by such bodies as—

The Industrial Intelligence and Research Bureau,
The Imperial Council of Agricultural Research, and
Departments of Industries.

Co-operation with bodies such as those mentioned above will enable the Institute to keep in constant touch with the industrial needs of India.

Suggestions for research initiated in the above way would be received in the ordinary course of business by the Registrar and would be submitted by him to the Senate which, in turn, would allocate the problem to the appropriate department or departments. In this way, each inquiry would receive the benefit of several expert opinions, a team spirit would be fostered, and the departments of the Institute would stand in less danger than at present of intellectual isolation. To make this proposal effective will demand something more than merely formal acquiescence on the part of all concerned. The active prosecution of applied research should be regarded as a duty, willingly undertaken with the certain knowledge that the more energetically this duty is fulfilled, the less scientific prominence becomes attached to the workers themselves. Few publications are likely to result from such research work, but this need not be deplored if in the end the Institute is made to play the part for which it was created. Above all, it will be necessary to develop in members of the Institute the idea that there is no loss of scientific dignity in directing scientific research to the service of man.

CONCLUSION

Throughout our inquiry and in compiling our Report we have been actuated by more than a desire to rectify an unhappy situation. It has been our earnest endeavour to make suggestions, conceived in a spirit of impartiality, which may help the Institute to attain a position where, without challenge, it will operate for "the benefit of India". Within the framework of our scheme and free from the distractions of routine administration, the Director may devote his full powers to fundamental researches in Physics which must redound to the fame of the Institute as a home of intellectual effort. Equally, the Professors in other departments are placed in a position which will enable them to bring their best energies to bear on research problems affecting the industrial welfare of India, and to equipping students to play their part in the application of such work. With improved status, a greater security of tenure, and a clearer prescription of their duty, there is every reason to believe that the Professors will render this service in a happier and more helpful atmosphere.

As we foresee the effect of our proposals, the Institute in the future may be regarded as divisible into three sections each with its special sphere of activity, viz., (a) Physical and Mathematical Sciences in which the research work will continue to be primarily of a fundamental nature with an allegiance to the intellectual rather than to the industrial aspects of life, (b) Chemical Sciences which will be called upon to carry the main responsibility for applied research while not neglecting original work of a more academic type, and (c) Engineering Sciences where the duties for the time being will be in part instructional and in part investigatory. We have suggested that these sections be granted a reasonable measure of autonomy, but they will not be isolated units, for they will find a common meeting place in the reconstituted Senate, where their efforts to serve science and to serve India will become in the best sense co-operative.

It may be the case that our proposals are a compromise, forced upon us by circumstances, but nevertheless we believe that they represent a workable solution of existing difficulties. If given a fair trial and if operated in the right spirit, they will enable the Institute to begin its second semi-Jubilee period with renewed hope. If our scheme fails, it can only be through the clash of personalities beyond the remedy of any powers possessed by a Reviewing Committee. Some of our proposals are far-reaching in their effect. Their full significance will be apparent only by a study of the complete text of our Report.

Educational Topics and Events

BIRMINGHAM.—The Huxley Lecture is to be delivered on December 10 at 5.30 p.m. in the Medical Theatre of the University, by Prof. A. M. Carr-Saunders, professor of social science in the University of Liverpool, who has chosen as his subject "The Population Problem in Great Britain".

CAMBRIDGE.—The Vice-Chancellor gives notice that the professorship of animal pathology is vacant by the resignation of Prof. J. B. Buxton. A meeting of the electors will be held on January 19. The Council of the Senate has determined that at this election preference shall be given to a candidate whose experience and interests lie chiefly in scientific investigation rather than in veterinary practice, and that a professional veterinary qualification, though undoubtedly advantageous, shall not be regarded as essential.

EDUCATIONAL films have been produced in such numbers and variety and are in such wide demand as to justify the publication by the Central Information Bureau for Educational Films (103 Kingsway, London, W.C.2) of a "National Encyclopædia" and of bi-monthly bulletins, entitled *Film Progress*, for keeping it up to date. Bulletin No. 4, issued in September, reviews the work of the Bureau from 1932, the year in which it was formed. It published in the following year a "Guide", which was brought up to date and re-issued as the "National Encyclopædia" a year ago. Through the medium of *Film Progress* it keeps in touch with schools in all parts of the Empire and in many foreign countries, including China, Chile, Holland, Latvia, Rumania, the U.S.A., and the U.S.S.R. It has advocated the formation of a school and parents film society to aid in the installation of projectors in schools, an object which is also attainable through the formation of local branches of the British Film Institute. The current issue of *Film Progress* includes several reviews of books, descriptive lists of new films and detailed practical suggestions on how to train members of the school staff and selected students in the handling of projectors. Very many of the new films described appear to be admirably suited for inclusion in cinema entertainment programmes but for the supposed prejudice of cinema-goers against everything admittedly educational. Among them is "Citizens of the Future", a survey of public education claiming to show how the schools are fitting children to employ their leisure time in useful occupations and preparing them to take their proper place in a world demanding high standards.

PROFESSORS of "Things in General" are needed to cope with the undergraduate situation in American universities to-day. This is one of a number of interesting conclusions reached by Prof. H. G. Merriam of Montana in a recent address on "The Liberal Arts College in State-supported Universities". The ancient ideal of making a scholar and gentleman as the aim of a university education was long ago given up, but the idea of making scholars continues to influence university instruction. Now it is recognized that among the myriads that pass on from high school to college, very few have the stuff from which scholars can be made, and a vast amount of instruction, lacking the integrating power of a clearly defined goal, is a futile hodge-podge. The primary function of instruction during their first two years in college should be, in State-supported, if not in all institutions, to train the students for worthy citizenship. Real problems of the individual and of society must be dealt with realistically and frankly, even when this involves breaking away from the American tradition that a college professor should avoid themes of popular contemporary interest lest he should be quoted in newspapers. The youth of to-day are impatient of theory except as manifestly applicable to live issues. The content and technique of instruction must be based on a consideration of such questions as: "What does the individual need to know about the fundamentals of the good life; about what good reasoning is and what its value; about the uses of emotion and the control of it; about society, its composition and working; about what factors in politics can be and should be controlled?"; and developed in the light of the conception of education as a gradual slow lifting of the people of a democracy to as high a level of thinking and feeling as possible.

Science News a Century Ago

Electric Currents in Metalliferous Veins

WRITING from 4 Clarence Street, Penzance, on December 6, 1836, to William Sturgeon, W. J. Henwood, the Assay Master of Tin in the Duchy of Cornwall, dealt with the subject of "Electric Currents observed in some Metalliferous Veins". In his communication he described briefly the geology of Cornwall and the methods of making his experiments, discussed the results obtained, and examined the various theories which had been put forward to explain the phenomena. Experiments were made by pressing plates of sheet copper 12–20 inches long and 3–4 inches wide closely against such portions of the metallic contents of the veins as were thought proper for examination. Copper wires 0·05 inches in diameter were connected to the plates and to a galvanometer. In some cases, 600 feet of wire were required. Copper, pyrites, vitreous copper ore, black copper ore, galena and blende were among the contents of the veins, but it was only from the metallic parts of the veins that currents were obtained. Henwood had assisted Robert Were Fox in the first experiments of the kind made, and he had then extended them to mines in all parts of Cornwall (*Sturgeon's Annals*, 1, 124).

Graham's Work on the Constitution of Salts

AT a meeting of the Royal Society held on December 8, 1836, Frances Baily being in the chair, the second part of a paper by Thomas Graham was read. It was entitled "Inquiries respecting the Constitution of Salts of Oxalates, Nitrates, Phosphates, Sulphates and Chlorides". "In the third section," said the report on the paper, "he discusses the constitution of the phosphates. Phosphoric acid, he observes, is quite peculiar in being capable of combining with bases in three different proportions; forming besides the usual class of monobasic salts, containing one atom of acid to one atom of protoxide as base, two other anormal classes of salts, in which two or three atoms of base are united to one atom of acid, namely the pyrophosphates and the common phosphates, as they are usually denominated, but which the author proposes to designate by the terms *bibasic* and *tribasic* phosphates. Arsenic acid forms only one class of salts; but that class is anormal; every member of it containing three atoms of base to one atom of acid like the common, or tribasic, phosphates. These anormal classes of phosphates and arseniates are the only known salts to which the ordinary idea of a subsalt is truly applicable: all other reputed subsalts being probably neutral in composition, as has been shown by the author in the case of the subnitrate of copper; for they all bear an analogy to this salt in their small solubility and other properties, while they exhibit little resemblance to those classes of phosphates and arseniates which really possess more than one atom of base."

The Gresham Lecturers

On December 9, 1836, the Court of Common Council of the City of London considered a report which had been presented on the question of transferring the Gresham Lectures from the small incommodious room at the Royal Exchange to the City of London School. In its report of the proceedings, *The Times* said: "There are seven lecturers under the will of Sir Thomas Gresham, each of whom is paid a liberal salary for occasionally lecturing upon scientific and other topics, in an obscure apartment in the Royal Exchange, and the very spacious and commodious school endowed by the Corporation being almost finished, a committee was appointed to consider and report the best means of deriving some public advantage from the employment of the lecturers. The Corporation have been for some time endeavouring to obtain the consent of the gentlemen who derive the pecuniary emolument from these appointments to transfer their exertions to some more enlarged sphere of action in the city; but hitherto all attempts to induce them to leave the old station, whose walls have so long witnessed their abortive labours, have been ineffectual."

The lecturers, with one exception, objected, maintaining among other things that the removal of the lectures to the School "would not be advantageous to the public, but on the contrary would be injurious to the foundation of the Gresham institution, by attaching it to the school and destroying its independence". *The Times* of December 13 contained a letter from one of the lecturers and a copy of the resolutions passed by himself and the others on November 17. One of these ran "That, in the opinion of the lecturers, there can be no want of funds to maintain or carry out the Gresham lectures according to the founder's intentions, it appearing from the report of the Charity Commissioners of 1821 that the yearly income of the Gresham estates then amounted to £6,080, while the yearly payments, on account of the trusts, only amounted to £1,113 4s."

The Gresham professorships of "divynitye, astronomy, musicke, geometry, law, physicke and rethoricke" date from 1595, Henry Briggs being the first professor of geometry. From 1597 until 1768, the lectures were given in Gresham's house in Bishopsgate Street. They were then given in the Royal Exchange until that building was destroyed by fire in 1838. In 1843 a special building was erected in Gresham Street, this being replaced in 1913 by the present College. The chairs of geometry and astronomy are the oldest in Great Britain.

Societies and Academies

Dublin

Royal Irish Academy, November 9.

Norman Harris: Petrological study of the Portrush sill and its veins. The Portrush sill has been mapped on the 25-in. scale, particular attention being paid to variations within the sill itself, and to the different types of veins and their relationship with the hornfelsed lias of the roof. The bulk of the intrusion is coarsely mottled olivine-dolerite; then passes marginally into a fine-grained intergranular type. Micrometric analyses show that the proportion of olivine and iron-ore increases with depth. Chemically the average rock corresponds to the Hebridean Plateau-Magma-Type. Various types of hornfels and their mineral developments are described. Several occurrences have been found of veins of mobilized hornfels which pass downwards into the sill from the roof. Other veins and sheets within the sill are shown to comprise metasomatized hornfels and also a variety of synthetic rocks which are referred to the action of the magma and its emanations on included rafts of hornfels. The absence of veins in the Lias roof and the capacity of the hornfels to inject the olivine-dolerite indicate that the hornfels was under internal compression, presumably due to expansion, while the upper part of the sill was contracting and under internal tension. A later hydrothermal stage is represented by widely distributed calcite-chlorite-zeolite veins. Five types of pyroxene have been recognized in the rocks investigated. Analyses are given of two of the pyroxenes: common augite and pigeonite.

Paris

Academy of Sciences, November 9 (*C.R.*, 203, 901–960).

Alfred Lacroix: The meteorites (æroliths) found in the Tanezrouft (Western Sahara). The two fragments found appear to have fallen at the same time, very recently. From the mineralogical and chemical examination, these meteorites are pliosideriferous chondrites.

Jean Cabannes and **Jean Dufay**: Regularities in the spectrum of cometary nuclei.

Marc Krasner: Multiplicative representation in the body of $\mathfrak{p}$-adic numbers relatively Galoisian.

Frédéric Roger: Taylor's formula and the differential geometry of ensembles.

Casimir Kuratowski: Projective ensembles and the operation (*A*).

P. Erdös and **Erwin Feldheim**: The mode of convergence for the Lagrange interpolation.

René Lagrange: The theorems of addition of Legendre functions.

Bohuslav Hostinsky: The superposition of two sinusoids.

Daniel Barbier: The emission of electrons by the sun and its relation with terrestrial magnetic phenomena.

Léopold Escande and **Georges Sabathe**: Errors produced by the inclination of the trajectories in calibrations carried out by means of hydrometric screws with counting gear. If the axis of the rotating screw is not in the same direction as the moving water, serious errors are produced. For an inclination of 20° the error is ten per cent, and this error increases rapidly with the angle.

Jean Louis Destouches: The generalization of the Lorentz transformation for a system of corpuscles.

Jacques Solomon: Diffusion of light by neutrons.

Mlle. Suzanne Veil: Electrometric potential and constitution of electrolytes.

Pierre Barchewitz: Study of the absorption spectra of benzene and its derivatives in the near infra-red (6000–9500 A.). A table of results for ten compounds is given: the figures confirm the views of R. Freymann on the influence of certain groups on the position of the bands (CH=).

Mladen Paić: Absorption spectra in the ultra-violet of coproporphyrin and of some of its metallic complex compounds.

Léon Jacqué: Mechanical properties of steels treated with hot hydrogen under pressure. Ordinary steels under this treatment are decarbonized and show a loss in mechanical strength. But steels with 3–6 per cent of chromium, 0·5 per cent of molybdenum, no nickel and low carbon retain their mechanical properties and hence are suitable for work at high temperatures under pressure of hydrogen.

Jean Wyart: The crystalline network and macles of leucite.

Gilbert Mathieu: The principal bands of phtanite of the Brinoverian of Vendée.

Marcel Thoral: Age and fauna of the Ordovician schists of Cabrières (Herault) known as 'Asaphus schists'.

Alexis Lambert: Presence of the Senonian in the Djurjura chain.

Jean Lacoste: Remarks on some structural characters and on certain aspects of petroleum geology, in two analogous regions, the Subcarpathians and the Sud-Rif regions.

Charles Bois: The importance of the long waves and the depth of focus in earthquakes.

Marius Chadefaud: The chondriosomes and plastids of *Caulerpa* (Green Algæ).

A. and R. Sartory and J. Meyer: Influence of a partial or high vacuum on the growth and morphology of some lower fungi.

Max Lafon: Weight evolution of the organs in mice deprived of lysine.

Paul Durand, Paul Giroud, Edouard Larrive and André Mestrallet: Susceptibility of animals to the virus of the *maladie des porchers*.

Geneva

Society of Physics and Natural History, October 22.

F. Chodat and G. Carrisson: The effect of sodium mono-iodoacetate on the respiration of the yellow *Staphylococcus*. The authors give measurements of the inhibitive action of sodium mono-iodoacetate on the respiration of *Staphylococcus aureus*. This is already apparent at a concentration of $M/50{,}000$ of the reagent, and is reduced to one half at a concentration of $M/1{,}000$.

P. Rossier: (1) The approximate expression of the colour index as a linear function of the inverse of the effective temperature of stars. A development, in series, of an expression obtained in a general theory of the index, gives sufficient expressions in some cases where the accuracy of the observations is not very great. (2) Observations of the 1936 comet. Photographic observations of July 19 and 23, 1936. Spectrographic observation of July 23. (3) Spectrographic observations of Novæ Herculis, 1934 and Aquilæ, 1936. The loss of brightness of Nova Herculis appears to have influenced the continuous spectrum and most of the emission lines, excluding those of ionized oxygen. The spectrum of Nova Aquilæ, 1936, shows the hydrogen line and the line at 4640 A. characteristic of novæ in the form of wide emission lines.

B. Hochreutiner: Announcing the republication of the "Flora orientali" of Edmond Boissier, of vol. 6 of de Candolle and the issue of a new periodical, *Le Boissiera*, Part 1.

Moscow

Academy of Sciences (*C.R.*, 3, No. 4, 1936).

E. Voronovsky: A minimum problem in the theory of sequence of moments, and the evaluation of the polynome (2).

S. M. Rytov: Diffraction of light by ultra-sound.

V. V. Werednikov: Influence of soil capillarity on the oozing of water with free surface.

P. P. Budnikov and E. I. Kreč: Evolution of sulphur oxides from calcium sulphate by means of chlorine, in the presence of catalysts, for simultaneous production of hydrochloric and sulphuric acids (2). Behaviour of different modifications of silica towards chlorine at high temperatures.

V. S. Sadikov and A. G. Pesina: Autoclave splitting of the non-extractable portion of beef by means of an aqueous solution of lithium carbonate.

T. T. Demidenko, A. A. Kulkes and V. P. Popov: Colloids in beef correlated with soil liming.

A. Schwartz and S. F. Kuzmin: The potato in its genetic aspect. (2) Variability of the protein content in the interspecific hybrids *Solanum phureja* × *S. rybinii*.

I. A. Filippenko: Physiological characteristics of vernalized and non-vernalized winter wheat.

N. Bezborodko: The Tchernigov-Donetz Basin zone of volcanism, and the geochemical province connected with it.

(*C.R.*, 3, No. 5, 1936).

M. Jaltunovskaja: A problem of interpolation.

N. S. Smirnov: Existence theorem of non-linear integral equations.

B. V. Numerov: Compilation of a fundamental catalogue of right ascensions.

G. Dubošin: One particular case of motion in the resisting medium with a variable mass.

V. Fabrikant: Contribution to the problem of the disappearance of spectral lines in strong electrical fields.

L. G. Gindin, I. I. Torsujev and W. A. Kazakova: Behaviour of sulphur solutions, and of a series of organic compounds of sulphur in saturated carbohydrates towards metals.

M. P. Volarovič and A. A. Leontjeva: An investigation of the elasticity of some molten rocks.

J. V. Rakitin: Controlling the ripening of the Japanese persimmon.

M. I. Saltykovskij: Cold resistance of the first generation of wheat hybrids.

A. N. Družinin: The problem of structure and the evolution of the elbow joint of Mammalia.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, December 7

Royal Geographical Society, at 5.—J. A. Steers: "Coral Islands of the Great Barrier Reefs".

University of Leeds, at 5.15.—Prof. E. A. Owen: "The Application of X-Rays to the Study of Alloys".*

Guy's Hospital Medical School, at 5.30.—Prof. George W. Corner: "The Ovarian Hormones" (succeeding lectures on December 8 and 9) *

Tuesday, December 8

Society for Constructive Birth Control, at 8—(at the Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, W.1).—Dr. Marie Stopes: "Some Biological and Physiological Details of Fertility".

Pharmaceutical Society of Great Britain, at 8.30.—Prof. Allan Ferguson: "Splashes and what they Teach".

Wednesday, December 9

Royal Society of Arts, at 8.—H. V. Potter: "Artificial Resins".

Birkbeck College, at 8.15.—Anniversary celebration to be held in the College Theatre.

Sir Frederick Gowland Hopkins, F.R.S.: Foundation Oration.*

Chadwick Public Lecture, at 8.15—(in Manson House, 26 Portland Place, W.1).—Sir Weldon Dalrymple-Champneys: "Modern Views on Infection and Disinfection".*

Thursday, December 10

Royal College of Surgeons, at 5.—Prof. George W. Corner: "Salernitan Surgery in the Twelfth Century" (Vicary Lecture).

Chemical Society, at 5.30—(at the Institution of Mechanical Engineers, Storey's Gate, S.W.1).—Prof. E. Paneth: "Study of Transmutation in the Chemical Laboratory" (Liversidge Lecture).*

University of Birmingham, at 5.30.—Prof. A. M. Carr-Saunders: "The Population Problem in Great Britain" (Huxley Lecture).*

Friday, December 11

Institution of Mechanical Engineers, at 6.—Dr. J. S. Owens: "The Smoke of Cities".

Royal Institution, at 9.—Dr. H. Spencer Jones, F.R.S.: "Large Telescopes, including the 200-inch Reflector".

Official Publications Received

Great Britain and Ireland

Transactions of the Royal Society of Edinburgh. Vol. 58, Part 3, No. 29: *Botryococcus* and the Algal Coals. Part 1: A Reinvestigation of the Alga *Botryococcus Braunii* Kutzing, by Dr. Kathleen B. Blackburn; Part 2: The Boghead Controversy and the Morphology of the Boghead Larvæ, by Dr. B. N. Temperley. Pp. 841–868+2 plates. 4*s*. 3*d*. Vol. 58, Part 3, No. 30: A Contribution to the Geology of the Faeroes. By Dr Frederick Walker and Charles F. Davidson. Pp 869–897+3 plates. 4*s* 9*d*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [1311

Committee of the Privy Council for the Organisation and Development of Agricultural Research. Report of the Agricultural Research Council for the Period October 1933–September 1935. (Cmd. 5293.) Pp. iv+130. (London: H.M. Stationery Office.) 2*s*. net. [1611

The North of Scotland College of Agriculture. Report on the Work of the North of Scotland College for the Year 1935–36. Pp. 39. (Aberdeen: North of Scotland College of Agriculture.) [1811

Board of Trade. Statistical Abstract for the British Empire for each of the Ten Years 1926 to 1935. Sixty-fifth Number. (Cmd 5298.) Pp. xviii+331. (London: H M Stationery Office) 5*s* net. [1911

British Empire Cancer Campaign. Thirteenth Annual Report of the Grand Council presented at the Meeting held at the House of Lords 23.11.36. Edited by J. P Lockhart-Mummery. Pp. xxviii+338. (London: British Empire Cancer Campaign) [1911

Hannah Dairy Research Institute. Bulletin No 7. An Inquiry into the Drinking Habits of Children of School Age, with Special Reference to Milk Drinking. By Dr. Norman C. Wright. Pp. 50. (Kirkhill, Ayr: Hannah Dairy Research Institute.) 2*s*. [2011

Fifth Quinquennial Congress of the Universities of the British Empire, 1936. Report of Proceedings. (Published for the Universities Bureau of the British Empire.) Pp. viii+202. (London: G. Bell and Sons, Ltd.) [2111

University of Cambridge: Solar Physics Observatory. Twenty-fourth Annual Report of the Director of the Solar Physics Observatory to the Solar Physics Committee, 1935 August 1–1936 July 31. Pp 4 (Cambridge: Solar Physics Observatory) [2111

East African Agricultural Research Station, Amani. Eighth Annual Report, 1935–36. (Colonial No. 119) Pp. 41. (London: H.M Stationery Office.) 1*s*. net. [2111

Public Social Services (Total Expenditure under certain Acts of Parliament) Pp. 20. (Cmd. 5310.) Pp. 20. (London: H.M. Stationery Office.) 4*d* net. [2111

Research Association of British Paint, Colour and Varnish Manufacturers. Bulletin 16: The Preservation of Iron and Steel by means of Paint. By Dr. L A Jordan and Dr. L. Whitby. Pp. 68. (Teddington: Paint Research Station.) 2*s*. 6*d*. [2311

Rothamsted Conferences, 22. Diseases of Bees; being a Report of a Conference held at Rothamsted on September 26th, 1936, under the Chairmanship of Sir E. J Russell. With Contributions by Sir E. J. Russell, Dr. H. L. A. Tair, Dr G. D Morison, Dr Otto Morgenthaler, Jas. I. Hambleton, and others. Pp. 43. (Harpenden Rothamsted Experimental Station) 1*s*. 6*d*. [2411

Other Countries

Dominion of Canada. National Research Council. Report No. 29: The Comparative Feeding Values for Poultry of Barley, Oats, Wheat, Rye and Corn; a Review and Analysis of Published Data. Prepared by Earle W. Crampton. Pp. 50. (Ottawa: King's Printer.) 25 cents. [1411

Memoirs of the Geological Survey of India. Vol 70, Part 2, No 1 An Attempt at the Correlation of the Ancient Schistose Formations of Peninsula India. By Sir Lewis Leigh Fermor. Pp. iv+53–217. (Calcutta: Geological Survey of India.) 2.4 rupees; 4*s* [1611

Proceedings of the United States National Museum. Vol. 83, No 2990: A Revision of the Chalcid Flies of the Genus *Perilampus latreille* occurring in America North of Mexico. By M. T. Smulyan. Pp. 369–412. Vol. 83, No. 2996: New Tertiary Foraminifera of the Genera *Operculina* and *Operculinoides* from North America and the West Indies. By Thomas Wayland Vaughan and W. Storrs Cole. Pp. 487–496+plates 35–38. Vol. 84, No. 2999: The Ichneumon-Flies of the Genus *Brachycyrtus* Kriechbaumer. By R. A. Cushman Pp. 17–24. Vol. 84, No. 3000. New Cottid Fishes from Japan and Bering Sea By Rolf L. Bolin. Pp. 25–38. (Washington, D.C.. Government Printing Office.) [1711

Smithsonian Miscellaneous Collections. Vol. 73, No 8: Opinions rendered by the International Commission on Zoological Nomenclature. Opinions 124 to 133. (Publication 3395.) Pp. ii+44. (Washington, D.C: Smithsonian Institution) [1711

U.S. Department of Agriculture. Farmers' Bulletin No. 1766: Game Laws for the Season 1936–37; a Summary of the Provisions of Federal, State and Provincial Statutes. By H. P. Sheldon and Frank G. Grimes Pp. ii+38. (Washington, D.C.: Government Printing Office.) 5 cents. [1711

U.S. Department of the Interior: Office of Education. Bulletin, 1936, No. 16: A Step Forward for Adult Education. Pp. 28. 10 cents Leaflet No. 36: Educational Law; Selected References. Compiled by Ward W. Keesecker. Pp. 15. 5 cents. (Washington, D C: Government Printing Office.) [1711

U S. Department of Agriculture. Technical Bulletin No. 518: A Second Revision of the Chalcid Flies of the Genus *Harmolita* (Isosoma) of America North of Mexico, with Descriptions of 20 New Species. By W. J. Phillips Pp. 26+10 plates. 5 cents. Technical Bulletin No. 582: The Comparative Moisture-Absorbing and Moisture-Retaining Capacities of Peat and Soil Mixtures. By I C. Feustel and H. G. Byers Pp 26. 5 cents. (Washington, D.C.: Government Printing Office.) [1811

Ministry of Agriculture, Egypt: Technical and Scientific Service Bulletin No 157: Pollination and Selection in *Anona Squamosa* and *Anona Cherimolia* By M. S Ahmed. Pp. iv+29+8 plates. 5 P.T. Bulletin No. 164: The Spacing of Sugar Cane in Egypt and Elsewhere. By Arthur H. Rosenfeld. Pp. iii+47+5 plates. 7 P.T. Bulletin No. 178: Preparation and Method of Application of the Zinc Phosphide Bait employed in the Control of the Mole-cricket *Gryllotalpa*. By A Kassab. Pp ii+12+8 plates. 3 P.T. (Cairo: Government Press.) [1911

Punjab Irrigation Research Institute. Research Publication, Vol. 2, No 13: Uplift Pressures under a Depressed Floor. By Dr. N. K. Bose and Harbons Lal Uppal. Pp. 12+10 plates. 7 annas, 8*d* Research Publication, Vol. 2, No. 15: Punjab Practice in Silt Observations. Pp. 18+6 plates. 6 annas; 7*d*. Research Publication, Vol. 5, No. 6: Pressure under Weirs—Depressed Floors with and without Sheet Piles. By Dr. V. I. Vaidhianathan, Gurdit Ram and Dr. E. McKenzie Taylor. Pp. 4+10 plates. 5 annas; 6*d*. (Lahore Punjab Irrigation Research Institute) [2311

Commonwealth of Australia Report of the Seventh Australian Cancer Conference, held at Melbourne, 4th–8th May 1936. Pp. 72 (Canberra. Government Printer.) [2311

Indian Forest Records (New Series). Vol. 1, No. 4: A Note on Protecting Indian Structural Timbers against Fire, Termites, Borers and Fungi (Rot). By S. Kamesam. Pp. ii+93–113. (Delhi: Manager of Publications.) 7 annas; 9*d* [2311

Gold Coast Report of the Forestry Department for the Year 1935–36. Pp. ii+13 (Accra: Government Printing Department; London: Crown Agents for the Colonies.) 1*s* [2411

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Armaments and the Scientific Worker

THE recently issued report* of the Royal Commission, which has dealt with the private manufacture and sale of munitions of war, contains a number of special points of particular interest to the scientific worker. A considerable amount of evidence was laid before the Commission designed to show that the manufacture of armaments should be concentrated in Government hands to promote the development of research, design and invention. It was argued that centralization of research work under unified control prevents dissipation of effort and that closer contact is possible between research and experimental work in Government stations, which have greater facilities than private establishments for experiment. Similarly, it was urged that money is more readily available for research in Government establishments, where there is not the necessity to visualize a prospect of dividend on capital that there is with private enterprise, as well as the danger of prejudicing the interests of the State if a private manufacturer does not develop a new invention which may not be to his own advantage, the motive of profit-making in certain circumstances tending to retard the development of new ideas.

Other evidence brought before the Commission denied that the development of research, design and invention in the matter of armaments would be facilitated by nationalization. It was stated that research work is cramped within Government departments, and that in peace time funds for research are more readily made available by private industry than by the Government. It was also argued that the supply of war material by Government establishments alone would result in sound but mediocre material because the atmosphere and conditions of Government service do not favour the development of new ideas. Moreover, since discovery, research and development of new ideas result from individual effort, they do not lend themselves to centralized organization, and Government employees do not seek to assume additional responsibilities or incur the risk of putting forward new ideas which may be regarded as impracticable in high quarters. Not only does competition under private manufacture provide a strong incentive to individuals to find new and improved devices, but also research conducted by commercial undertakings in non-military matters is just as likely to result in discoveries of military value, the tank itself being cited as an idea which emanated from a private engineering firm.

The report itself makes no pronouncement either upon the separate aspect of the case of the opponents of private manufacture based upon its alleged inefficiency and the lack of opportunity for fully developed research, or upon the counter arguments in this matter of the supporters of the present system. Neither side refers to the ethical questions of the participation of men of science in preparations for war or the possible formulation of a professional code of ethics which at the present time is seriously occupying the minds of scientific workers whose participation is essential under either system of control. None the less, this is probably the most important aspect so far as the stimulation of invention and discovery is concerned.

Disgust and dissatisfaction at the prostitution of scientific effort to the elaboration of even more destructive weapons is now too widespread to be disregarded. Any system, whether national or international, which encourages unlimited misuse in this way can scarcely long escape repudiation and overthrow. While scientific workers are of no two minds as to the necessity for whatever armaments we must have being efficiently produced and maintained, they would find a very considerable support for opposition to any system which demanded their efforts in the development of offensive, as opposed to defensive, weapons indefinitely. Moreover, the scientific worker in matters of national defence should require no further stimulus than his specific occupation if those ethical needs are satisfied. If, on the other hand, they are left unsatisfied, it is doubtful whether any system of armaments manufacture can supply a stimulus as effective.

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* Royal Commission on the Private Manufacture of and Trading in Arms (1935–36): Report. (Cmd. 5292.) Pp. 101. (London: H.M. Stationery Office, 1936.) 1s. 6d. net.

The report of the Royal Commission accordingly will be something of a disappointment to those scientific workers who are concerned with the ethical aspects of their participation in the preparations for national defence. It gives no lead on certain of these questions of research and development which, apart from the ethical aspect, are equally to be encountered in other fields of industrial and scientific research. At least, however, it emphasizes once more that the task of constructing world peace involves not merely the abolition of war, but also the far-reaching and impartial study of all its many causes, and not least that of the contribution and organization of the armaments industry itself.

Genetics and Race

IN the classificatory systems of a number of sciences the term 'race' occurs. Its meaning differs somewhat from science to science, but in all it has two main connotations, one being community of descent, the other distinctness from other races. Years ago the term signified something rather definite, but as time has passed and knowledge has advanced, this has given place to something much more vague. In general biology, for example, 'race' has now been largely abandoned in favour of 'sub-species'—a term much more in harmony with the concept that it is used to portray.

So long as the definition of race in the usage of one science does not invade the territory of another, it is a matter of no great importance if there are as many definitions as there are sciences; but if and when the term race as used by the physical anthropologists, for example, comes to have genetical implications, then it is reasonable for the geneticist to express the view that the anthropologists' definition must neither disregard nor offend genetic principles. This it does, for the anthropological use of the term dates from the time when it was believed that organic inheritance was of the blending variety, so that a mixed population would speedily approximate to a characteristic uniform type. This assumption has been shown to be incorrect by the establishment of the Mendelian basis of inheritance, and it is now known that constellations of characters necessarily become broken up and their ingredients shifted back and forth, combined and recombined, when, consequent upon the removal of isolation and inbreeding, crossing occurs. Furthermore, the assumption that man's evolution has taken the form of a separation into discrept isolated units is also incorrect, since migration and crossing have been operative for tens of thousands of years, so that, whereas the evolution of most animal types is divergent, that of man has been what may be called reticulate.

This was the reason for a joint meeting on September 11 of Sections H (Anthropology) and D (Zoology) of the British Association at Blackpool, at which the speakers were primarily concerning themselves with the question of whether or not the anthropologist's definition of race required modification in consequence of recent developments in genetics. But no one at this crowded meeting was unaware that the speakers were indirectly commenting upon the exploitation of the race concept by politicians who apparently are deliberately confusing linguistic terms such as 'Aryan', cultural terms such as 'germanic' and genetic terms like 'Nordic' by using them synonymously. It undoubtedly is the case that the term 'race' is now being used in a pseudo-scientific sense to further purely political interests, and this being so, it behoves all scientific workers—anthropologists, ethnologists and the rest—to respond to the demand on the part of the general public for guidance concerning the quality of the pronouncements of those who claim scientific endorsement for their own peculiar attitudes toward such matters as territorial readjustment, immigration quota or the relative intellectual pre-eminence of certain national groups.

The impression left at the end of this meeting was that the anthropologist's definition of race has genetical implications, that it has been established that the rise of modern genetics has necessitated a thorough overhaul of the basic concepts of physical anthropology, that the techniques of genetics should now be added to those of the anthropologist, and that genetical analyses of human differences and the correlation between them should be undertaken, and that, as applied to mankind, it is now quite impossible to give a scientific definition to the term 'race' since this has connotations which do not apply in human species. Now that the politician has appropriated the term, it is time for the man of science to relinquish it.

Sixty Years of Physical Science

Recollections and Reflections
By Sir J. J. Thomson. Pp. viii +451 +10 plates. (London: G. Bell and Sons, Ltd., 1936.) 18*s*. net.

IT is hard to believe that Sir Joseph Thomson will enter the ranks of the octogenarians on December 18—he has given, and is giving, so much to the world that it may very well happen to him as to Voltaire, who awoke one morning to find the world celebrating his eightieth birthday, he himself having scarcely had leisure to realize that he had reached middle-age.

Sir Joseph has seen many cities and many men; and, in the spirit of the Spanish proverb which says that "He who would bring back the wealth of the Indies must take that wealth with him", we should expect Sir Joseph's reflections on his voyagings in thought and in space to yield a rich harvest indeed.

Nor shall we be disappointed. The changes which he records are, in the total, almost incredible in their extent and variety. In that Palmerstonian world into which he was born, the University of Cambridge was still governed by those medieval statutes of the workings of which the late Dr. John Venn has left so vivid a picture. Memories of those days, when Hall was at 4, when water, of doubtful origin, was carried from pumps, and smallpox patients went through the various stages of their disease in bedrooms opening on a common staircase, still lingered on in that yet far-off Cambridge of 1876, when J. J. Thomson entered his name on the books of Trinity College. Sixty years have passed and the undergraduate of 1876, now Master of Trinity, has kept every term since then, and has been in residence for some part of every long vacation. Nor, as he remarks, can he remember any day during the last sixty years when his work has been interrupted by bad health. A remarkable record, and one which has probably been surpassed only by old Dr. Routh (1755–1854), the venerable President of Magdalen, who walked over Magdalen bridge, an undergraduate of fifteen years of age and thereafter left Oxford but once, on an abortive trip to France.

The Cambridge of 1876 was awakening to the importance of physical science. Maxwell had been appointed to the Cavendish chair in 1871 and the quadrant electrometer loomed large in the land. Maxwell himself was deeply immersed in the study of the Cavendish papers, and was enthusiastically repeating those remarkable experiments in which Cavendish had arrived at correct notions of the meaning and magnitude of electrical resistance by making of himself a human galvanometer, estimating current strength by the intensity of the shock he felt in his elbow when the current was discharged through his body. Distinguished visitors were called on, very much against their wills at times, to repeat the experiment, and Sir Joseph's recollections of the period range easily from topic to topic, now sketching Maxwell's work, now moving to a masterly account of Cavendish's meticulously accurate experiments and queer personality and again moved by a recollection of Cavendish's 'gar-do' methods, as the Scots phrase has it, making a neat comparison of Cavendish's and the late Lord Rayleigh's experimental technique, for each experimenter had the gift of seeing what was the vital point in the experiment, so that "though the apparatus as a whole might look untidy and haphazard, the parts that really mattered were all right. It was a 'rum 'un to look at, but a beggar to go'."

Sir Joseph's interests are catholic and his memories are ranging. Figure after figure comes to life, invoked by the power of a kindly memory and a genial pen, and we hear much of the giants of past days, and something of those who are still with us. The portraits of Butler, Thompson and Whewell, Sir Joseph's predecessors in the mastership of Trinity, are skilfully etched, and it is pleasant to recall the personality, sketched from first-hand knowledge, of the Master who reminded his fellows that "we are none of us infallible, not even the youngest". Sir Joseph notes that Thompson had a liking for puns and instances his comment on Courvoisier's execution : "every valley shall be exalted". It would be interesting to know his views concerning the authenticity of what Dean Merivale, who credited the saying to Thompson, regarded as the best classical pun on record. In Merivale's day, a certain fellow named Money retired, took to himself a wife, and developed uxorious habits. The lady duly became as one of those who love their lords and, as the event approached, so waxed Money's uxoriousness. "Quite so," said Thompson, "crescit amor nummi, quantum ipsa pecunia crescit".

But, though Cambridge claims sixty years of Sir Joseph's working life, a portion of it, and that not the least important, lies outside the pale of Cambridge, for Manchester and Owens College claim a share in the shaping of Sir Joseph's genius.

Manchester was a remarkable centre of scientific activity, and the Manchester Literary and Philosophical Society, founded in 1781, had, in the eighteen fifties, three quarters of a century of fruitful work on which to look back. Dalton, Joule, Sturgeon and Henry are names indissolubly associated with Manchester, and the educational influence of the city was further strengthened by the foundation in 1851 of the Owens College, John Owens, a Manchester merchant, having left his estate to be devoted to the establishment of a College free from religious tests. The College, housed in Cobden's old house in Quay Street, was struggling to prosperity when J. J. Thomson entered in 1871. Greenwood was its principal, Barker its professor of mathematics, of whom Sir Joseph remarks, "I have never known a better teacher of mathematics than Barker, and in some respects no one so good". Roscoe taught chemistry, Balfour Stewart physics, Osborne Reynolds engineering ; and when we are told that W. C. Williamson took all natural history for his province, that there was Stanley Jevons for logic and economics, Adolphus Ward for history and English, and Bryce for law, it is obvious that Sir Joseph is making no overstatement when he says that "though Owens College was badly housed, no university in the country had a more brilliant staff of professors".

It is interesting to learn that Sir Joseph's intention was to take up engineering as a profession ; to that end his first three years at Owens College were spent mainly under Osborne Reynolds, "one of the most original and independent of men, who never did anything or expressed himself like anybody else", and it was not until he had received a diploma and a scholarship in engineering that the young student turned his energies towards the acquiring of a mathematical scholarship at Trinity College and embarked on a career which has so profoundly affected the thought of the age.

The hundred or so pages that Sir Joseph devotes to the story of the advances made in physical science in his day end all too soon. It would be difficult to find, within a compass so restricted, a clearer or more enthralling account of the exciting happenings of the days that heralded the discoveries made in our own generation.

Sir Joseph was, perhaps, fortunate in his age ; as he points out, the discovery of Röntgen radiation coincided most happily with the advent of research students at the Cavendish Laboratory, and "to have come upon a method of producing conductivity in a gas so controllable and so convenient as that of the X-rays was like coming into smooth water after long buffeting by heavy seas". The discovery of the electron, the first and most famous of a long series of particles, was not long delayed, and was announced at the historic Friday evening discourse at the Royal Institution on April 29, 1897.

The electron, positive rays, isotopes ; radioactivity, argon, relativity, electron diffraction—the story of these discoveries, discoveries in which the Cavendish Laboratory has played so dominating a part, is unfolded in a pleasantly easy fashion that reminds us that Sir Joseph Thomson is a great teacher, as well as a great pioneer of discovery ; and withal so critical that we are in no danger of forgetting his own wise saying that a scientific theory should be considered as a policy rather than a creed.

In the hurly-burly of modern discovery, we are apt to lose sight of the great volume of work associated with Sir Joseph's name which bears some marks of the influence of his great teacher, Routh. Vortex rings are perhaps not so fashionable as they were fifty years ago, but his applications of Lagrangian methods to problems of physics and chemistry are as fresh now as they were in 1884, and the connoisseur in such matters does not permit the modest little volume containing the exposition of these methods to gather dust upon his shelves.

Much remains that can be no more than noted in passing—poignant memories of the years of War, recollections of visits to America, impressions of adventures in the region of psychical research.

We owe much to Sir Joseph Thomson, and these "Recollections and Reflections" add to our debt. It is impossible to close the book without an increased sense of admiration for a great genius, of affection for a wise and kindly personality.

A. F.

King Coal

Coal:
Its Constituents and Uses. By Prof. William A. Bone and Dr. Godfrey W. Himus. With a supplementary Chapter upon Fuel Economy and Heat Transmission in Industrial Furnaces by Dr. Reginald J. Sarjant. Pp. xvi+631+22 plates. (London, New York and Toronto: Longmans Green and Co., Ltd., 1936.) 25s. net.

THIS important work by very capable authors is one of the most complete and exhaustive treatises on the subject of the constitution and use of coal which has appeared in the English language.

The subject of coal, from whatever aspect one views it, is of outstanding consequence to all students of economics, for, as is well said in the introductory chapter, "the overwhelming supremacy in ship-building and mercantile marine which the United Kingdom had established over all nations by the end of the nineteenth century, was due to cheap coal and iron, favourable geological position, climatic conditions, combined with the policy of free imports".

The authors do not mince matters; it is clear that they are ardent advocates of free trade—and who shall blame them: "the adverse effects of the recent shrinkage of international trade," they say, "have undoubtedly been accentuated since 1931 by the country's departure from free trade", and they advance good reasons for the faith that is in them. They point to the important fact that "the continued production of relatively cheap coal remains the keystone of her [Great Britain's] whole economic structure"—would that our legislators were of like opinion—and that "the World's markets are now in the grip of a pernicious economic nationalism; lofty tariff-walls, import quotas and licenses, and restrictions upon the exports of currencies have combined to hold up the free exchange of goods without which world prosperity cannot be restored". The reviewer is of like opinion, but the difficulty is to determine what action our country ought to take in respect of these barriers to free trade erected by other nations. Every thinking person ought to agree that "neither dear coal nor monopolistic methods will solve the industry's difficulties", though, alas, the trend of present-day legislation is in the direction of such methods.

But this survey of the economic position is merely of an introductory character. The work ranges over a far wider field, dealing, well and truly, with such matters as that of the origin and formation of coals of all kinds; of the coalfields of Great Britain, of weathering and spontaneous heating; of the smoke nuisance and its abatement; of the production of oil from coal; of combustion and heat transmission; of coke, gasification, fuel economy in the manufacture of iron and steel; of power production from coal and of domestic heating.

It is a work which should occupy an important niche in the library of every scientific worker, manufacturer, chemist or engineer—and, I think we may add, of the would-be statesman! If one is not in entire agreement with all the statements and conclusions of the authors, that fact does not in any way detract from one's appreciation of the value of their admirable work. It might, for example, be pointed out that one of the reasons advanced to account for the decline in output of coal (p. 19), namely, fuel economies in power production in iron and steel manufacture, and in carbonization processes, does not accord with Jevons's doctrine to the effect that economy in use of an essential commodity is not conducive to decline in the aggregate consumption of that commodity, but the reverse.

The authors, too, scarcely do justice to the subject of low-temperature distillation of coal, for whilst they state (p. 234) that if the resultant semi-coke "could be made available in adequate quantities at a price comparable with that of a good house-coal, the domestic smoke problem would soon be in a fair way to solution"; yet earlier on in the work (p. 24) they severely criticize the possibility of supplying 30 million tons of semi-coke annually, without advancing any argument in support of their contention which cannot be contraverted. For example, they state that the fuel oil obtained in the distillation is of "inferior quality"; the answer to this is that it is of a quality satisfactory enough to permit of its use by the Royal Navy. Again, that "the transport of vast amounts of solid fuel of lower density than coal would involve formidable difficulties especially in the Metropolis and other large cities". It is difficult to imagine why, seeing that the transport of the semi-coke would present no greater difficulties than in the case of the transport of the gas-coke at present supplied in large quantities. There is no reason why the low-temperature distillation of coal should not be carried out at gas works.

The assertion in regard to the advantage of oil over coal as a marine fuel, namely that "in view of the World's assured abundance of petroleum for the next generation or two there seems little prospect of raw coal recovering what it has lost in that direction", is scarcely warranted. The late Sir Charles Parsons and others, of whom I was one, calculated, some ten years ago, that at the prices then ruling coal, were it used in the most economical way, that is, on chain grates under tubular boilers, with high-pressure steam (600 lb. per square inch and above) to drive turbines, after making due allowance for flexibility in use, saving in labour and gain in space, the advantages rightly claimed for oil, it would be more economical to use coal than oil. I believe that when this fact is fully realized by ship-owners, there will be a return to the use of coal.

The authors are in error (p. 29) in their account of how the chemical survey of the coalfields of Great Britain came to be inaugurated. The Fuel Research Board (which I suggested, in a memorandum drawn up for the guidance of the late Lord Haldane, should be set up for a period of five years to carry out scientific investigatory work for the "Coal Conservation Commission", of which Lord Haldane was chairman and I was a member) consisted of Sir George Beilby, Sir Charles Parsons, Mr. (afterwards Sir) R. Threlfall and myself; following upon a discussion with Prof. R. V. Wheeler, I brought before the Board the subject of a chemical survey of the coalfields and it was agreed to have such a survey carried into effect.

The information contained in Chapter iii of the book relating to the origin, formation and classification of coals is not quite correct in several instances. Thus, the authors are wrong in believing that coal does not exist in any of the geological systems older than the Carboniferous Age. Humic coals exist in the Devonian formation, for example, in the coalfield of Bear Island in the Arctic regions, where seams of 3 ft. 6 in. thickness occur.

In their description of the plants of the Carboniferous period which went to form coal, the authors might have mentioned the fact that the vegetable forms which flourished in the carboniferous period were not entirely of the giant club moss and tree fern, *Lepidodendron* and *Sigilaria* types, for an important constituent in some coals is a true forest tree, *Cordaites*.

On the subject of the origin of anthracite the authors are somewhat hazy (pp. 35, 87). As Strahan pointed out (A. Strahan and W. Pollard, "The Coals of South Wales . . ." *Mem. Geol. Survey*, 1908) the anthracites of South Wales were not derived from humic coals; the mother substances of the two coals differ in the nature of the vegetation of which they consisted or in the biochemical changes to which they were afterwards subjected. He emphasized the low ash content of these anthracites as pointing to the existence of a special type of mother substance. The authors say (p. 87) that "other reasons can be assigned for the lower ash content in question" but do not inform us what the reasons are.

But these are all comparatively inconsiderable errors and omissions. Upon the subject of the fusibility of ash in coal—a very important item in regard to the selection of coals for raising steam, especially where forced draught is employed—as the authors (p. 126) rightly say, "our knowledge is not sufficiently definite to warrant the laying down of any precise rules", though possibly it is related to the fusibility of alumina silicates. They have observed that it increases up to a certain point, "sometimes with its ferruginous character, sometimes, however, with its lime content, and, speaking generally, with the content of some 'most variable' constituent".

The exigencies of space do not permit of further perusing the fascinating subject of the chemical composition of coal, so ably and clearly and exhaustively treated in Chapters ix, x and xi, in which the work of Bedson, Burgess, Wheeler, Porter, Taylor, Discher and Bone, and other workers on the subject is fully discussed.

In regard to the subject of the action of oxygen at low temperatures on coal: the oxidation of coal is, as is now generally accepted, the cause of gob fires, but it cannot be accepted that "anthracites and anthracitic coals are so little affected that they may be considered as practically immune" (p. 194). I used to hold this view, until actual instances of spontaneous heating of anthracite in the mine, not only in the United States of America, but also in one case in a South Wales anthracite mine were brought to my notice.

Concerning the smoke nuisance, it was estimated, some years ago, that the material damage due to this cause in London alone amounts to £4,000,000 annually, and in Manchester, to £1,000,000 in addition to the "immeasurable evil effects of smoke and fog upon public health" (p. 218), a position which would be greatly aggravated by the establishment of super power stations in the proximity of our large towns were it not for the fact that they are compelled to adopt remedial measures. Such a station may burn upwards of one thousand tons per day (p. 231) with the resultant formation of 45 tons of sulphuric acid, 3–7 tons of nitric acid, and about 0·5 ton of hydrochloric acid, the danger from which being the fact that these deleterious substances are emitted from an area of a few hundred square yards instead of from five square miles of a town consuming the same amount of coal in its domestic fireplaces. It is gratifying to learn, however, that "a substantially complete removal is obtained at Fulham and at Battersea power stations by skilfully devised abstergent processes".

The authors deal consummately with the subject of the by-products derivable from coal; of particular interest in this respect is their account of a method of producing *methanol*, a possibility which has been explored since the War, namely, the pressure-catalytic-synthesis of methyl alcohol ('Methanol') from carbonic oxide and hydrogen contained in 'water gas', by exothermic action. A quite recent development of this process—the Fischer-Tropsch process—has resulted in obtaining thereby light oils, waxes and heavier oils, which by another process of treatment can, according to Prof. Fischer, be converted into lubricating oils. This process for the purposes of oil and petrol production may turn out to be a formidable rival to that of the hydrogenation of coal.

But I must bring this review to a close, however enthralling the subject. Enough, it is hoped, has been said to point to the catholicity and profundity of the work and to induce all interested in the subject to read it for themselves. The style is lucid and easy. To each chapter is appended an excellent bibliography. The illustrations are clear and helpful, and the tables, of which there are no less than 136, are not the least valuable part of the work—a work on which the authors are to be congratulated as well as the publishers.

R. A. S. REDMAYNE.

Properties of Carbon Dioxide

Carbon Dioxide
By Prof. Elton L. Quinn and Charles L. Jones. (American Chemical Society, Monograph Series, No. 72.) Pp. 294. (New York: The Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1936.) 37*s*. 6*d*. net.

THIS book is one of the American Chemical Society's valuable series of monographs which fulfil the dual purpose of presenting the available knowledge on the particular subject in a form generally readable by the scientific worker, and of promoting research by furnishing a well-digested survey of the progress already made in the field and by pointing out directions in which investigation needs to be extended.

In the present monograph, a survey has been made of physical, chemical and physiological properties of carbon dioxide, which should prove useful and suggestive, but the reviewer considers that there is a lack of proportion in the monograph as a whole and that too much space has been allocated to the three chapters on the commercial production and application of carbon dioxide in liquid and solid form. It may be mentioned that the two most important applications are the carbonation of beverages, for which the liquid is employed, and the refrigeration of ice cream, which requires the solid form The possibility of commercial application also appears to have influenced somewhat the selection and arrangement of the scientific data, due possibly to the fact that while one of the authors is a professor of chemistry the other was formerly chief engineer to the American Dry Ice Corporation.

In the first two chapters are found the scientific and industrial history of carbon dioxide and an account of its occurrence and functions in Nature. A later chapter of ten pages deals with carbon dioxide in relation to vital processes. Since carbon dioxide is not an active compound, it is perhaps not surprising that twenty-three pages have been found adequate to deal with its chemical properties. The authors themselves point out that the purpose of this chapter is to consider many of the acidic reactions in aqueous solution and to deal also with some reactions taking place in the dry gas. Physical properties are described in great detail in a chapter of seventy-nine pages, but here the authors confess that selection of the best and most reliable physical data is most difficult, and in many cases practically all the recorded data have been included and it has been left to the reader to select those he considers the most useful The remaining three chapters, dealing with manufacture and commercial applications, comprise nearly half the book, although the authors state in their preface that they have made no special effort to paint a picture of the carbon dioxide industry as it exists to-day.

From the preface also it appears that difficulty was experienced in presenting "a well co-ordinated discussion" of "such widely divergent ideas as the natural occurrence of carbon dioxide in Yellowstone National Park, the treatment of skin diseases with solid carbon dioxide and the blasting down of coal with the liquid form". It is suggested that the difficulty has arisen by failure to realize that carbon dioxide itself is the only co-ordinating factor, and whatever ramification the subject may possess it should be possible to adhere to the two purposes which this series of monographs seeks to fulfil.

R. T.

Vitamine und Mangelkrankheiten:

ein Kapitel aus der menschlichen Ernährungslehre. Von Dr. Hermann Rudy. (Verständliche Wissenschaft, Band 27.) Pp. ix+160. (Berlin: Julius Springer, 1936.) 4.80 gold marks.

THIS little book, which is of a size and price that would cause it to be sold for about 2*s*. 6*d*. in Great Britain, avoids many of the characteristics of current German scientific publications. Being of a semi-popular nature, it quite rightly refrains from giving detailed references and also, for the most part, investigators' names.

Few errors have been detected in the text, but the formula given for calciferol is now (and had been for months before this book was published) known to be inconsistent with experimental facts, which demand the presence of a methylene group and three conjugated double bonds. On the other hand, the recent work of Dam and his associates, leading to the recognition of an anti-hæmorrhagic factor, vitamin K, is given notice.

Dr. Rudy's observations (pp. 143 *et seq.*) on "Die Vitamine als Heilmittel" are particularly interesting and significant. Without at any point departing too ostensibly from current orthodox pharmacology, he gets extremely near to suggesting that the vitamins may be regarded, and used, as individual specific therapeutic agents, on the basis of their established physiological action rather than of their 'normal' role in 'natural' nutrition. So far, this view has only been tentatively and timidly adumbrated in speculative or controversial articles, but seldom, if ever, put forward in print for serious consideration by those who direct official medical and biochemical opinion. That it should now be implied or expressed in a book, and in a German book at that, seems to the reviewer a sign of the times. A. L. B.

Memoir on Fossils of the Late Pre-Cambrian (Newer Proterozoic) from the Adelaide Series, South Australia

By Sir T. W. Edgeworth David and Dr. R. J. Tillyard. Pp. xi+122+13 plates. (Sydney: Angus and Robertson, Ltd.; London: Australian Book Co., 1936.) 7*s*. 6*d*.

THIS volume appears to have been issued as a memorial to the late Sir Edgeworth David. It gives a fuller and more detailed account of the work published in 1928, of which a notice appeared in NATURE (123, 659). The supposed fossils were found in the Adelaide Series near Adelaide, and are regarded as indicating the existence of Algæ, Radiolaria, annelids and arthropods in pre-Cambrian times. The specimens which have been seen in England are far from convincing, but it is claimed that as the result of the mass effect of a very large collection "no Australian scientist, whether palæontologist, zoologist, or geologist, who has taken the trouble to study the specimens, has any doubt whatever as to their being genuinely organic".

The chief addition in this volume is an account of the supposed arthropods by Dr. R. J. Tillyard. He maintains their arthropod nature on the grounds that the specimens, although fragmentary, do show evidence of bilateral symmetry, segmentation, segmented appendages and sculpture. After comparing them with various groups of arthropods, he concludes that they show some relationship to the Eurypterida, but that they are more primitive than any known arthropods, and must be placed in an independent class, since the prosoma is formed of distinct segments, each with a pair of appendages. The abdomen is regarded as formed of seven segments, but without segmented appendages. The restorations give a clear idea of Dr. Tillyard's interpretation, but we cannot test their validity from the evidence of the specimens figured. An excellent portrait of the late Sir Edgeworth David forms the frontispiece to the volume.

Ziema:

Fizyka globu, mórz i atmosfery. Napisał Dr. Edward Stenz. (Z Dziedziny Nauki i Techniki, Tom 11.) Pp. xiv+303+26 plates. (Warszawa: "Mathesis Polskiej", 1936.)

THIS comprehensive Polish work on the physics (and incidentally much geology) of the globe, the sea and the atmosphere is a noteworthy publication and does credit to its author and his nation. It opens with a brief history of astronomy with reference to the earth and its relation to the sun, moon and planets. This is followed by a sketch of the geological epochs and such physical and chemical considerations as the magnetism and composition of the interior of the earth.

The section devoted to the sea is concerned with its magnitude and saline contents, and with tides and inundations. The role of the atmospheric envelope and the stratosphere and phenomena associated with them are considered, and in his final section the author discusses various cosmic phenomena, the age and probable fate of the world. Discoveries by Polish savants are referred to in detail and emphasis is given to matters of direct interest to Polish students. Thus, illustrations and examples are drawn wherever possible from local sources.

Food and the Principles of Dietetics

By Dr. Robert Hutchison and Prof. V. H. Mottram. Eighth edition. Pp. xxvii+634+3 plates. (London: Edward Arnold and Co., 1936.) 21*s*. net.

WHEN this work was first published, thirty-six years ago, little attention had been given in Great Britain to scientific problems relating to food and human dietetics. The authors were among the pioneers in this field, and their work greatly assisted in creating new interest in the subject. In the eighth edition, now available, the history of dietetics is outlined in a new chapter in which it is pointed out that "If the nineteenth century was the quantitative epoch of dietetics the present century has so far been a qualitative epoch". The great advance of knowledge of food and nutrition has necessitated a number of changes and additions, and these will serve to maintain the position of the volume as a readable account of human foods and principles of feeding, as well as an authoritative work of reference.

Soil Science in the Twentieth Century*

By Prof. J. Hendrick

MOST of our scientific knowledge of the soil has been built up during the past century. It was only with the development of modern science, and especially of chemistry and geology, that such knowledge could advance, and it was about a century ago that our early knowledge of the chemical composition and mineral constitution of the soil was built up. This knowledge has been advancing ever since but with particular rapidity during the present century.

Soil science in Great Britain was in a comparatively stagnant state at the beginning of this century. Britain had done much in the development of the fertilizer industry, though even in this, while other countries were advancing rapidly, we had been falling somewhat into the background during the last quarter of the nineteenth century.

A comparison of the text-books on agriculture and agricultural chemistry of the beginning of the century with those of the present day will illustrate the great change in outlook on soil science. There were no British text-books on soil science in 1900. Any text-books on this subject in English were American. Our knowledge of what was being done by soil investigators abroad was not extensive; of what was being done in Russia we knew nothing.

Britain is a comparatively small country falling within ten degrees of latitude, with a climate which is in all parts temperate and humid and with a rainfall which is well distributed throughout all seasons of the year and which varies from moderate to high. The soils of Britain had not been studied even over the whole limited range of the country, but almost entirely in a small region in the south-east and mainly at Rothamsted and Woburn. These were looked upon as typical soils, and all others were supposed to be more or less similar. If that was not definitely stated, it was tacitly assumed. It may be said that until the present century, and even until the second decade of the present century, our view of soils was narrow and insular. All others were expected to conform to "This blessed plot, this earth, this realm, this England", and it was a most blessed plot of the south-east of England which was the standard.

We did ourselves no good service from an imperial point of view by taking such a narrow and insular view of soils. While Britain is a small country of limited latitude and climate, the British Empire exists in every latitude and every kind of climate. In agricultural science and not least in soil science, great sections of the British Empire, not merely Canada, but Australia and South Africa as well, came to look to the United States rather than to Britain for information and guidance.

There are two great countries which, unlike Britain, extend through wide ranges of latitude and climate. These are Russia and the United States. Russian territory extends from arctic tundra to the subtropical, and embraces every kind of climate from warm humid and cold humid to arid and desert. The same is true of the United States, especially if we include Canada, which, in this respect, is in very close association with the United States, whose workers keep in view the soils of the whole North American continent.

The scientific work of the United States is published in English and is therefore always easily accessible to us. Russia, on the other hand, is cut off from us by the barrier of a language which few can read, and the remarkable soil work which was going on in Russia and has now produced such a great change and widening of the views of soil investigators throughout the world, was unknown in Great Britain until after the Great War, when it began to filter through to us from America, Germany and other countries.

What are these fresh views which we all sat at the feet of the Russians to learn? They treat the soil as an independent natural object worthy of study for its own sake and not merely as a useful medium in which to grow crops, or as a subsidiary branch of geology or chemistry or any other science. The branch of science which deals with soils they treat as an independent branch, which they call pedology. Many people in Great Britain and in America have now adopted this term and prefer to be pedologists—a word not in the dictionary—rather than soil scientists. My own preference is for a term which is readily understood by ordinary people.

Next, the Russians insist that the soil is the natural product of a number of soil-forming factors of which the most important is climate, and that its nature is not determined by its geological origin. Their great primary classification of soils is into a number of climatic zones. The most notable feature in the whole Russian philosophy of soils is the insistence on the importance of climate as a soil-forming factor. Climate plays the central part in their system of soil classification. This recognition of climate is not entirely a new idea. Hilgard in America, and others, had already shown that climate has a great effect on the nature and composition of soils.

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* From the presidential address to Section M (Agriculture) of the British Association, delivered at Blackpool on September 14.

In the old Russian Empire, and the modern union of Soviets, there are soils which have been produced in a great variety of climates in Russian Europe and Asia. The Russian soil workers set themselves to collect these and to examine them critically, and came to the conclusion that soils produced from a geological formation in a cool climate were very different from those produced from the same geological formation in a hot climate, and that those produced in a moist climate were very different from those produced from the same parent materials in an arid climate. In fact they showed that soils cannot be classified and characterized on a geological basis. Possibly some of them, and still more some of their enthusiastic converts in other lands, go too far in excluding geological origin altogether as a factor in soil formation.

The next great feature of the Russian system is the classification of soils according to what is found in the soil profile. The profile, as is now well known to all of us, though that was not so twenty years ago, is a section of the soil from the surface down to the parent material. If such a section is examined, it is almost invariably found to consist of a number of different layers, called horizons, which are generally easily distinguishable from one another. When a great many such profiles are examined from different parts of the world it is found that they fall into a number of definite types characteristic of the different types of soil. The profile is an expression of the results of the different soil-forming factors, and therefore characterizes the different types of soils as produced by the action of these factors. This is expressed by saying that the profile is the resultant of the pedogenic processes. The modern soil surveyor studies morphology of soil profiles and classifies his soils accordingly.

This is in outline very simple; in practice it is often very difficult, and is apt to give rise to differences of opinion, especially when those accustomed to the profiles of one part of the world are introduced to a new region with conditions different from those to which they are accustomed. It will be seen, too, that this scheme of a profile made up of horizons is a development of the old division of the soil into soil and subsoil. But there is an important difference; the terms soil and subsoil were applied to cultivated soils mainly, and the soil was, generally speaking, the layer which had been mixed and influenced by the implements and processes of cultivation, while the subsoil was the layer which was not touched by instruments of cultivation. Such a division is of no use to the modern student of soil morphology and genetics. The processes of cultivation have turned over and mixed the surface layers and have also modified those below the region reached by the plough The modern soil investigator, therefore, insists that the profile must be studied in undisturbed soil which has existed in its natural condition for a long period of time. To him the profile is the soil unit which must be studied as a whole, unmodified by artificial operations of man. This of course introduces difficulties in old settled countries of dense population, like our own, where most of the soils which are worth cultivation have been broken up and cultivated at one time or another. In the extensive, lightly populated areas of Russia or North America there are plenty of natural soils; but in applying modern methods of soil study to the soils of much of western and southern Europe and other regions of ancient civilization, modifications have to be introduced to allow for the influence of cultivation which, in many cases, extends over long periods of time.

The whole of the processes of soil formation are very complex and require much more study before we can hope to reach, I will not say a final, but a sound system of soil classification. The soil itself is, from every point of view, a very complex and variable material; and our present methods for its study and classification, though a great advance on what went before, are of very recent origin, and no doubt further great progress will be made as a result of the intensive studies to which soils are now being subjected in many lands.

In the above sketch I have merely referred to one or two features of the Russian soil philosophy which appear to me to be outstanding. Much of the Russian soil science is at present remote from agricultural practice. It is curious that in spite of their theories of Government and of five-year plans for the rapid practical improvement of the condition of the people, the Russians are the champions of pure soil science, of the view that our study of soils should proceed without reference to any use that may be made of such knowledge for the service of agricultural practice, or for the production of wealth from the soil.

The fundamental importance of soil moisture has been known for ages. Without water, crops cannot grow, and with excess of moisture we get marsh or swamp and our ordinary crops are drowned out. A proper supply of moisture is more important to crops than all the fertilizers put together. In the modern theory of soil formation and classification the important part played by water is recognized. The two important factors in climate, those which do most to determine what the soil is to be, are the supply of water and the temperature. In considering water supply it is not sufficient to consider the rainfall—the humidity, the distribution of the rainfall and the topography all enter into the picture. A rainfall which is sufficient to wash through the soil and leach away soluble constituents in a cool humid climate may all be re-evaporated and leave nothing to wash through the soil in a warm climate with a dry atmosphere. Again, if all the rain falls at one season of the year a part of it may seep through the soil and escape as drainage water, while if the same rainfall is distributed throughout the year so much may be re-evaporated that there will be none to escape as drainage.

Considering the importance in soil formation of water which passes through the soil, and of the amount and nature of materials in solution and suspension which are washed away by such water, or removed by it to lower layers of the soil, and the importance to soil fertility of the relations of the soil to water, and of the economic importance of drainage in connexion with the loss of nitrogen, lime and other manurial constituents from the soil, it has always been a matter of surprise to me that more use is not made in soil studies of drain gauges or lysimeters, or instruments of a similar kind.

The first drain gauges, so far as I am aware, were made by Lawes and Gilbert at Rothamsted more than sixty years ago. They were designed to study evaporation and percolation in relation to depth of drainage, and were therefore of different depths, 20, 40 and 60 inches respectively. They were also used to study the amount of nitrogen washed away from uncropped and unmanured soil. The blocks of soil enclosed in these drain gauges were never broken up, they were built with as little disturbance as possible into the water-tight structures which enable the drainage to be measured. They consist therefore of real soils which have been formed by a long course of natural soil-forming processes. Similarly the drain gauges which I have had built at Craibstone, near Aberdeen, have been formed by enclosing, without disturbance, in water-tight boxes of Caithness slate, blocks of natural soil which have never been broken up. My drain gauges are intended to study the changes which take place in cultivated soil, and the losses which take place in the drainage water during ordinary processes of cropping and manuring.

Such drain gauges are not easy to construct. I suppose that is why this method has been so little used in the study of soils. It is much easier, and cheaper, to build a water-tight box and fill subsoil and soil into it, than it is to enclose a block of natural soil, weighing several tons, in a water-tight structure. If the easier method is adopted, as has been done to a large extent in America and elsewhere, its limitations must be recognized. The soil, once it is broken up and filled into a lysimeter, is no longer a natural soil, and it is difficult to say how long it will take under the influence of the soil-forming processes of the locality to become once more a real soil such as is provided in Nature.

The development of our knowledge of soil colloids and base exchange during the present century is second in importance only to the advance which has been made in the science of soil formation, structure and distribution. The beginnings of our knowledge of this subject can be traced back to the middle of last century when Way showed that the ammonium of ammonium sulphate, or the potassium of potassium sulphate, was retained by the soil while an equivalent amount of calcium went into solution and could be washed away as sulphate. He also showed that this power resided in the finest mineral part of the soil, the clay, and he regarded the action as an ordinary case of double decomposition between clay and the soluble, neutral salt in solution.

Though there was much discussion about these phenomena, which were regarded as of the greatest practical importance because they showed that valuable manurial bases when applied in a soluble form could be absorbed and retained in the soil, and though soil investigators of last century were divided into two camps, one regarding this fixation of bases as a chemical precipitation by double decomposition and the other looking upon it as a physical process of absorption, little further advance was made until the present century. By that time, considerable advance had been made in our knowledge of colloid chemistry, and we also knew that there were two types of colloid complexes found in soils, one mineral and the other organic.

We now know that this process of base exchange is a colloid phenomenon, and follows the laws of colloid chemistry. It is not confined, as Way supposed, to the fine mineral matter of the soil, but is a property of the organic colloids also. The old controversy as to whether this is a chemical or a physical phenomenon is thus cleared up and both sides are shown to be right or both wrong, according to taste, for both sides knew nothing of that border-line field of colloid phenomena where physics and chemistry blend, and, in the best modern manner, tend to become indistinguishable.

Our knowledge of the chemistry of humus, in spite of the great amount of work which has been done upon it in recent years by workers in many countries, is still in a state of doubt and darkness, but in the last few years we have learned a great deal about the chemical structure of clay. The application of X-ray methods of analysis has shown that much clay material exhibits a definite lattice structure, and that there are several different minerals, showing at least two different types of lattice structure, to be found in clays. Some light has also been thrown by this work on the nature of the base exchange capacity of clay and on the great differences in base exchange capacity which are found in different types of clay substances.

One cannot give a very hopeful account of the progress of our knowledge of humus. We have not yet found any clear method of unravelling its structure and of showing what is the nature of the colloid molecules which build up the main part of this very important soil constituent.

In many other directions, fundamental soil science has made in this century, and is making, marked advances. Fertilizers, for example, we may class along with the soil, for they are substances used to increase the productivity or make up the deficiencies of the soil. From small beginnings a century ago, the fertilizer industry has grown to be one of the world's greatest chemical industries. In the early days of the industry Great Britain played a notable part, but in the latter part of last century and the early part of this one, when the whole of our soil science was in a somewhat backward position, our fertilizer industry also fell into the background. We have recently seen a great revival consequent upon this industry again becoming scientific instead of depending merely upon commercial and business ability. For this change and improvement we may, I think, give much of the credit to Imperial Chemical Industries, Ltd., who are now our greatest fertilizer manufacturers, and who make the manufacture of manures an important section of their business. The older type of fertilizer manufacturers may have employed a few works analysts, but they did not pay for the best scientific brains to help them to introduce new processes and to improve old ones. That has been changed by I.C.I., and we have a new spirit in the fertilizer industry and we are regaining something of the great position we once held in that important branch of chemical manufacture. It is to be hoped that this will continue. If we are not to fall back into the old state of lethargy we must continue with long-range research, as the Germans and Americans are doing, carried out by educated and competent persons. That is the only way if we are to continue to advance and keep in the front.

Physics is not the only branch of science in which revolutionary changes have been made in the twentieth century. Even in soil science we have seen a structure built up which the agricultural chemists of a generation ago would find strange. In the British Isles at the beginning of the century there was almost no soil science; now we are taking our due part in building up and nurturing this branch of knowledge. We have now not only the great station at Rothamsted but also the Macaulay Institute at Aberdeen, which is engaged in the study of soils of different types from those of the south-east of England and is approaching soil study from a somewhat different angle. There are also in our universities and agricultural colleges quite a number of soil investigators of distinction who are dealing with the soils of many other parts of the country. At the same time, it is probably true to say that in Britain the fundamental attitude towards soil study remains the same. It is difficult for us to achieve the complete detachment of the Russians and study soils entirely apart from any practical agricultural applications which our studies may have.

But to what are we heading ? Of what use is it all ? Are we only increasing sorrow by increasing knowledge ? Our increased knowledge should give us increased power to use the soil, and that surely means increased production. We are told there is already over-production and that what is required is restriction of production. We read in our papers of crops being destroyed because they cannot be used, or because it does not pay to harvest them. In the United States, and elsewhere, the growth of fundamental food crops, like wheat, has been restricted. In Great Britain arable land is decreasing while at the same time the import of foodstuffs is being restricted.

Has everybody in this country, and in every other country, too much, or even enough, food ? Do we not, at the same time as we are crying out about over-production, hear an equal outcry about malnutrition and under-feeding even in this comparatively prosperous country ? The two things do not fit together. They cry out against one another. They cannot both be right. But we all know that there are many people, forming quite a large section of the population, who have not over-abundance, who have not even enough. This, which is true of Great Britain, is, unless we are strangely misinformed, true in a much higher degree of the world at large. This is not a problem of soil science, but a problem for the statesman, the social reformer and the economist. The soil scientist can safely go on and increase our knowledge of soils, and hope that, in the long run, it will increase production and lessen labour. Increased wealth, especially in the essential things produced from the soil, is a blessing, not a curse, and if it can be obtained more easily, and more certainly, through the power and control provided by increased knowledge, that is all to the good.

The solution of our difficulties must be looked for by the increase of impartial scientific knowledge in other directions. It is our social organization, our statesmanship, our economic system which are at fault when the abundance which is produced cannot be brought to the many who are in need of it. Social and political sciences and even economic science are no doubt applying themselves to this problem, and let us hope they will be able to remove it from an atmosphere of social prejudice and party bias to the calm, truth-seeking atmosphere of pure scientific investigation. Agricultural science can go forward fearlessly to increase knowledge in the good hope and belief that increased knowledge will be in itself a blessing.

Cancer Research in Great Britain

THE thirteenth annual report of the British Empire Cancer Campaign was presented at a meeting held at the House of Lords on November 23. The report gives an effective summary compiled by institutions and individuals of the greater part of British research on malignant disease. The field of cancer research may be divided into three parts : the origin of the disease ; the nature of malignant growths ; and the effect of treatment in alleviating or curing the disease. Investigations in man, in animals and in cells growing outside the body in tissue culture have been made in all three directions during the last year.

Attempts to understand the nature of the processes which cause cancer in man have been made by studying cancer mortality according to the organ in which it occurs in different districts and different occupations. Observations of this kind have in the past indicated that coal tar and certain lubricating oils might be carcinogenic and so lead eventually to the isolation of the pure carcinogenic compound, benzpyrene. Previous investigation into the mortality from cancer in different countries has shown surprising differences, such as the high incidence of liver cancer in the East and its comparative rarity in Europe. In Switzerland, cancer of the œsophagus is more frequent than in the rest of Europe. Dr. Stocks, of the General Register Office, has examined the geographical distribution of 522,251 deaths occurring between 1921 and 1930 from cancer in the counties of England and Wales. He has calculated the "actual mortality per cent of that expected from the distribution of population by age and class of district". The results are depicted in a series of maps. Some of the more outstanding differences are shown in the accompanying table.

Death from cancer of all sites is more common than would be expected in North Wales and unexpectedly rare in Radnor and East Suffolk. In Wales, gastric cancer is frequent, and Carnarvonshire accounts for more than twice the expected number of deaths, but lung cancer is rather infrequent. The results show resemblances between the distribution of œsophageal cancer and rectal cancer, while the distribution of gastric cancer is quite different. The distribution of the ratios for breast cancer is much more uniform than for any other type of cancer shown. It is as yet impossible to determine whether these differences are due to genetical factors, to geological or meteorological conditions, to the different diets and habits of people, or to the difference in accuracy of diagnosis.

DEVIATION OF ACTUAL MORTALITY FROM THAT EXPECTED FROM THE DISTRIBUTION OF POPULATION BY AGE AND CLASS OF DISTRICT.

	High Incidence	Low Incidence
All sites (males)	Flint, London, Huntingdon.	East Suffolk, Radnor.
All sites (females)	Anglesey, Merioneth	Radnor.
Stomach (males)	Ely, Anglesey, Carnarvon, Denbigh, Merioneth, Montgomery, Pembroke.	East Suffolk.
Stomach (females)	Anglesey, Carnarvon, Denbigh, Merioneth, Pembroke.	West Sussex.
Œsophagus (males)	Berkshire.	Durham, Lincoln (Holland and Lindsey), Northumberland, Nottingham, Merioneth, Monmouth
Skin (males)	Lincoln (Holland), Anglesey, Cardigan	Gloucester, Carnarvon, Radnor
Lung (males)	Hertford, London, Middlesex, Essex, Nottingham.	Berkshire, Cumberland, Devon, Dorset, Durham, Gloucester, Lincoln (Holland), Northampton, Suffolk, all Wales except Flint.

Prof. E. L. and Mrs. Kennaway have computed the incidence of death from cancer of the lung and larynx in a large number of occupations, for the years 1921–32. During the period 1919–34 there was an eight-fold increase in the mortality from lung cancer. The cause of this increase has not been identified, but it does not appear to be due to urbanization as the relative increase among agricultural workers is only slightly less than among the total population. Workers exposed to coal gas and tar and those engaged in tobacco and metal grinding trades show high susceptibility, while coal miners, cotton spinners and agricultural workers have a low susceptibility to lung cancer. This latter finding is reflected in one of Dr. Stocks's maps. Mortality from cancer of the lung is less than would be expected in agricultural areas and in the mining areas of South Wales, Cumberland and Durham.

Results obtained in studying the effect of X-rays and radium on malignant growths are reported from many centres in Great Britain, Australia and Canada. In treatment there has been a tendency to utilize deep X-ray therapy for lesions in which radium has previously been usually employed. An interesting development of X-ray technique is the use of the low-voltage (60,000 volt) tube advocated by Prof. H. Chaoul of Berlin With this instrument the actual source of the X-rays can be placed within a few millimetres of the tissues. It is as yet too early to compare this with the older methods, but it should be advantageous in certain cases. The comparison of results obtained by different methods of therapy will be simplified by the adoption of a standard method of recording cancer cases in different hospitals. The value of such standard records is enhanced now that it is realized that accurate dosage is important for successful treatment. It is essential to protect the operators from stray radiation, and workers in some centres carry small charged condensers, the amount of discharge occurring in the condenser gives a measure of the radiation and acts as a warning or tell-tale to the therapist.

X-rays and radium are both able to produce tumours and also to destroy them. Dr. A. Haddow has found that several chemical agents which produce cancer when applied to animals also inhibit the growth of tumours. The inhibition appears to some extent specific for carcinogenic agents, although feebly-carcinogenic and non-carcinogenic compounds are sometimes inhibitory. Many non-carcinogenic compounds have no growth-inhibiting effect. Not only tumour growth but also body growth is decreased by treatment with carcinogenic hydrocarbons, and it is suggested that the carcinogenic action is the result of a restraining action rather than stimulating action on cell growth. The movement of the fluorescent carcinogenic hydrocarbons in the body has been observed in a darkened room under ultra-violet illumination by Dr. P. R. Peacock. He finds that colloidal particles of hydrocarbons are rapidly removed from the blood stream by the liver and then excreted into the intestine, dissolved in bile. It is possible that the compounds are reabsorbed from the intestine into the blood stream.

The first known pure carcinogenic compound was 1 : 2 : 5 : 6-dibenzanthracene, and it is interesting to see how its molecular structure can be modified without destroying the biological activity, as shown by further work at the Royal Cancer Hospital. 1 : 2 : 5 : 6-dibenzfluorene, in which the 6-membered central ring is replaced by a 5-membered ring, is carcinogenic. 1 : 2 : 5 : 6-dibenzacridine and 3 : 4 : 5 : 6-dibenzacridine, in which one of the central carbon atoms of the original compound is replaced by nitrogen, are carcinogenic. While 1 : 2 : 5 : 6-dibenzanthracene is much more active than the 1 : 2 : 7 : 8- (or 3 : 4 : 5 : 6-) compound, 3 : 4 : 5 : 6-dibenzacridine is much more active than 1 : 2 : 5 : 6-dibenzacridine. If two carbon atoms are replaced by nitrogen as in 1 : 2 : 5 : 6-dibenzphenazine the activity disappears. Other new carcinogenic compounds are 1 : 2 : 5 : 6-dibenzcarbazole and 3 : 4 : 5 : 6-dibenzcarbazole, which may be considered as dibenzfluorene compounds with one nitrogen in place of one central carbon atom. These compounds resemble the acridine derivatives in that greater activity is associated with the 3 : 4 : 5 : 6-configuration. Painting of mice with 3 : 4 : 5 : 6-dibenzcarbazole produces epitheliomata on the skin and proliferation of the bile ducts, and nodules resembling hepatoma in the liver.

Some derivatives of 1 : 2 : 5 : 6-dibenzanthracene have considerable œstrogenic activity. Profs. Cook and Dodds and Dr. Lawson have shown that 9 : 10-dihydroxy-9 : 10-di-*n*-propyl-9 : 10-dihydro-1 : 2 : 5 : 6-dibenzanthracene can fully reproduce almost all the biological effects that are known to be produced by the natural hormone œstrone. New compounds have now been tested which have œstrogenic activity but do not contain the phenanthrene nucleus. The most active of these new substances appears to be 1 : 2-dihydroxy-1 : 2-di-α-naphthylacenaphthene and the simplest compound known to have œstrogenic activity is 4 : 4′-dihydroxy diphenyl.

Further work on the relation of ovarian hormones to cancer is reported. Mr. Burrows obtained mammary tumours in castrated male mice which were painted with a benzene solution of œstrone. Dr Bonser has compared the reaction of male mice of two pure strains to painting with œstrone. In one agouti strain, in which spontaneous mammary cancer never occurs, there was widespread generalized growth with production of acini but no production of mammary cancer. In an albino strain, the females of which often develop mammary cancer, the males treated with œstrone showed a more localized acinar development, and this was associated with the development of mammary carcinoma. The results show how reaction to œstrone is dependent on the ancestry of the animals used, and also how the two factors, heredity and environment, are concerned in the origin of malignant disease. There is little doubt that when we can fully account for the distribution of human cancer in terms of these factors, we shall be near to the solution of the problem of the prevention of the disease.

The Observational Approach to Cosmology

SINCE its first announcement by Dr E. P. Hubble in 1929, the existence of a linear relation between 'velocity' and distance among the extra-galactic nebulæ has excited a great deal of theoretical interest, the more so since it appeared to be a direct confirmation of the instability of the Einstein universe predicted by Lemaître. It was therefore not unfitting that the discoverer of the relation, himself a Rhodes scholar, should have been invited to deliver the Rhodes Memorial Lectures in Oxford on October 29 and November 12 and 26, or that he should have used this opportunity to present the observer's interpretation of the wealth of material since accumulated on this problem by himself. The lectures, which dealt in turn with the observable region, the role of the red-shifts, and possible models of the universe, have revealed that a static universe with a hitherto unsuspected dependence of light frequency on distance is probably more acceptable than one or other of the homogeneous expanding models of general relativity.

This startling conclusion depends in a very large measure on the 'luminosity' methods of distance determination necessarily used for the extra-galactic nebulæ. The intrinsic luminosity of the average extra galactic nebula having been determined by means of the Cepheid variables found in nebulæ of the 'local group', the distance of any nebula can be found from its apparent luminosity and the inverse square law. The apparent luminosity is, however, affected by the observed redward displacement of the spectrum. Assuming that the energy distribution in the spectrum of an extra-galactic nebula is similar to that of the sun, as is very nearly the case, and correcting for atmospheric absorption, reflectivity of the telescope and plate sensitivity, one can find empirically the correction, Δm_1, to be applied to the apparent photographic magnitude for any desired red-shift; with sufficient accuracy this correction is given by $\Delta m_1 = 3\Delta\lambda/\lambda$. If, however, the nebulæ are actually receding from us, an energy correction alone will not suffice, but in addition a correction must be made for the fact that we receive fewer quanta per second from a receding nebula than from a stationary one. This correction amounts to $\Delta m_2 = \Delta\lambda/\lambda$. Clearly the apparent luminosity to be used in finding the distance of the nebula from its intrinsic luminosity and the inverse square law will depend upon whether the nebula is receding or not, and if there were only some independent means of distance determination the presence or absence of recession could be immediately inferred. Even in the absence of an independent method of distance determination, it is still possible to make some progress in distinguishing between recession and non-recession by counts of nebulæ.

If the total number of nebulæ, or the number of nebulæ per square degree, are counted to different limiting apparent magnitudes, and these limiting magnitudes after the appropriate corrections for recession or non-recession converted to distances, the nebular counts will yield immediately the spatial distribution of nebulæ as a function of distance. In his recent lectures, Hubble used five nebular counts to limiting apparent magnitudes 18·5, 19·0, 19·4, 20·0 and 21·0, the second of these counts having been made by Mayall with the 36-in. Crossley, the remainder by Hubble with the 60-in. and the 100-in.; the last count, it is interesting to note, is within half a magnitude of the limit set for the 100-in. by scattered sky light. Correcting these limiting magnitudes for energy effect alone (no recession), the five counts are perfectly represented by the relation

$$\log N(m) = 0{\cdot}6\,(m - \Delta m_1) + \text{constant}.$$

This linear relation is precisely that which would hold if the spatial distribution of the nebulæ were uniform out to the limit of the counts, that is, to a distance of some five hundred million light years. We can interpret this result to mean that we are seeing only a portion of a much larger universe, a portion within which the spatial distribution of nebulæ is uniform, and a universe in which the frequency of a light quantum varies linearly with the distance. Without in any way straining the observations, but at the expense of a newly postulated property of radiation, we can describe the nebular counts in terms of a simple static universe.

If, on the other hand, the limiting magnitudes of the nebular counts are corrected for recession as well as for energy, the resulting apparent spatial distribution is one centrally symmetrical about the galactic system with necessarily increasing spatial density outwards. Since our galactic system appears to be closely similar in intrinsic luminosity and mass to the nebulæ whose density distribution we are discussing, there is no reason why the galactic system should occupy so dominant a position in the universe, and we must regard this spatial distribution, found when we assume the nebulæ to be receding, as only apparent. On

Milne's original kinematic model of the universe, this outward increase in density is just what would be expected from the fact that we do not have, as it were, an instantaneous view of the universe, but are seeing the more distant nebulæ as they were some five hundred million years ago. When the observed density distribution is corrected to the instantaneous view, the resulting spatial distribution turns out to be uniform ; since on the kinematic model, however, uniform density distribution can only occur once, Hubble finds it nearly as unsatisfactory to suppose that we are just happening to observe the universe at a special instant in time, as if we were observing from a specially favoured point in space

Still assuming that the observed red displacement is due to a velocity of recession, and that therefore the apparent spatial distribution of nebulæ increases radially outwards, Hubble next examined the apparent distribution of nebulæ predicted by the homogeneous expanding models of general relativity, a special case of which also includes in many of its aspects Milne's kinematic model. Tolman has shown that the nebular counts predicted by these models take the form

$$\log N(m) = 0{\cdot}6\,\{m - \Delta m_1 - \Delta m_2 + F(R)\}$$

where R is the radius of space curvature. At the very outset an almost insuperable difficulty is encountered in that the observed counts do not obey a relation of this form. If, however, it be assumed that the observed counts are subject to almost impossibly large systematic errors, the relation and the observations may be used to calculate a value of R. The resulting value is of the order of five hundred million light years, rather less than the penetrating power of the 100-in. telescope, and since there is a relation between R and the density of matter in space, the density must be 10^{-26} gm. cm.$^{-3}$, which is many times greater than the mean density produced by the nebulæ alone. To account for this density we must postulate that inter-nebular space is filled with matter the mass of which is greatly in excess of the total mass of the nebulæ, and which is distributed in such a form as to produce no absorption of light in space, since any absorption would demand a still smaller radius of curvature and larger mean density.

If no recession is assumed, the observed nebular counts are satisfactorily described by supposing that we are observing a finite portion of a much larger universe of nebulæ, but a universe in which the frequency of light varies uniformly with the distance. If, on the other hand, recession is assumed, the observed nebular counts are not satisfactorily described by any of the homogeneous expanding models of general relativity, but if forced to fit require that the universe be closed, that we have already explored it to its outmost bounds with the 100-in. telescope, and that it is a universe dominantly filled with non-luminous matter distributed in such a way as to absorb or scatter negligibly small amounts of light.

The large and appreciative audiences who followed the three lectures, each a model of exposition and clarity, had little difficulty in agreeing with Dr. Hubble that the consequences of assuming no recession were the less difficult to accept.

H. H. P.

News and Views

Prof. A. N. Talbot

Prof. Arthur N. Talbot, emeritus professor of engineering in the University of Illinois, has been awarded the John Fritz Gold Medal, the highest of American engineering honours. Prof. Talbot, who is seventy-nine years of age, was cited as "moulder of men, eminent consultant on engineering projects, leader of research, and outstanding educator in civil engineering". The award is made annually by a board composed of sixteen past-presidents of the four national societies of civil, mining and metallurgical, mechanical and electrical engineers. Prof. Talbot was born in Cortland, Ill., on October 21, 1857. He has been engaged in engineering work since 1881, his activities embracing railroads, roads, bridges, buildings and municipal public works. Prof. Talbot aided in the development of the testing laboratories and the College of Engineering of the University of Illinois. He has been active in the formation and development of the Illinois Engineering Experiment Station, in connexion with which he has made numerous investigations in the properties of steel, brick, concrete and reinforced concrete, and in water purification, sewage treatment and hydraulics. Among previous recipients of the John Fritz Gold Medal have been Lord Kelvin, Thomas Edison, Guglielmo Marconi, Elihu Thomson and Sir Robert Hadfield.

Sir Robert Mond

Sir Robert Mond has been elected an associate foreign member of the Académie des Inscriptions et Belles Lettres in Paris, in succession to the late King Fuad of Egypt. Sir Robert Mond's wide interests are illustrated by the fact that he is honorary secretary of the Davy Faraday Research Laboratory at the

Royal Institution, chairman of the Norman Lockyer Observatory Corporation, and also president of the Egypt Exploration Society; he is a Messel medallist of the Society of Chemical Industry, a past president of the French Society of Chemical Industry, and he has carried out noteworthy archæological excavations at Thebes, in Palestine, and in Brittany. The museum at St. Germain has been much enriched as a result of his excavations in Brittany. The Académie des Inscriptions, by its election of Sir Robert as a foreign associate member, has attracted to its service one whose knowledge in many fields can scarcely fail to promote its activities and influence.

Prof. A. F. Burstall

Dr. Aubrey F. Burstall has been elected professor of engineering and dean of the faculty of engineering in the University of Melbourne, Australia. Dr. Burstall is a son of the late Prof. F. W. Burstall, who was professor of mechanical engineering in the University of Birmingham in 1896–1931. Dr. Burstall, who is thirty-four years of age, received his education at King Edward's School (New Street), Birmingham, at the University of Birmingham and at St. John's College, Cambridge. The results of his work on the combustion of various gaseous fuels in the high-speed internal combustion engine were published in a series of papers before the Institution of Automobile Engineers. Dr. Burstall joined in 1925 the staff of Synthetic Ammonia and Nitrates Ltd. at Billingham, which in 1928 became a constituent company of Imperial Chemical Industries Ltd. He held various positions of increasing responsibility on the engineering staff and in 1930 was appointed deputy chief engineer of the Billingham Factory. In 1933 he resigned his position to become technical adviser to the Aluminium Plant and Vessel Company of Wandsworth, London. The Engineering School at the University of Melbourne, to which Dr. Burstall is going, is one of the largest in Australia, the students numbering nearly two hundred. During the last two years of the four year course the undergraduates specialize in either civil, mechanical, mining, electrical or metallurgical engineering before taking their degrees. Dr. Burstall succeeds Prof. Wilfrid Kernot, who is retiring in March at the end of the present academic year.

Ernst von Bergmann

Ernst von Bergmann, who was one of the most skilful surgeons and commanding personalities in Germany of the last century, was born at Riga on December 16, 1836. He received his medical education at Dorpat, Vienna and Berlin and qualified on November 13, 1860. He commenced his career as assistant in the Dorpat surgical clinic and afterwards served as a medical officer in the Prussian Army in the war with Austria in 1866 and in the Franco-Prussian war in 1870. He was elected professor of surgery at Dorpat in 1871. In 1877, when war broke out between Turkey and Russia, he became consulting surgeon to the Russian Army invading Rumania, and in the treatment of wounds carried out the antiseptic method just introduced by Lister. His activities as a military surgeon, however, were cut short by a severe attack of dysentery, and in 1878 he was appointed professor of surgery and senior surgeon to the Julius Hospital at Wurzburg. He remained there until 1882, when he succeeded Langenbeck in the chair of surgery at Berlin. In 1887 he attended the Emperor Frederick in his last illness, when an unfortunate dispute as to the correct diagnosis and treatment arose between the German surgeon and Morell Mackenzie, the well-known London laryngologist and author of "Frederick the Noble".

Von Bergmann is best known for his introduction of aseptic surgery, the principles and practice of which he described at the Tenth International Medical Congress held at Berlin in 1890 in conjunction with his assistant C. S. Schimmelbusch, whose work on the subject is a surgical classic. Von Bergmann also made a valuable contribution to the literature of military surgery by his works on injuries to the head and brain and gunshot wounds of the knee-joint. In association with Profs. von Bruns of Tübingen and Mikulicz of Breslau, he edited a handbook of practical surgery, of which the first edition appeared in 1900. He took an active part in the promotion of post-graduate study and was the founder and moving spirit of the Berlin ambulance organization. He was the recipient of many honours both in Germany, where he was given the title of Excellency and made a member of the Prussian House of Lords, and in other countries including England, where he was elected in 1900 an honorary fellow of the Royal College of Surgeons. He died at the age of seventy years on March 25, 1907, and was succeeded in the chair of surgery at Berlin by Prof. August Bier, who celebrated his seventy-fifth birthday on November 24.

Alexander Neckham (1157-1227)

In his Friday evening discourse at the Royal Institution on December 4, Sir Stephen Gaselee discussed "Natural Science in England at the End of the Twelfth Century". It was impossible to survey all the English writers who were treating of natural science about A.D. 1200, but there is fortunately one who was widely read and a good compiler, and at the same time a personal observer of Nature—Alexander Neckham, born in 1157. He was born at St. Albans; afterwards he was headmaster of a school at Dunstable, and also studied in Paris. He later joined the Augustinian Canons at Cirencester, where he spent the rest of his life, becoming their abbot in due course, and died about 1227. He was an author of many and various works: one is called "Of the Natures of Things", and is partly a compilation from Pliny, Solinus and Cassiodorus; but is not without evidence of his own personal investigations. There is continuous moralizing throughout the book; but in natural science he begins with a description of the firmament, the sun, moon and stars; then the four elements; and then starts a survey of the animal world, beginning with birds. He intersperses his scientific descriptions with anecdotes, sometimes amusing, as of those of the hawk and the eagle, the parrot, and the wren. Turning to fishes, he first refers to some of the physical properties of water and then describes the inhabitants of the deep with a story about the plaice: fishes finished, he describes minerals, with an interesting account of the properties of the loadstone, and vegetables: and then the animal kingdom, with amusing stories about weasels, monkeys and lions: and finally comes to the 'lord of creation', man; after a talk of light and mirrors, he describes the purports of the farm-yard and the dwelling house, with an interesting discussion on silk-worms, and incidentally mentions education and the universities of his day.

British Association: Officers for 1937

THE annual meeting of the British Association will be held next year in Nottingham on September 1–8 under the presidency of Sir Edward Poulton. The following sectional presidents have been appointed: Section A (Mathematical and Physical Sciences), Dr. G. W. C. Kaye; B (Chemistry), Dr. F. L. Pyman; C (Geology), Prof. L. J. Wills; D (Zoology), Prof. F. A. E. Crew; E (Geography), Prof. C. B. Fawcett; F (Economics), Prof. P. Sargant Florence; G (Engineering), Sir Alexander Gibb; H (Anthropology), Dr. J. H. Hutton; I (Physiology), Dr. E. P. Poulton; J (Psychology), Dr. Mary Collins; K (Botany), Prof. E. J. Salisbury; L (Education), Mr. H. G. Wells; M (Agriculture), Mr. J. M. Caie.

Peking Man: Further Discoveries

RECENT excavation in the cave of Choukoutien, the home of Peking man, has proved fortunate beyond all expectation. No less than three new skulls of *Sinanthropus* have been added to the relics of this primitive type of early man. On October 22, Mr. L. P. Chia, of the National Geological Survey of China, brought to light a left mandible with teeth pronounced to be male in type, to which Sir Grafton Elliot Smith refers in a letter to *The Times* of December 5. This was followed by the discovery by the same excavator of two skulls (*The Times*, Nov. 20) and to this in turn has succeeded a further discovery of another skull, which, if the description given in the dispatch from the Peiping correspondent of *The Times* of December 8 be accepted as accurate, may well prove of even greater significance than the earlier finds of new material. With the two skulls previously known, of which the first was found by Mr. W. C. Pei in December 1929, there are now five skulls of *Sinanthropus pekinensis* in existence, while a sixth has been reconstructed from fragmentary finds by Prof. Franz Weidenreich, the director of the Cænozoic Research Laboratory of the Geological Survey. The new material is of outstanding importance in view of the fact that the skulls are those of fully developed adults, whereas the two skulls previously known were those of adolescents. Of the skulls recently discovered, the first two are of a male and a female, in age between forty and fifty years. Added evidential value attaches to the third skull owing to the fact that it is in a more complete state of preservation than any previous specimen. Certain parts of the base of the skull missing in the other skulls are here present, as well as parts of the facial skeleton and nasal structure.

Significance of Peking Man

THE relics of Peking man available for study at the Peiping Union Medical College, together with the new skulls, represent twenty-four individuals, and include twelve lower jaws and nearly one hundred teeth. They fully justify the description of them by Prof. Weidenreich as the "richest and most complete collection of human fossils ever recorded, unique in every respect" (*The Times*, Nov. 25). Since Prof. Weidenreich's appointment to the Rockefeller Institute, constituting him Director of the Cænozoic Research Laboratory in succession to the late Dr. Davidson Black—an appointment made on the recommendation of Sir Grafton Elliot Smith, as the latter now reveals in his letter to *The Times*, where, however, by a clerical error the name appears as "Weideman"—he has naturally devoted much time and attention to the study of Peking man, and in a recent publication (see NATURE, **173**, 73) has put forward some interesting and suggestive conclusions as to the relation between *Sinanthropus* and Mongolian man, while further important results have accrued from his comparative studies based more particularly on the examination of the endocranial casts (NATURE, Oct. 17, p. 689). With this additional important material at his disposal, illuminating studies may be anticipated. While it is too early, and too little information is available, to attempt any forecast of the direction in which results are likely to tend, it is interesting to note that it is stated that the female skull has many similarities to *Pithecanthropus*, while the male skull is much higher and nearer Neanderthal man. Further, Prof. Weidenreich is reported to have said that the various specimens of Peking man form links between *Pithecanthropus* and Neanderthal man. Sir Grafton Elliot Smith's letter to *The Times*, relying on information supplied by Mr. W. C. Pei, now superseded, expresses some anxiety as to the future of these investigations. Clearly, in view of the importance of the material now awaiting examination, any serious interruption or even break in continuity would be a catastrophe.

British Launderers' Research Association

EXTENSIONS to the laboratories of the British Launderers' Research Association were opened by Sir William Bragg on December 1. Mr. W. H. Markham, chairman of the Association, mentioned, in his introductory remarks, that the recent extension of the basis of membership of the Association has met with a good response from the industry, and also that, with an increase of the maximum grant received from the Department of Scientific and Industrial Research, the income of the Association in the coming year will exceed £10,000. The Association, which was formed in 1921, early commenced a systematic investigation of each section of the laundry process. It instituted methods of measuring colour and observing the efficiency of cleansing on washed articles. Research work now in progress includes studies of the fundamentals of detergency, for example, an investigation of the physical properties of soap and alkaline solutions as well as those of the new detergents known as sulphonated fatty alcohols. Work is also proceeding upon engineering problems which are encountered in laundry machinery. The examination of plant, products and materials, of new and laundered fabrics, is a part of the routine work of the laboratories. In addition, an analytical department undertakes the analysis of products used by the launderers. The information gained is published in the form of reports to members, and a bulletin is issued quarterly in order to inform members of the work in progress, etc. The Association has published three books: "Control of Laundry Operations", "Chemistry of Laundry Materials" and, recently, "Technology of Washing".

Ancient Egyptian Sculpture

MR. C. S. GULBENKIAN's loan to the British Museum (Bloomsbury) of fourteen pieces of ancient Egyptian sculpture from his collection, for a period of eighteen months, which is now on view in the entrance hall, not only illustrates Egyptian art for a period of 2,000 years from the Middle Kingdom to Ptolemaic times, but it also serves to bring out in a marked degree certain characteristics in which the masterpieces of that art stand out, as against the products of the classical period, and in which it is, in fact, closely akin to the aims of certain schools of modern art. Egyptian art, and more especially Egyptian sculpture, when freed from the conventions imposed by the necessities of formal presentation for State or official purposes, showed a remarkable, and indeed an exceptional, ability to express character and individuality in portraiture. While this is generally admitted in the obvious instance of the Tell el-Amarna school under the influence of Akhnaton, which usually, though not invariably, emphasizes and idealizes a defect, it would seem, in preference to strength, it is equally true of the more robust tradition, which can be traced so far back as the Fourth Dynasty and produced, for example, such well-known specimens as the statuette of Khufu and the effigy of the "Sheikh ed-Beled". That this tradition persisted through a prolonged period can be seen in some of the later exhibits in the British Museum loan collection, such as, for example, the remarkable head of a man in green schist of the sixth century B.C., though possibly many may consider the gem of the collection to be the head in obsidian attributed as a portrait of Amenemhat III to the Twelfth Dynasty, in which the characterization is no less remarkable than the technical skill, which could subdue so refractory a material to its purpose. Another exhibit, in bronze, though of a different genre, attracts attention, and charms by its unusual subject—a cat with two kittens playing

Sir Robert Hadfield's Gift to Harvard

IN a supplement to the *Engineer* of November 20, there were reproduced photographs of four very striking water-colour drawings depicting war-time work in three departments of Messrs. Hadfields Ltd., of Sheffield. The artist, Mr. Herbert J. Finn, in these drawings, has succeeded in conveying in a remarkable manner the sense of intense activity and vibrant energy of the giant furnaces and myriads of whirling belts of an engineering shop, which may come to be regarded as characteristic of this machine age. Equally vivid, but of totally different character, is Mr. Finn's water colour "Oxford from the Sheldonian Theatre", a pictorial representation of Oxford's spires and domes—a vista breathing the peace and quietude of medieval England. Sir Robert Hadfield has acquired this picture and has presented it to Harvard University in connexion with the occasion of its tercentenary celebrations. Harvard's leading metallurgist, Prof. Albert Sauveur, himself an old friend of Sir Robert, is well known in British engineering circles, for he was the recipient in 1924 of the Bessemer Gold Medal of the Iron and Steel Institute; on the other hand, Sir Robert is probably equally well known on the west of the Atlantic, for he is a foreign associate of the National Academy of Sciences, he received the John Fritz Gold Medal of the United Engineering Societies of the United States in 1921 and the Elliott-Cresson Gold Medal of the Franklin Institute in 1901. Sir Robert's gift is not only a mark of his own respect and admiration for a great centre of learning in the United States, but also a further link between the universities of Great Britain and the New World, helping to hold them together in the ever-intensifying quest for knowledge.

The Parliamentary Science Committee

THE Council of the British Association resolved, at its meeting on Friday last, that the Association should become a constituent member of the Parliamentary Science Committee, and appointed as its representative Prof. Allan Ferguson, one of the general secretaries of the Association. The arrangement made is subject to revision after three years. The announcement will afford particular pleasure to the members of the British Science Guild, which has now been incorporated with the British Association. The Guild and the Association of Scientific Workers were the parent bodies of the Parliamentary Science Committee, which came into being in October 1933, almost immediately after the presidential address of Sir Frederick Gowland Hopkins at the Leicester meeting of the British Association.

Research Co-ordination Group

AT a meeting on December 2 at River Court, Hammersmith, London, W.6 of the Research Co-ordination Group (see NATURE of February 22, p. 311, and May 30, p. 898) a number of problems dealing mainly with (1) rise in the standard of living and (2) security, were suggested for the attention of scientific investigators. Among these were: the standardization and extension of statistical information, both as regards production and consumption; nutritional needs and national fitness; population problems and genetics questions; scientific agriculture, afforestation, land reclamation; regional distribution of industry; hydro-electric power, new industrial developments (light metals, carbide and acetylene, plastics, cellulose, synthetic fats); aircraft and poison gas defence; psychology and war; educational use of cinema; vocational outlet for trained workers; and several others. These are to be grouped around the various sciences to which they are related. The chairman (Sir Richard Gregory) referring to the fact that many of these problems have been discussed at recent meetings of the British Association, suggested that the closest co-operation be maintained with the Association, and it was agreed that, if possible, suggestions be made to recorders of suitable sections for the inclusion of such papers in the programme of the next meeting at Nottingham. Material on the above or other suitable topics should be sent to the Honorary Secretary, Research Co-ordination Committee, Hazlitt House, Southampton Buildings, W.C.2 (Telephone, Holborn 1713).

Relativity and the Quantum Theory

IN a lecture given before the Newcastle-upon-Tyne Astronomical Society on November 5, Prof. R. A. Sampson discussed "The Spectroscope in the Observatory". Remarking that the spectrum, along with Wilson's cloud chamber and photographs of diffraction patterns due to electrons, furnishes visible records of things that are too small to see, Prof. Sampson pointed out that Dirac holds it is quite impossible to make a rational theory of these things without reconstructing our ideas of the nature of matter altogether. This has led to the two great theories of modern times, namely, relativity and the quantum theory. They are not yet fully reconciled. In his opinion, there are considerable philosophical difficulties in holding either. Relativity, on its merits, may seem a probable theory, but it cannot do its feats without making time an equal co-ordinate with the familiar three of space. Now we cannot think time away, without sacrificing the possibility of expressing ourselves intelligibly to others, and living in a world where history and cause and effect have no meaning. Nor does it upset our own affairs alone; we see the grass grow in summer and die away in winter. That must be an illusion. It seems to Prof. Sampson a simpler hypothesis to suppose that the intellect is limited. The quantum theory, which is obviously on the right lines, makes in small matters an enormous logical difference, and gives a new meaning to the question "Will the sun rise tomorrow?"—for example, when we are dead, or last century, before we were born. We must confess that we have no means of verifying whether it does or not. It seems that both these theories spell the exhaustion of the constructs of the intellect, of which a necessary part is the four elements of space-time, which must be exhausted sooner or later. Leaving these philosophical questions, Prof. Sampson gave a description of the ordinary theory of stellar sequences, etc., including the Russell diagram of the relation of luminosity to spectral class, and white dwarfs.

Supervision of the Nation's Food Supply

IN the fifteenth Benjamin Ward Richardson Lecture which was delivered on November 10 before the Royal Sanitary Institute, Dr. Gerald Leighton, late Medical Officer of the Department of Health for Scotland, stated that from the public health point of view three conditions are required for the proper supervision of the nation's food supply. In the first place, there must be a concentration and collection at certain centres of large quantities of the food material, so that there may be adequate inspection. Although the necessity of this condition was recognized more than forty years ago by the United States Department of Agriculture, which established a well-regulated system of slaughter houses, Great Britain has been very slow in adopting the system of public abattoirs, the need of which was so strongly urged by Benjamin Ward Richardson himself. The second condition necessary for effective supervision is the supply of a sufficient number of highly trained inspectors. Great progress has been made in this respect during the last twenty years, training for students as meat inspectors being provided by veterinary colleges, some universities and other educational bodies. Lastly, a uniformity of system and practice is essential. The inspectors should be trained to work on a uniform system and to a uniform standard instead of, as in the old days, each inspector being a law to himself. Dr. Leighton then dwelt on the desirability of securing and adopting the most rapid, skilled and humane methods of slaughtering all kinds of animals for human food, a topic which formed part of the life work of Richardson. In conclusion, he expressed the view that in the progress of the supervision of a nation's food, the introduction of legal standards, as in most European countries, America and various parts of the Empire, for the majority of foods is the most important step for future development.

The London Telephone Trunk Exchange

IN a paper read on November 13 to the Students' Section of the Institution of Electrical Engineers, Mr. H. M. Wells discusses the effects of the rapid increase of the telephone service in Great Britain on the methods of working. The country is divided up into zone areas and subdivided into group areas. Major trunk lines connect main zone exchanges with London and with one another. They are so designed that a minimum of duplicate plant is necessary. By the use of thermionic amplifiers, the volume of speech fed into a line is made equal to the volume received at the far end. When things are properly adjusted, there is thus no loss of sound. One result is that the speech on the London-Moscow circuit is as good as that on a local London call. The insulation materials of the cables used are paper and 'air-space'. The 'air-space' is filled with carbon dioxide which possesses desiccating qualities and can be readily pumped out from the cable and replaced by fresh gas capable of restoring the dry atmosphere required to maintain a high insulation resistance. In the exchange itself, the type of apparatus employed is designed to permit calls to be completed on demand, that is, whilst the calling subscriber is held on the line. Timing the duration of calls is a problem which has received special attention. In the trunk exchanges, all calls are timed automatically; this obviates any error due to the human element, and, as the calls are expensive, this is very desirable. The particulars from the time-recording instruments, together with the called and calling subscribers' numbers, are entered on a ticket by the operator and circulated to a central pricing position. The circulation is effected by pneumatic tubes. The power for the exchange is derived from secondary cells of large capacity. A voltage of 50 is used for normal speech and apparatus purposes, but the signalling lamps on the switchboard are worked at six volts from an alternating current source.

Grading of Teak Squares

WITH the hearty co-operation of business firms, the Forest Research Institute at Dehra Dun has published a small pocket monograph entitled "Rules for the Grading of Teak Squares", prepared by L. N. Seaman, officer in charge, Timber Testing Station, and V. D. Limaye. In a preface, Mr. C. G. Trevor, Inspector General of Forests, states that the work was undertaken at the request of the Chief Conservator of Forests, Burma, and the Indian Railways, and the Burma forest officers were deputed to the saw mills of the five chief teak firms to observe and write down in tabular form all the defects in each teak square passed by the respective firms as belonging to different existing grades. The data so obtained were dispatched to Dehra Dun for analysis, and preliminary draft rules were drawn up by Mr. Seaman and his staff. These rules were discussed at a meeting held in Rangoon between the parties interested, and a trial was made of them. As a result of experience gained, the rules were re-written by Mr. Limaye (Mr. Seaman having left India on retirement) and are now published in the present handy form. The rules express, in so many words, the actual practice that is followed in the trade in the grading of teak squares. The rules have been accepted by the teak lessees of Burma and the timber adviser to the Railway Board and the Army. The rules are equally applicable to mill-sawn squares from Siam and other countries, and it is suggested that in future they will always be used for the buying and selling of teak squares.

Design in Industry

AT the opening meeting of the new session of the Royal Society of Arts on November 4, the chairman of the Council, Sir Henry McMahon, announced the institution of a new distinction of D.I. (Designer for Industry) for designers for industry who have attained eminence in creative design. The distinction is limited in the first instance to ten and the number of holders of it at any one time will not exceed thirty. The essence of the scheme is to encourage the improvement of industrial design by enhancing the status of the designer in the public regard, and thereby arousing a more general recognition of the importance of industrial art. This latest step is in continuance of the Society's efforts in this field from the eighteenth century onward, and is a natural development of the annual competition of industrial designs initiated in 1923 and of the Exhibition of British Art in Industry organized at Burlington House last year in co-operation with the Royal Academy. The very success of the Exhibition, which stimulated a widespread movement advocating the cause of art in industry, emphasized the fact that no recognition or distinction was heretofore available for designers, who through their great work for industry are deserving of wide public recognition of their valuable services to their country. This gap, it is hoped, will be filled by the new distinction.

The *Geographical Magazine*

THE completion of the second year of the *Geographical Magazine* directs attention to the value of its articles and the excellence of its illustrations, the photogravure and coloured plates in particular reaching a high standard. Among articles in the December issue is one by Dr. R. Zeller on the "Development of Alpinism in Switzerland" which is illustrated by a large number of old prints. In view of the modern vogue of alpinism, which the writer defines as an interest in high mountains and their exploration, it is worth noting that at least until the eighteenth century the Alps repelled travellers. The influence of two writers, von Haller and Rousseau, did much to direct attention to the Alps, but with a few exceptions there was little real mountaineering until Paccard and Balmat climbed Mont Blanc in 1786. Maps did not become available until the nineteenth century, and from the middle of that century onwards accurate maps and guide books were great stimuli to active alpinism, while the twentieth century may be said to have seen its popularization.

Demographic Statistics

ACCORDING to statistics recently published in Germany, the average duration of human life in most countries was about fifteen years longer in 1921 than in 1871. In 1880 in Germany, 261 out of 10,000 inhabitants died as compared with 212 in 1900 and 111 in 1930. During the same periods there were 205, 182 and 114 deaths in England, and 198, 176 and 113 in the United States. In Hungary the decline of mortality was most pronounced, there being 386 deaths per 10,000 inhabitants in 1880 and only 155 in 1930. During the same period of half a century, the percentage fall of mortality in different countries was as follows: Germany, 54·8; England, 44·4; France, 22·6; Italy, 41·7; Switzerland, 51·8; Sweden, 39·7; United States, 40·4; and Australia, 46·9 (*Bruxelles Méd.*, October 25).

International Congress for Applied Mechanics

THE fifth International Congress for Applied Mechanics will meet in Cambridge, Massachusetts, on September 12–16, 1938, at Harvard University and the Massachusetts Institute of Technology. The programme will cover three main divisions of applied mechanics as follows: (1) structures, elasticity, plasticity, fatigue, strength theory, crystal structure; (2) hydro- and aero-dynamics, gas dynamics, hydraulics, meteorology, water waves, heat transfer; (3) dynamics of solids, vibration and sound, friction and lubrication, wear and seizure. Further information can be obtained from the Secretary, Fifth International Congress for Applied Mechanics, Massachusetts Institute of Technology, Cambridge, Mass.

Announcements

PROF. G. I. TAYLOR will deliver the Christmas Lectures "adapted to a juvenile auditory" at the Royal Institution, 21 Albemarle Street, London, W.1 on December 29 and 31 and January 2, 5, 7 and 9. The subject of the lectures will be "Ships". Further information can be obtained from the Assistant Secretary.

THE following appointments and promotions in the Colonial Service have recently been made: Lieut.-Commander J. R. de la Haule Marett, to be assistant in ethnology, Colombo Museum, Ceylon; J. A. Richardson, to be field geologist, Malaya; F. J. Ryeland, to be inspector of mines, Gold Coast; J. R. Lockie (assistant conservator of forests, British Guiana), to be assistant conservator of forests, Nigeria; F. R. H. Green (inspector of mines, Kenya), to be superintendent of surveys, Lands and Mines Department, British Guiana; V. T. Hockin (assistant inspector of mines), to be inspector of mines, Tanganyika; S. Napier-Bax (senior field officer), to be assistant director, Tsetse Research Department, Tanganyika; Capt. A. T. A. Ritchie (game warden, Kenya), to be chief game warden, Federated Malay States; N. H. Vicars-Harris (assistant director, Tsetse Research Department), to be secretary of the Department of Lands and Mines, Tanganyika.

AN annual sum of about £30 is available from the Clough Memorial Research Fund, which was instituted in 1935 for the purpose of encouraging geological research in Scotland and the north of England (Northumberland, Cumberland, Westmorland, Durham and Yorkshire). Applications for grants are invited for the period April 1, 1937–March 31, 1938. Further information can be obtained from the Secretary, Clough Memorial Research Fund Committee, Edinburgh Geological Society, Synod Hall, Castle Terrace, Edinburgh.

PROF. FRIEDRICH ZAHN, president of the Bavarian Statistical Office, has been nominated president of the International Statistical Institute.

PROF. EMIL ABDERHALDEN, director of the Physiological Institute at Halle, has been nominated an honorary member of the Sociedad Cubana de Biologia.

VIENNA has the lowest birth-rate in the world; in 1935 there were only 7 births per 1,000 inhabitants. In March 1936, there were 978 births, of which 496 were males and 482 females, while there were 2,219 deaths, of which 1,123 were males and 1,096 females, so that in a single month the population fell by 1,243.

ERRATUM.—In the record of the award of the Darwin Medal of the Royal Society in NATURE of December 5, p. 980, for Edgar James Allen, read Edgar Johnson Allen.

IN NATURE of November 28, p. 914, it should have been stated that the Rev. Wm. Tuckwell's surviving daughters are Miss Gertrude Tuckwell and Mrs. Marian Ethel Grew; Lady Welch died three years ago.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

Engineer in a War Department establishment at Sutton Oak, Lancs—The Chief Superintendent, Chemical Defence Research Department, 14 Grosvenor Gardens, London, S.W.1 (December 15).

Scientific officers (chemistry), junior scientific officer (chemistry or physics), assistants (Grades I, II and III—chemistry) in the Chemical Defence Research Department—The Chief Superintendent, 14 Grosvenor Gardens, London, S.W.1 (December 15).

Mechanical engineering designer in the Design Department, Royal Arsenal, Woolwich—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (Quote Appts./9) (December 15).

Assistant lecturer in civil engineering in the City and Guilds College—The Secretary, Imperial College of Science and Technology, Prince Consort Road, South Kensington, S.W.7 (December 15).

Head of the Engineering Department of the North Staffordshire Technical College—The Clerk to the Governors, Town Hall, Hanley, Stoke-on-Trent (December 16).

Assistant in the Research and Technical Publications Section of the Air Ministry—The Secretary, Air Ministry, Adastral House, Kingsway, W C.2 (December 19).

Biochemist in the Royal Berkshire Hospital, Reading—The Secretary (December 31).

Research officer on the scientific staff of the Agricultural Research Council for work on coccidiosis—The Secretary, 6A, Dean's Yard, Westminster, S.W.1 (January 1).

Lecturer in mechanical engineering in the Derby Technical College—The Clerk to the Governors (January 4).

Physicist in the Research and Development Department of the Cambridge Instrument Co., Ltd., Cambridge.

Lecturer in pathology of the diseases of infancy and childhood in the University of Glasgow—Secretary of the University Court.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1018.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

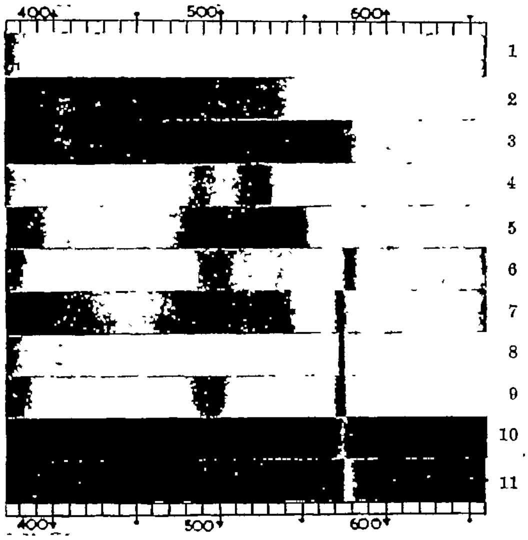
Spectral Absorption and Fluorescence of Dyes in the Molecular State

As Prof. R. W. Wood has stated on p. 648 of his "Physical Optics" (3rd ed.) that no liquid or solution has been found to exhibit the slightest trace of resonance radiation, it seems of interest to record that the effect has now been observed. It has been found possible to prepare suspensions of many dyes in solids and liquids, which possess an extraordinarily narrow absorption band associated with fluorescence of slightly longer wave-length. Three more or less general methods of preparation have been discovered, which possess the common feature that they cause the dye to pass from the dissociated state in true solution, through a transitory molecular state which exhibits a characteristic absorption and fluorescence, to the crystalline state. The effect is shown in a particularly striking manner by the dye 1 : 1′ diethyl-ψ-cyanine chloride, for which details of the three methods of obtaining the molecular absorption spectrum are given.

Method 1. A concentrated solution of 1 : 1′ diethyl-ψ-cyanine chloride in a strongly polar solvent, such as nitrobenzene or pyridine, was rapidly diluted with a non-polar or feebly polar liquid such as ligroin, carbon tetrachloride, benzene, toluene or xylene. The liquid became fluorescent and exhibited a very sharp absorption band having a maximum at λ=576 mμ. The position of the band was somewhat different for the different halides of the dye. Both the fluorescence and the absorption band rapidly disappeared as the dye passed into the crystalline state.

Method 2. The dye was dissolved in a fused strongly polar substance, for example, benzophenone, which was then crystallized by sudden chilling, whereby some of the dye remained molecularly dispersed in the solid. The position of the band depended on the particular salt of the dye, but did not seem to depend on the solid in which it was dispersed. It has been found that the sharp absorption band is not dichroic (not a function of the vibration direction), whereas absorption bands of crystals of the dye are strongly dichroic. This method is a general one for salts of basic dyes. The molecularly dispersed dyes slowly pass into a micro-crystalline condition, and the sharp absorption band disappears as this takes place.

Method 3. A solution of the dye in methyl or ethyl alcohol was added to 5*M* sodium chloride solution. The liquid became strongly fluorescent, and exhibited a very sharp absorption band at 574 mμ. The fluorescence consisted of a narrow band having a maximum intensity at 577mμ, which was excited almost entirely by the absorption band at 574 mμ. On heating the liquid to 60° the molecular absorption and fluorescence disappeared, and were replaced by the characteristic absorption spectrum given by the dye cations in alcoholic solution. On slowly cooling, the molecular absorption and fluorescence gradually increased in intensity, and the cation absorption correspondingly diminished. Similar reversibility was shown on varying the concentration of alcohol. A number of other dyes which have been examined behave in the same way, but the duration of molecular absorption may be anything from a fraction of a second to some weeks.



(1) Spectrum of tungsten arc lamp (containing neon).
(2) and (3) The two principal absorptions corresponding to the *X* and *Y* vibration directions of crystals of 1 : 1′ diethyl-ψ-cyanine chloride.
(4) Absorption spectrum of the dye in methyl alcohol.
(5) Absorption spectrum of the dye in nitrobenzene
(6) Absorption spectrum of a molecular suspension of the dye in toluene.
(7) Absorption spectrum of the dye molecularly dispersed in benzophenone crystals
(8) and (9) Absorption spectra of two different concentrations of the dye in sodium chloride solution.
(10) Fluorescence spectrum of the dye in sodium chloride solution.
(11) Fluorescence spectrum of the dye in sodium chloride solution. In this case the fluorescent light has been made to traverse a small thickness of unilluminated solution, so that the absorption band is seen superimposed on the fluorescence band. It will be noticed that the two do not exactly correspond.

On illuminating the fluorescent liquids with plane polarized light, the fluorescence was found to be unpolarized, showing that there is a time interval between the absorption and re-emission of light. The fluorescence is, therefore, visible when the liquids are examined between crossed nicols with a polarizing microscope. This is further proof that the fluorescence is a resonance effect, and is not light scattered by small solid particles of dye. It has also been noted that the dye in the molecular state shows a strong tendency to adsorb on the walls of the containing vessel, and in some experiments such adsorbed films showed the sharp molecular absorption band and associated fluorescence for a minute or so after their preparation, but the effect rapidly disappeared as the film passed into the crystalline state. Dyes adsorbed on filter paper, cotton wool, kaolin, etc., frequently possess an absorption maximum agreeing in position with the molecular band. This seems to indicate that some of the adsorbed dye is present in the molecular state.

A similar type of very narrow absorption band associated with fluorescence of approximately the same wave-length was discovered in the ruby by Ebert, and was examined in detail by Mendenhall and R. W. Wood. The ruby consists essentially of a crystal of aluminium oxide containing dissolved chromium oxide. The method of preparation of synthetic rubies corresponds in principle with the present method of producing the molecular absorption band of $1:1'$ diethyl-ψ-cyanine dispersed in a solid crystalline substance.

These phenomena are illustrated in the attached spectrograms which were photographed on 35 mm. Panatomic film by means of a grating microspectrograph described elsewhere[1].

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[1] *J. Roy. Micr. Soc.*, **56**, 101–112 (1936).

The Beilby Layer on Non-Metals

IT is now generally accepted that the polish layer on metals is amorphous. The observations which led Beilby to formulate his famous conception of the vitreous nature of this layer were not, however, confined to metals, but had also been made with non-conducting crystals such as quartz, fluorspar, calcite and others. But Hopkins[1], working in G. P. Thomson's laboratory, has shown that the polish layer on Iceland spar cleavage faces is crystalline; and Raether's[2] electron diffraction patterns from polished natural faces of rocksalt, fluorite, calcite and pyrites are also wholly characteristic of crystalline structure. Nevertheless, the directness and simplicity of his experiments, in particular the exposure by etching of scratches eliminated by polishing, seem to speak convincingly in favour of Beilby's views.

Recently we have examined a wide variety of polished non-metallic single crystal surfaces, with results which go far towards reconciling the apparent conflict of evidence hitherto afforded by Beilby's microscope and the electron diffraction camera. Thus we have found that, whilst polished plane surfaces, cut in quite arbitrary directions from many types of single crystals (quartz, diamond, natural and synthetic sapphires, almandine and demantoid garnets, topaz, chrysoberyl, epidot, olivine, sphene, andalusite), yield electron diffraction patterns of spots and lines and thus provide irrefutable evidence of the crystalline structure of the polish layer on such surfaces, other crystals, notably white beryl, zircon, tourmaline, cassiterite and hæmatite, give the pattern of diffuse haloes more or less submerged in background which is so characteristic of liquid mercury, glasses, vitreous silica and of the amorphous Beilby layer. From other polished crystal facets (brown beryl, moonstone, orthoclase and cordierite) composite patterns were obtained in which the single crystal pattern showed faintly through that due to the amorphous layer. Spinels, both synthetic and natural, yielded either halo patterns or haloes and spots, only faintly distinguishable through the general background scattering. In some cases the structure of the polish layer appeared to be determined by the crystallographic nature of the facet examined. Thus one facet of a blue kyanite yielded a Beilby layer pattern through which single crystal spots were faintly distinguishable, whilst other facets of the same specimen gave single crystal patterns. Again, though the end faces of the prisms of a Zeiss nicol afforded quite good single crystal patterns, those from the junction faces were characteristic of the true amorphous Beilby layer. After etching, which revealed many coarse grinding scratches on all these faces, only typical single crystal patterns were obtained.

These results seem clearly to establish the validity of Beilby's view of the formation of the polish layer. That the layer is, however, often crystalline may be ascribed, except perhaps in the case of the diamond where polishing is possibly the effect of attrition alone, to a ready and spontaneous re-ordering of the molecules, disarranged by the act of polishing, in more or less strict orientation with those of the crystal matrix, whilst the amorphous nature of the polished surfaces of other crystal facets is evidence of the reluctance of the flowed layer to recrystallize; a reluctance which appears to be determined in some cases by the nature of the mineral, in others by the crystallographic direction of the polished facet.

Carborundum affords an example of a chemically formed amorphous polish layer. The untreated crystals, even though possessing perfect mirror-like surfaces, invariably yield typical Beilby layer patterns. Abrasion with fine emery paper (mainly rouge and aluminium oxide) or immersion in hydrofluoric acid appear to have no visible effect; nevertheless, after either of these treatments, carborundum flakes furnish single crystal patterns of quite exceptional clarity. Presumably the raw crystal surfaces are covered by a thin film of glassy silica formed by superficial oxidation during cooling of the charge[3].

An important result of these experiments is that the study of the diffraction of electrons by single crystals need no longer be confined to the often imperfect natural or cleavage faces. Any desired type of face can be exposed for this purpose by grinding and polishing, followed by etching in those cases where the polish layer happens to be amorphous. Finally, we have obtained good single crystal patterns from all over the curved surface of a short-focus plano-convex quartz lens. Thus every conceivable crystal plane should be accessible to the electron beam in a single crystal ground and polished as a sphere.

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[1] Hopkins, *Phil. Mag.*, **21**, 820 (1936).

[2] Raether, *Z. Phys.*, **86**, 82 (1933).

[3] Germer, *Phys. Rev.*, **49**, 163 (1936), also obtained a halo pattern from carborundum and concluded that this vitiated the usual interpretation of the haloes obtained from polished surfaces; had he, however, removed the glassy film due to surface oxidation, a single crystal pattern would certainly have been obtained.

Scattering of Neutrons by Protons

THEORETICAL investigations of the interaction of protons and neutrons have been given by Wigner, Heisenberg and Majorana. A very valuable check on their conclusions is provided by the study of the scattering cross-section of the hydrogen nucleus for neutrons of various energies. Cross-sections have been measured for neutrons of low energies (a few volts) by Fermi and his collaborators[1]; for the photo-neutrons from heavy hydrogen (energy about 250 k.v.) by Goldhaber[2]; and for the neutrons obtained by bombarding carbon with heavy hydrogen (600–1,200 k.v.) by Tuve and Hafstad[3]. Dunning[4] also gives a value for the fast portion of the continuous spectrum of radon-beryllium neutrons, of which the average effective scattering energy probably lies in the region of 3–4 m.e.v.

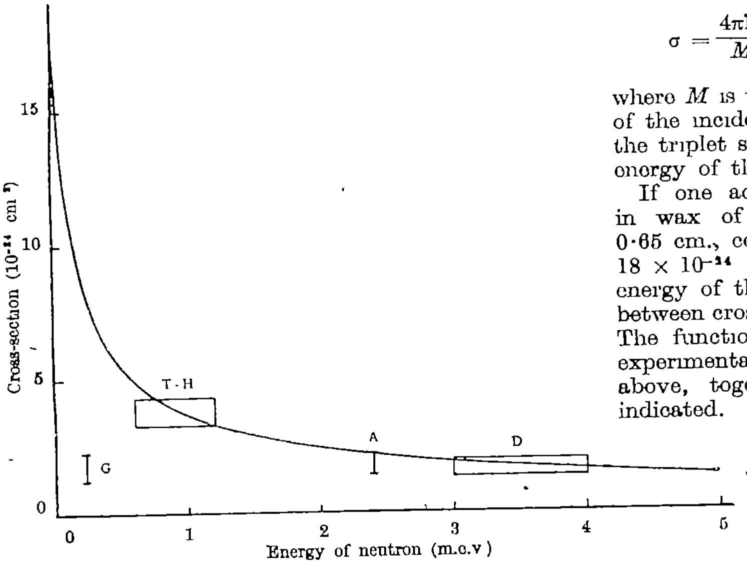

FIG. 1. The curve represents Wigner's theoretical neutron-proton scattering cross-section for neutrons of various energies. Experimental results of various investigators are also shown: G = Goldhaber, T-H = Tuve and Hafstad; A = Booth and Hurst; D = Dunning.

We have measured the cross-section of protons for the 2·4 m.e.v.[5] neutrons obtained from the D + D reaction. A fast neutron detector, consisting of an indium foil embedded in a block of paraffin wax 9·5 cm. × 5·5 cm. × 6·5 cm. was placed 23 cm. from the heavy phosphoric acid target. This detector was wrapped in cadmium foil to prevent so far as possible the entrance of any slow neutrons reflected from the surrounding walls: extraneous neutrons would tend to make the measured value of the cross-section too low. The scatterer consisted of a sheet of paraffin wax 7·7 cm. long, 4·8 cm. wide and 1·85 cm. thick. This was placed midway between the target and the detector. A thin packet of phosphorus, which responds only to fast neutrons, was placed near the target to enable a correction to be made for small variations in the intensity of the neutron source. The activities induced in the phosphorus and indium were measured on a Geiger-Muller counter.

Ten runs, five with and five without the scatterer, were made. After correcting for neutrons which were scattered and yet entered the detector, a free path of 4·6 ± 0·9 cm. was obtained for the neutrons in the wax. For the carbon correction, we adopted Dunning's value of $1{\cdot}7 \times 10^{-24}$ cm.^{2} for the scattering cross-section, for fast neutrons in carbon. After applying this correction we find a cross-section of $(1{\cdot}8 \pm 0{\cdot}4) \times 10^{-24}$ cm.^{2} for 2·4 m.e.v. neutrons scattered by protons.

A theoretical formula, assuming singlet and triplet states for the neutron-proton system, has been derived by Wigner. This gives the cross-section as a function of energy in the form

$$\sigma = \frac{4\pi\hbar^2}{M}\left[\frac{1}{4}\cdot\frac{1}{\varepsilon^1 + \frac{1}{2}E_0} + \frac{3}{4}\cdot\frac{1}{\varepsilon + \frac{1}{2}E_0}\right],$$

where M is the mass of the proton, E_0 is the energy of the incident neutron, ε is the binding energy of the triplet state (2·15 m.e.v.) and ε^1 is the binding energy of the singlet state.

If one adopts Fermi's value for the free path in wax of the DABI neutron groups, namely, 0·65 cm., corresponding to a cross-section of about 18×10^{-24} cm.^{2}, one can determine the binding energy of the singlet state and obtain the relation between cross-section and energy of incident neutron. The function is shown graphically (Fig. 1). The experimental results of the investigators mentioned above, together with our own value, are also indicated. The agreement between theory and experiment is satisfactory at the higher energies, but further experimental work seems to be needed in the intermediate region between 0·1 and 1 m.e.v.

A target of heavy ice cooled with liquid air has been installed since the above experiment was completed. As a consequence the neutron yield has been increased by a factor of five, and we hope to repeat the measurements using phosphorus as the neutron detector.

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[2] Goldhaber, NATURE, **137**, 824 (1936)
[3] Tuve and Hafstad, *Phys. Rev.*, **50**, 490 (1936)
[4] Dunning, *Phys. Rev.*, **45**, 586 (1934).
[5] Bonner and Brubaker, *Phys. Rev*, **49**, 19 (1936); and *Proc. Roy. Soc*, A, **148**, 623 (1935).

Inconsistency of the Neutrino Theory of Light

The neutrino theory of light proposed by Jordan[1] postulates a connexion between the quantized wave function of the light field (F) and that of the neutrino field (Ψ). Since Ψ satisfies the commutation rules for Fermi statistics and F those of the Bose statistics, the connexion cannot be a linear one. On the other hand, we know from quantum electrodynamics that F satisfies a linear differential equation; a similar equation of d'Alembert's type is to be expected for Ψ. Thus a contradiction arises between the linearity of the equations and the non-linearity of the connexion between F and Ψ. (This contradiction is avoided only in the case of plane waves propagating in one definite direction.) Besides, serious doubts arise as to the possibility of expressing the quantized amplitudes $b(\nu)$ for F (Bose statistics) in terms of the amplitudes $\gamma(\nu)$ for Ψ (Fermi statistics), the operators $b(\nu)$ and $\gamma(\nu)$ being of a quite different mathematical nature.

Jordan proposes[2] the following expression:

$$\sqrt{\nu}\, b(\nu) = \int_{-\infty}^{+\infty} \gamma^{+}(\alpha)\gamma(\nu+\alpha)\, d\alpha \qquad (1)$$

But it may be shown that the operators $b(\nu)$ so defined commute with one another as well as with the conjugate operators. In fact, applying the Fourier transformation from $\gamma(\alpha)$ to $\Psi(x)$, it is easily seen that (1) is equivalent to

$$\sqrt{\nu}\, b(\nu) = \int_{-\infty}^{+\infty} e^{-\nu x}\, \Psi^{+}(x)\, \Psi(x)\, dx \qquad (2)$$

The operator on the right-hand side has in configuration space of n particles (neutrinos) the meaning: multiplication by $\sum\limits_{k=1}^{n} e^{-i\nu x_k}$ and thus commutes with the conjugate one. The converse conclusion reached by Jordan is obviously due to some mistake in his calculations, most probably to the fact that he implicitly uses in his arguments indefinite expressions of the form $\infty - \infty$.

Since the relation (1) is the mathematical basis of Jordan's theory, the disproof of this relation entails the failure of the whole theory, at least in its present form.

From general arguments developed above, it is to be expected, however, that no consistent neutrino theory of light based on a relation between F and Ψ can be constructed.

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[1] *Z. Phys.*, **93**, 464 (1935).

[2] P. Jordan, "Anschauliche Quantentheorie" (Berlin: Springer, 1936), p. 260.

Minimal Lines and Geodesics within Matter: a Fundamental Difficulty of Einstein's Theory

ACCORDING to Einstein's relativity theory *the minimal lines*, $ds^2 = g_{\iota\kappa}dx_\iota dx_\kappa = 0$, represent, in any circumstances (that is, in space-time upon which any metrical tensor $g_{\iota\kappa}$ satisfying the field-equations has been impressed), *light-lines*, and thus the laws of propagation of light. Now, *in vacuo*, the representation is of course correct, giving—apart from minor refinements—uniform, isotropic propagation with the velocity c, as pre-arranged. But inside matter, considered as a continuous medium characterized by the material tensor $T_{\iota\kappa}$, the minimal lines manifestly *cannot represent light propagation*, even to a rough approximation. For in such a medium, supposed isotropic, the light velocity is, essentially, c/μ (where μ is the refractive index, say, for light of a fixed frequency), whereas $T_{\iota\kappa}$, determining the $g_{\iota\kappa}$, contains no trace of μ, in fact, no properly optical feature of the medium in question. Thus, even without detailed mathematical deduction, one can see that, *within matter*, minimal lines are *not* light-lines; that is, $ds = 0$ does not represent light propagation.

To illustrate my point, let us consider the case of Schwarzschild's incompressible liquid sphere in equilibrium, that is, $T_1^1 = T_2^2 = T_3^3 = -p/c^2$, $T_4^4 = \rho$ (density) = constant, for which the complete solution is available. Take, for example, the case of purely radial propagation. Then, rigorously,

$$ds^2 = \frac{1}{4}\left(3\cos\frac{a}{R} - \cos\frac{r}{R}\right)^2 c^2dt^2 - dr^2,$$

where r is radial length in 'natural measure', $r = a$ the boundary of the sphere, and $R = c\sqrt{3/8\pi k\rho}$ the curvature radius of the manifold within the sphere (k = gravitational constant). Thus the minimal lines give for the velocity of propagation:

$$v = \frac{c}{2}\left(3\cos\frac{a}{R} - \cos\frac{r}{R}\right).$$

This velocity, then, is a curious function of the distance r from the centre of the sphere, but manifestly wrong. For of the properties of the medium, say, water, it contains only the mass-density ρ, through R. If $\rho = 0$, we have $R = \infty$ and the expression reduces to $v = c$, as it should. But this (absence of matter) *is the only case* when things are correct.

The net result is that within any material medium, as water or glass, Einstein's minimal lines express nothing of physical interest.

In much the same way, the *geodesics*, $\delta\int ds = 0$, which are claimed to represent the motion of free particles in any field $g_{\iota\kappa}$, have this property *in vacuo*, but not within a material medium. This may again be illustrated by Schwarzschild's solution, ds, for a liquid sphere as medium. The corresponding geodesic equations are readily written down, and they yield the following result.

If the Schwarzschild sphere is comparatively small (a/R a small fraction), a 'particle' placed in it at rest, at a distance r from the centre, is subjected, according to Einstein's theory, to an initial acceleration

$$E = -\frac{4\pi k\rho}{3}r,$$

towards the centre, no matter what the density (ρ_p) of the particle itself, whereas the (approximately) correct, Newtonian acceleration is, of course,

$$N = \frac{4\pi}{3}k\rho r\left(\frac{\rho}{\rho_p} - 1\right).$$

The Einsteinian acceleration E, as claimed by the geodesic, happens to agree with the Newtonian acceleration N when $\rho_p = \infty$, but in no other case. Of course, the correct acceleration would come out if we had supplemented the geodesic equations by the resultant of the pressures of the liquid upon the surface of the particle (Archimedes). But we are concerned here with the pure *geodesics* as characteristic lines of the four-dimensional manifold.

In fine, in the geodesic scheme, no account whatever is taken of the 'density' of the immersed test particle. The failure of the geodesics as representatives of motion within a material medium is quite analogous to that of the minimal lines, where no account is taken of the features of the immersed light, so to speak (namely, of its frequency entering into μ or into the dielectric constant of the medium). In fine, similarly to the minimal lines, the geodesics within matter express nothing of physical interest.

The whole part of Einstein's theory which claims to deal with the phenomena within material media would, then, have to be thoroughly rebuilt, which seems scarcely possible without entering into the granular structure of matter—a formidable task.

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An Ecological Aspect of the Gulf Stream*

THE view has been increasingly accepted, since first put forth by Nathansohn[1], that the fertility of the sea depends upon the restoration to the surface of plant nutrients such as phosphates and nitrates liberated by the decomposition of organic matter within its depths. In shallow coastal waters the turbulence due to wind and tide, aided in high latitudes by the instability resulting from cooling in winter, suffice to maintain this part of the nutritional cycle. In the deep sea, organic matter generated in the surface as the result of photosynthetic processes appears in large part to sink to great depths before being finally oxidized to its ultimate inorganic products. This is evidenced by the increasing concentration of nitrate and phosphate (and decreasing quantity of oxygen) which is observed until depths of 800–1,000 metres are reached.

Wattenberg[2] has recently listed four processes by which these materials are brought again to the surface in the Atlantic Ocean and thus made available for the organic cycle. These are: (1) upwelling resulting from offshore trade winds off the African coast; (2) upwelling of deep Atlantic water in the Antarctic; (3) upwelling in the boundary between currents as in the Arctic polar front; and (4) winter convection in high latitudes. The present note is intended to direct attention to an additional and hitherto unrecognized mechanism which would appear to accomplish the same end and particularly to maintain the high fertility of the waters of the eastern coast of North America.

In a paper entitled "The Dynamics of Steady Ocean Currents in the Light of Experimental Fluid Mechanics", Rossby[3] has shown that the Gulf Stream may be likened to a wake stream discharging into the upper layers of a stratified medium. A wake stream, which appears to be a divergent current, is actually drawing in water from the surroundings. In a stratified medium the boundary between the layers must dip down towards the right in the northern hemisphere, as the isopycnics are observed to do in sections across the Gulf Stream, and this dip is to be regarded as the result rather than the cause of the current flow. The compensating movements set up in the surroundings of a wake stream must have a component in the direction of the current itself on the right side. The Antilles current appears to be such a compensating current. On the left side, the compensating movements must appear as a counter current, represented by the slope water of the American coast.

It is brought out that the absorption of water into the wake stream must take place primarily along the right edge, and that water will be ejected from the wake stream into the counter current. It results that water may be transferred across the current from the open ocean basins to the right into the limited body of water to the left of the current. This lateral transport must take place principally along isopycnics, which are known to slope sharply as they cross the Gulf Stream. Water is thus carried upward as well as shoreward as the result of the primary stream.

The observations of Seiwell[4] on the distribution of oxygen and phosphate in the north Atlantic make it clear that the apparent site of maximal decomposition of organic matter lies much closer to the surface (250 metres) in the continental slope water than in mid-ocean (800 metres). Such a large difference cannot reasonably be ascribed to differences in the rate of sinking or of decomposition of organisms in the contrasted localities. The findings are, however, entirely consistent with the wake stream theory developed by Rossby, since on this view the slope water is derived in considerable part from water absorbed at a greater depth along the offshore edge of the Gulf Stream. The close correlation which may be observed in a section across the Gulf Stream between the conservative properties of temperature and salinity, on one hand, and the properties of biological origin such as oxygen, phosphate and nitrate concentration, on the other, suggests that the observed distribution of the latter is the result of hydrographic factors rather than biological action *in situ*. The products of decomposition which appear at a depth of 200–300 metres in the slope water may have been actually derived from a much greater depth in the open ocean.

Rossby's wake stream theory thus provides a mechanism for the transport of water rich in organic nutrients from the depths of the Atlantic basin on to the edge of the continental shelf. Here it comes within the influence of tidal mixing and winter convection, which complete the transport of nutrients to the surface. The latter stages in the process may be observed in the Gulf of Maine, into which slope water penetrates, and along the continental shelf[5]. Rossby's study suggests that the absorption of oceanic water into the Gulf Stream takes place chiefly south of the latitude of Chesapeake Bay; the discharge of this water at a lesser depth occurs from Chesapeake Bay to at least Nova Scotia. If his theory is correct, he has discovered a mechanism on which the fertility of the waters of the Atlantic Coast of North America must largely depend.

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* Contribution No. 122 from the Woods Hole Oceanographic Institution.

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[4] H. R. Seiwell, "Papers in Physical Oceanography and Meteorology", **3**, No. 1 (1934) *ibid*, **3**, No 4.

[5] H. B. Bigelow, "Papers in Physical Oceanography and Meteorology", **2**, No. 4.

Devernalization of Winter Rye by High Temperature

ALTHOUGH the effect of low temperature in inducing vernalization is now well established, it is by no means clear to what this effect is due. It appeared possible that the mere check in growth at low temperature is the chief factor. The results of Vasiljev[1], which showed that when the period of low temperature treatment is included the time taken to flower remains nearly constant, lends support to this view.

Experiments were therefore performed in which growth was checked by keeping the imbibed grain in an atmosphere of nitrogen for varying periods of time. At low temperature (1° C.) this may be extended to twelve weeks, and the seeds on exposure to air are viable and produce normal plants. They are, however, unvernalized. At 20° C. the seed does not remain viable if the continuous anaerobic period extends for more than three weeks. After such a period of checked growth, the further time required to flower is equal to that required by untreated plants.

It may therefore be stated that the check to growth is not the potent factor in vernalization, but that the effect must be attributed to the low temperature. This result also confirms the statement of Lysenko[2] that oxygen is necessary for the vernalization process.

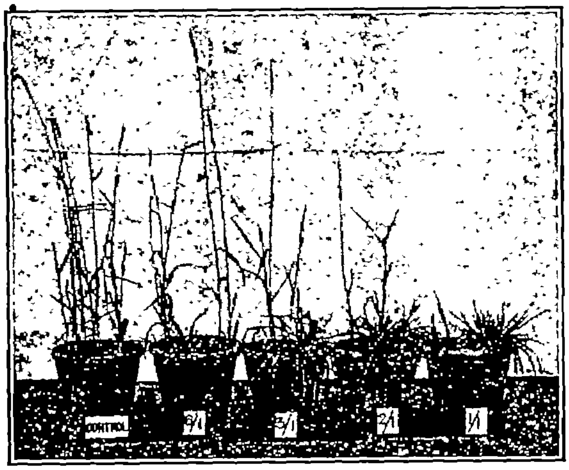

FIG. 1

By giving periods at 1° C. in air, alternating with periods in nitrogen at 20° C., it was possible to test whether high temperature can act antagonistically to low temperature. The alternating periods varied from six days in air at 1° C. followed by one day in nitrogen at 20° C., to one day in air at 1° C. followed by one day in nitrogen at 20° C., in each case the total period at 1° C. being six weeks. The controls were kept at low temperature continuously, but were in air and in nitrogen for alternate days for a total period of twelve weeks, thus also receiving six weeks of normal low-temperature treatment. The controls were all vernalized, whereas when the alternating periods in nitrogen were at 20° C. and of equal duration to the cold periods, vernalization was prevented. The results of four series with varying ratios of exposure to high and low temperatures are shown in the accompanying table.

Winter rye: total period at 1° C., six weeks in every case.

Treatment $\frac{\text{Duration in air at 1° C.}}{\text{Duration in N at 20° C.}}$	Days to anthesis from planting (average of those plants which eared)	Proportion of vernalized plants
1 . 1	unvernalized	None
2 : 1	106	20 per cent
3 · 1	99	60 ,, ,,
6 · 1	89	100 ,, ,,
Control	71	100 ,, ,,

The results show that high temperature negatives the effect of low temperature progressively as the relative period of high temperature is increased; further, this effect is not directly due to the anaerobic condition as the control experiments show.

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Colloids and the Biological Effect of Radiation

IN a previous publication[1] I have pointed out that the problem of the primary process of the effect of radiation on living objects is a question of the action of rays on the different colloidal systems of the living cell. Therefore the question arises whether it is necessary to assume a special colloidal-chemical theory for the biological action of radiation.

The present investigation was undertaken to obtain information regarding the effect of ultra-violet light on colloids. Proteins, the most important colloidal constituents of the living cell, are of too complex a nature, and therefore difficult to study. As simple models, the ferric hydroxide sol (positively charged) and the negatively charged mastic and congorubin-red sol were therefore used; furthermore, I have studied the negatively charged gold and platinum sols, which were protected by decomposition derivatives of protein. These colloids are interesting models of bio-colloids. As source of light, a mercury vapour lamp was used. The exposures were made in water-cooled Petri dishes. The lamp was kept at a distance of 25 cm. above. The determination of the precipitating threshold of electrolytes (potassium chloride, hydrogen chloride, sodium hydroxide) was used as a test of the reaction to radiation.

The following results were obtained: (1) A completely negative result of irradiation in the precipitation of iron hydroxide sol; no visible change of the colour occurred, and no photo-chemical decomposition on measuring the pH by the electrical method of Michaelis. This completely negative effect agrees with the results of Burton[2] obtained with the electro-positive copper oxide sol. (2) The mastic sol demonstrates also no visible change, but a marked acceleration of electrolyte precipitation. This effect of irradiation outlasts the irradiation itself. An explanation of this phenomenon is only possible assuming a photo-chemical decomposition either of the particles themselves or the charging ions. (3) The irradiation of the congorubin-red sol effects a visible change of colour, making the photo-chemical decomposition of the particles very obvious. It was impossible, therefore, to precipitate the irradiated sol with electrolytes. (4) The irradiated gold and platinum sols demonstrate no visible change but a clear acceleration of electrolyte precipitation. Again this effect outlasts the irradiation itself. This effect points to a photo-chemical decomposition on the periphery of the particles, as photo-chemical decomposition of the particles themselves is not tenable. As these colloids were protected by decomposition derivatives of protein, the assumption appears permissible that the necessary photo-chemical action takes place in the protecting agents. This fact is of great importance in the examination of the action of radiation on bio-colloids, because many of them are known to be protected by light-sensitive substances.

Surveying these results, the following conclusions can be drawn: (1) The effect of ultra-violet light on colloids is purely a photo-chemical one. (2) The photo-chemical action can affect the particles themselves or their covering, for example, the protecting colloid, the charging ions. (3) The photo-chemical decomposition can cause a change of the electrical charge of the colloids corresponding to the electrical properties of the radiation, but it may also have just the opposite effect. (4) Where no photo-chemical action takes place, neither is there any change in the electrical charge. (5) In agreement with Nordenson[3] working with ultra-violet light and gold sols, and Annets[4] working with cathode rays and many positively and negatively charged colloids, it was found that the effect of irradiation is independent of the electrical charge of colloids. (6) It appears, therefore, unnecessary any longer to postulate a special colloidal-chemical theory of the biological action of radiation. (7) The photo-chemical theory of the effect of irradiation may also be applied successfully to the phenomena observed in different colloids after irradiation.

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[1] I. M. Vasiljev (1934). Quoted as reference No. 28 in N. I. Maximov, "The Theoretical Significance of Vernalisation", I.A.B. Herbage Publication Series, Bull. 16, Dec. 1934.

[2] *ibid.*, p. 8.

F. ELLINGER.

Biological Institute of the Carlsberg Foundation,
Copenhagen.
Nov. 10.

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[1] Ellinger, "Die biologischen Grundlagen der Strahlenbehandlung" (Berlin, 1935).

[2] Burton, "The Physical Properties of Colloidal Solutions" (London, 1921).

[3] Nordenson, *Z. phys. Chem.*, 90, 603 (1915).

[4] Annets, *J. Phys. Chem.*, 39, 509 (1934).

Oxygen Consumption of Mayfly Nymphs in Relation to Available Oxygen

LITTLE is known of the reasons why freshwater animals are confined to certain habitats, or of the effects of their particular environments on the metabolism of the animals. The first steps in a study of these questions were reported in NATURE, 130, 277 (1932). It has been shown that certain animals living in swift streams have a higher oxygen consumption and rate of heart beat than nearly related animals living in still waters, and that they are less resistant to water lacking oxygen[1,2,3]. The next step has been to study the oxygen consumption of such animals in terms of the available oxygen, and we have confined ourselves to mayfly nymphs. We have used *Baëtis scambus* and *Baëtis* sp. (the latter is one third the weight of the former) from a swift stream, *Leptophlebia vespertina* from Lake Windermere, *Cloëon dipterum* from a pond, and *Ephemera vulgata* living in mud in a pond. Our results are summarized in Fig. 1, in which the vertical line at an oxygen concentration of 7·9 c.c. per litre marks the oxygen content of water in equilibrium with the atmosphere at the temperature of the experiments, namely, 10°.

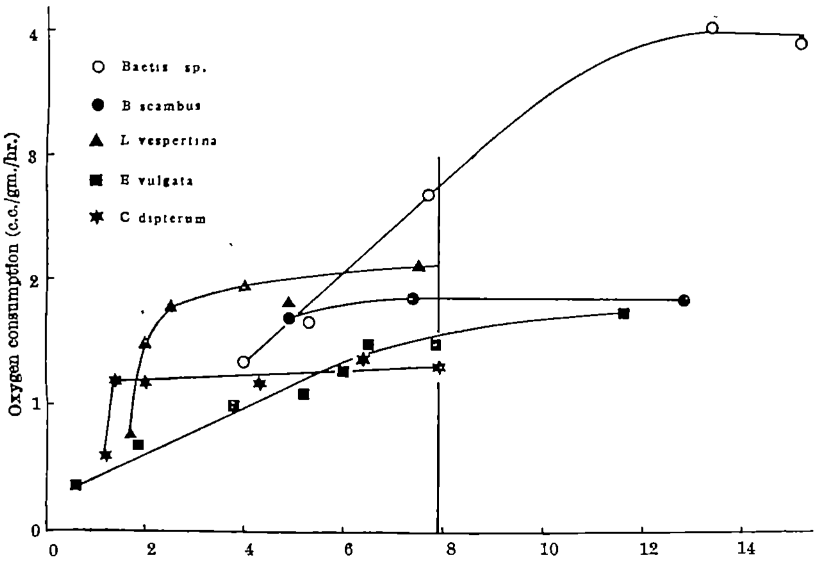

FIG. 1.

It is clear that *Baetis* sp. and *Cloeon dipterum* present extreme contrasts: as the available oxygen falls below air saturation, the oxygen consumption of *Baëtis* sp. falls off at once, while that of *Cloëon dipterum* does not decrease until the oxygen concentration is below one fifth air saturation. The oxygen consumption of *B. scambus*, which is much lower than that of *Baëtis* sp., decreases very little when the oxygen in the water diminishes. The oxygen consumption of *Ephemera vulgata* falls as soon as the oxygen in the water begins to decrease, but less rapidly than that of *Baëtis* sp. *Leptophlebia vespertina* recalls *Cloëon dipterum*: its oxygen intake falls slowly at first, and then, below one third air saturation, it drops suddenly.

As the oxygen in the water is raised above air saturation, *Baëtis* sp. increases its oxygen consumption until it has reached one and a half times its value in Nature, while, on the contrary, the oxygen intake of *Baëtis scambus* remains steady, and that of *Ephemera vulgata* scarcely rises.

It is evident that the species most dependent on the oxygen in its environment is *Baëtis* sp., and it lives in streams where oxygen is always abundant. *Cloëon dipterum*, the most independent form, was taken from a pond in which the oxygen falls low at night in summer. But if the behaviour of these species fits their environments, that of *Ephemera vulgata* apparently does not do so, for it was found buried in mud in a pond, yet its oxygen intake drops as soon as the oxygen in the water decreases.

These results will be published in full in the *Journal of Experimental Biology*.

H. MUNRO FOX.
C. A. WINGFIELD.
B. G. SIMMONDS.

Zoology Department,
University, Birmingham.
Nov. 11.

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[1] H. Munro Fox and B. G. Simmonds, *J exp. Biol.*, 10, 67 (1933).

[2] H. Munro Fox, B. G. Simmonds and R. Washbourn, *J. exp Biol.*, 12, 179 (1935).

[3] R. Washbourn, *J. exp Biol.*, 13, 145 (1936).

Diastase in Rabbit Saliva

IT is frequently stated in general zoological literature that rabbit saliva contains an enzyme capable of hydrolysing starch to sugar. There is, however, so far, very little published experimental work to substantiate this statement. In fact, Schwartz and Rasp[1] were of the opinion that it was doubtful whether rabbit saliva contains a starch splitting enzyme of any kind. The low diastatic activity which they estimated, they were inclined to attribute to enzymes inherent in the food of the animal. Dukes[2] accepts this statement in a summary of recent work on the physiology of digestion.

Schwartz and Rasp, estimating the diastatic value by the production of achroodextrin from starch, reported that rabbit saliva (quantity unstated) would hydrolyse 2 c.c. of a 1 per cent starch solution in times varying from 50 to 81 minutes with an average of 68 minutes. I have been able to obtain complete hydrolyses of the same volume of starch solution in times varying from 30 seconds to 7 minutes. This marked difference in results seems to arise from the method by which the saliva is obtained from the animal. Schwartz and Rasp procured the secretion by placing in the rabbit's mouth a small wad of cotton wool which absorbed any free saliva in the mouth cavity. This was then placed in the given quantity of starch solution. I have been able to obtain the saliva by a suction method directly from the mouth, the fluid being collected in a small glass vessel. In this way, up to 0·3 c.c. can be procured in 3–5 minutes. I have also demonstrated that by placing a shred of cotton wool in the saliva so obtained, its activity is very considerably impaired. The low diastatic activity observed by Schwartz and Rasp, then, seems to lie in the fact that the enzyme is readily adsorbed by the cotton wool and so removed from the sphere of activity.

Work is at present in progress to try to account for the marked fluctuations in reaction time observed with saliva obtained by the suction method.

Rabbit saliva, like human saliva, has no effect whatsoever on uncooked or unbroken starch grains, owing to the resistant sheath of amylopectin in which the individual grains are enclosed. Work done by Pozerski[3] (1927) suggests that only a very small percentage of the grains are broken in the process of mastication. This brings to light the rather interesting problem of the possible utility of the enzyme in rabbit's saliva.

University College, Cardiff. I. M. THOMAS.

[1] C. Schwartz and F. Rasp, *Fermentforsch.*, 9, p. 50 (1926).
[2] H. H. Dukes, *J. Amer. Vet. Assoc.*, ii, 30, 225 (1930).
[3] E. Pozerski, *Compt. rend. Soc. Biol.*, 97 (35), 1592–4.

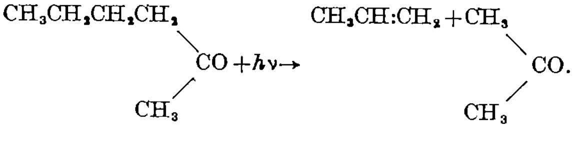
Photodecomposition of Aldehydes and Ketones

WE have recently extended our study of primary photochemical change by an investigation of the photodecomposition of the homologues of acetone in cyclohexane solution. It has been shown that in the gas phase there are two main types of decomposition. Type I occurs in short-chain aldehydes and ketones, and consists of an elimination of carbon monoxide, and the formation of an approximately equivalent amount of saturated hydrocarbon, resulting from the primary rupture of one of the carbonyl bonds; for example, in the case of acetone at 60° C. we have[1,2,3,4]:

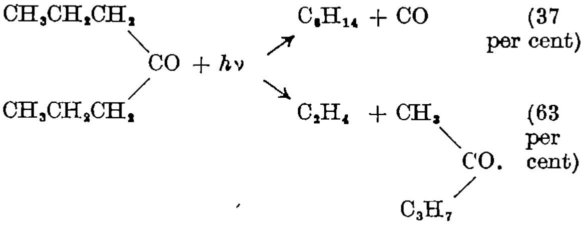
$$\begin{aligned} CH_3COCH_3 + h\nu &\rightarrow CH_3CO + CH_3 \\ CH_3CO &\rightarrow CH_3 + CO \\ 2CH_3 &\rightarrow C_2H_6. \end{aligned}$$

Type II, on the other hand, may be described as a species of cracking of the hydrocarbon chain in the $\alpha - \beta$ position to the carbonyl group, with the production of an olefine, and occurs increasingly with the higher homologues[2,5].

Thus with methyl-*n*-butyl ketone we have:



It has been shown that some carbonyl compounds in the gas phase decompose simultaneously in the two ways. This is the case with di-*n*-propyl ketone, in which both types have approximately equal probabilities of occurrence:



In solution and in the liquid state these results are considerably modified. Liquid acetone and acetone dissolved in benzene show no reaction whatever. In cyclohexane solution, however, as has been shown by Bowen[6], some reaction occurs with the solvent. Thus Type I decomposition is completely suppressed, and the excited molecules first formed must persist long enough to be deactivated by collision, or for reaction with the solvent.

With 10 per cent solutions of methyl-*n*-butyl ketone and di-*n*-propyl ketone in cyclohexane, however, at 20° C. we find a steady evolution of gas—practically pure propylene in the first case, and 98 per cent ethylene in the second, while in the irradiated solution of methyl-*n*-butyl ketone we have detected the presence of free acetone. It is therefore clear that while photodecomposition of Type I is almost completely suppressed, decomposition of Type II continues apparently unabated in solution. This is particularly apparent in the case of di-*n*-propyl ketone, in which both types occurred nearly equally in the gas phase.

At temperatures of *c.* 100° C., on the other hand, we have found that decomposition of Type I can also readily occur. For example, while pure liquid di-*n*-propyl ketone at 20° C. gives 98 per cent ethylene, at 90°–95° C. it gives a mixture consisting of *c.* 61 per cent ethylene, 30 per cent carbon monoxide and 9 per cent of ethane. At the same time the absolute amount of reaction according to Type II appears to be approximately independent of temperature.

It may be concluded from these results that:

(*a*) The mechanism of Type II decomposition is entirely separate from that of Type I.

(*b*) Molecules of the carbonyl substance can be activated in two alternate ways. In the first case (Type I), the excited molecule has a comparatively long life and is subject to strong deactivation by collision with the solvent, but the probability of reaction increases with temperature. In the second case (Type II), the time between excitation and reaction is so short as to be comparatively uninfluenced by the solvent molecules.

R. G. W. NORRISH.
C. H. BAMFORD.

University Chemical Laboratory,
Cambridge.
Nov. 10.

[1] Norrish and Kirkbride, *J. Chem. Soc.*, 1518 (1932).
[2] Norrish and Appleyard, *J. Chem. Soc.*, 874 (1934).
[3] Norrish, Crone and Saltmarsh, *J. Chem. Soc.*, 1456 (1934).
[4] Spence and Wild, NATURE, 138, 206 (1936).
[5] Bamford and Norrish, *J. Chem. Soc.*, 1504 (1935).
[6] Bowen, Communication to the Chemical Society (Nov. 5, 1936).

A Novel Interrelationship in the Triterpene Group

WE have elsewhere described the isolation of a diethenoid alcohol, $C_{30}H_{50}O$, accompanying β-amyrin and lupeol in the non-saponifiable fraction of shea nut oil[1]. We have now found that this alcohol, for which we propose the name basseol, is very readily cyclized by a variety of reagents to β-amyrin. This reaction is, we believe, the first example of the conversion of a naturally occurring tetracyclic triterpene to a likewise naturally occurring pentacyclic triterpene. It is of considerable biological importance in that it supplies an experimental realization of one stage in the natural evolution of a pentacyclic triterpene from presumably an acyclic structure of the squalene type by means of stepwise cyclizations.

A full account of this investigation will be published shortly.

J. H. BEYNON.
I. M. HEILBRON.
F. S. SPRING.

University,
Manchester.
Nov. 19.

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[1] Heilbron, Moffet and Spring, *J. Chem. Soc.*, 1583 (1934).

Radio Fadings and Bright Solar Eruptions

WITH reference to the three recent large sunspots reported in NATURE of December 5, p. 965, it is of interest to note that on December 3 a bright hydrogen eruption was observed at the Royal Observatory, Greenwich, to take place near one of them which was at the time 55° west of the sun's central meridian. The region in question was under observation with the spectrohelioscope (using the hydrogen line of the solar spectrum, $H\alpha$) at $11^h\,46^m$ U.T., when a minor bright eruption was seen to be in progress. At $11^h\,57^m$ a recrudescence of activity began, and by $12^h\,03^m$ the bright hydrogen eruption had become as bright as the continuous spectrum 4A. from the centre of the $H\alpha$ line. At $12^h\,18^m$, cloud unfortunately intervened, but from previous experience it is known that the average duration of the major bright eruptions is 30–45 minutes.

The chief interest of the present solar eruption is that a marked abnormality in the ionosphere affecting radio transmission was reported to the Royal Observatory as having occurred on the same day from $12^h\,12^m$ until $12^h\,42^m$.

In a memorandum issued by the Astronomer Royal on December 1, it is pointed out that, from a preliminary comparison of twenty-three marked radio fadings and bright solar eruptions recorded during the twelve months, July 1, 1935–June 30, 1936, eight radio fadings occurred during the actual observation of bright eruptions on the sun. In addition, two fadings occurred when a bright eruption was listed as having been seen some minutes later to be already in progress, although its time of origin was not observed owing to cloud or some other circumstance. Of the remaining thirteen radio fadings, in one case the sun was not under observation at the time, and in twelve cases it could not be ascertained from the international solar data (published in the Zurich solar *Bulletin*) whether any solar eruption was observed at the respective times—the sun being actually under observation—or whether, owing to cloud, observations were impossible.

The memorandum proceeds to point out that since nine or ten marked radio fadings were closely associated in time with bright solar eruptions (the expectation of chance coincidences being less than two, if solar eruptions of all intensities be considered and almost negligible if the proportion of the more intense solar eruptions, appropriate to the twenty-three radio fadings, be taken into account), a definite correlation is suggested between the two phenomena, the relationship appearing to depend on a rapid transmission of some solar agency travelling with a speed approaching that of light.

It is suggested that in future the published international solar data should be still further extended, so as to provide the additional information as to whether at the time of any marked radio fading the sun was actually under observation at one or more of the observatories equipped with spectroheliographs and spectrohelioscopes.

H. W. NEWTON.

Royal Observatory,
Greenwich,
London, S.E.10.
Dec. 5.

Natural Selection

IN reply to Prof. MacBride's letter in NATURE of November 21, p. 884, may I just say that, both by my distinguished predecessor and myself, the study of as many specimens as possible has been recognized as of the first importance, and that is done not only at Oxford but also by visits to the British Museum (Natural History) and to Lord Rothschild's wonderful collection at Tring: indeed I was there yesterday.

The study of geographical variations, as we have so often emphasized, plays a leading part in the subject of mimicry; and, to paraphrase my friend's words, if he really wishes to know how the evolution of a mimetic pattern proceeded, let him come to the museum at Oxford. There he will see hundreds of *Papilio dardanus*, and all stages of evolution of the sundry mimetic tail-less forms of female from the tailed, male-like form.

I do not attempt to meet Prof. MacBride's arguments about mutations because, as I said in NATURE of October 17, they should be answered by more competent hands than mine.

G. D. HALE CARPENTER.

Hope Dept. of Entomology,
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Oxford.
Nov. 28.

Professional Associations of Scientific Workers

THE leading article in the issue of NATURE dated November 14 directs attention to the limited scope of most professional associations of scientists and emphasizes the need for one which concerns itself with the social aspects of science. The Association of Scientific Workers has for many years tried to fulfil this function, as reference to its policy will show. "The main objects of the Association are to promote the interests of the Scientific Worker and to secure the wider application of science and scientific method for the welfare of society."

It must not be thought that the Association believes that society is likely to be ruled by 'technocrats' in this or any other country in the near future. Political power is wielded by dictators and by organized masses, but not by professional associations. Even so, as NATURE asserts, scientists have an important contribution to make to the government of our country, and the Parliamentary Science Committee is a live expression of the holding of this belief by many scientists. The Association has played a large part in the formation of this Committee, which now speaks on behalf of 100,000 supporters in its constituent bodies.

Attention to the influence of science in national affairs and its bearing on current legislation is one aspect of the Association's work. In its other functions it is more like other professional associations which dislike the name trades union; like both, it takes an active interest in the conditions of employment and security of tenure of scientific workers of all kinds—it has often been able to assist individual members in cases of unfair treatment. Because of the general character of the work done by the Association, we feel justified in seeking your courtesy in publication. At the same time, we wish to urge all who would see science properly applied to get in touch with the Association and either join it or give it financial support.

W. A. WOOSTER.
Hon. General Secretary.

Association of Scientific Workers,
Kelvin House, 28 Hogarth Road,
South Kensington,
London, S.W.5.

Points from Foregoing Letters

DR. E. E. JELLEY finds that certain dyes exhibit a characteristic absorption spectrum associated with fluorescence of slightly longer wave-length, on precipitation from their solutions, before they become crystalline. He considers that they are then in a molecularly disperse state. The author describes the preparation of such disperse systems of a ψ-cyanine dye in both liquids and solids. They show an unusually narrow absorption and fluorescence band, analogous to that of the ruby.

Prof. G. Ingle Finch reports that whilst polished surfaces of single crystals of certain substances (quartz, diamond, sapphire) yield electron diffraction patterns of spots and lines characteristic of crystalline structure, polished surfaces of other crystals (zircon, tourmaline, cassiterite) give patterns of diffuse haloes typical of liquid mercury and various glasses. Etching removes the amorphous polished layer and restores the crystalline pattern. This, the author considers, supports Beilby's view of an amorphous layer of polish which, however, may afterwards recrystallize.

The mean free path of neutrons of 2·4 m.e.v. in paraffin wax is found by E. T. Booth and Dr. C. Hurst to be $4 \cdot 6 \pm 0 \cdot 9$ cm., which corresponds to a scattering cross-section of $1 \cdot 8 \times 10^{-24}$ cm.^{2}. This value together with the neutron-proton cross-sections found by other investigators, for neutrons of different energies, is compared with the theoretical scattering curve derived from Wigner's formula.

V. Fock finds a contradiction in Jordan's neutrino theory of light, owing to the linearity of the equations and the non-linearity of the connexion between F, the quantized wave function of the light field, and Ψ, that of the neutrino. He considers, moreover, that no consistent theory of light can be constructed based on a relation of F and Ψ.

A difficulty in Einstein's theory when applied to phenomena within material media is discussed by Dr. L. Silberstein. Both the minimal lines which represent laws of propagation of light, and the geodesics which give the motion of a free particle in a field, are applicable, according to Dr. Silberstein, only in the absence of matter.

Dr. A. C. Redfield states that a theory proposed by Rossby concerning the Gulf Stream and its associated counter currents provides a mechanism for the transport of water rich in organic nutrients from the depths of the Atlantic basin, on to the continental shelf of North America, thus accounting for the fertility of the water of this region.

Prof. F. G. Gregory and O. N. Purvis report that winter rye is not 'vernalized' at low temperature (1° C.) if oxygen is excluded; also that seeds can be 'devernalized' by keeping them at a temperature of 20° in nitrogen for a period equal to that which they have been exposed at the low temperature.

The effect of ultra-violet light upon the stability of several colloidal systems (sols of ferric hydroxide, mastic, etc.) has been investigated by F. Ellinger. The author enumerates some of the results obtained which, he considers, bear upon the question of whether a special colloid-chemical theory is necessary to explain the biological action of radiation.

The oxygen consumption of various species of mayfly nymphs has been studied by Prof. H. Munro Fox, C. A. Wingfield and B. G. Simmonds, in relation to the amount of oxygen in the water. In some species the oxygen intake does not diminish until the available oxygen has fallen to a very low value; in others it decreases as soon as the environmental oxygen drops. In the presence of more oxygen than is available normally in Nature, the oxygen intake of one species rises as high as 1½ times its normal value.

That the rabbit saliva has the power of changing (broken) starch grains to sugar is confirmed by I. M. Thomas. He states that Schwartz and Rasp had failed to prove this conclusively because they had used cotton wads to collect the saliva, with the result that the enzyme responsible for the hydrolysis of the starch was adsorbed and rendered ineffective.

The chemical action of light upon compounds belonging to the acetone series, in cyclohexane solution, is found by Dr. R. G. W. Norrish and C. H. Bamford to be of the 'cracking' type only (leading to the formation of unsaturated hydrocarbons like ethylene), while in the gaseous state the same compounds under the action of light yield, in addition, saturated hydrocarbons like methane. The authors suggest an interpretation of these results based upon the length of life of the 'excited' molecules.

Research Items

Palæolithic Site in Manchukuo

PALÆOLITHIC artefacts excavated at Ho-Chia-Kou in Ku-Hsiang-Tung in the environs of Harbin, Manchukuo, by the Japanese First Scientific Expedition to Manchukuo, 1933–34, have been described by Shigayasu Tokunaga and Nobuo Naora (Report: Section 6, Anthropology, Pt. 2. Waseda University, Tokyo). The deposits had been much eroded by river action, which had exposed clay, now being used for making bricks, and fossil mammalian remains. The site was excavated by members of the expedition in 1933 and 1934. At a depth of 1–3 m. below the surface were found numerous fossil mammalian and plant remains, as well as artefacts coeval with the fossil remains. This account deals only with the artefacts. A notable feature of the culture of the site is the great preponderance of bone artefacts; 262 artefacts were unearthed, of which 24 were stone, 217 bone, 4 horn, and 11 tusk. A large quantity of charcoal was found, which may have served for fuel. There were also hundreds of animal bone pieces. The types represented in the stone implements were the willow type, the triangular type and the scraper type. The workmanship is generally rough. Though there are indications that some of the implements may have been manufactured locally, there is no material available within fifty kilometres of Harbin. The implements resemble the Far Eastern series which has been found at the base of the loess at Ordos and Shansi, and belong to the culture of the Loess period, which Boule, Breuil and others regard as either Mousterian or Aurignacian. They are, however, decidedly oriental. The bone artefacts include sixteen forms, among which are spear-head shape, harpoon shape, chisel, chopper, bowl, spoon, arrow-head shape, axe, wedge, etc. There are edged tools made from an animal pelvis, and a bowl-shaped artefact made from a deer's cranium. The tusk implements are all of mammoth ivory. Several walnut fruits were found.

Physiological Effects of Pressure

A USEFUL review of the researches on the physiological effects of pressure is provided by McKeen Cattell (*Biol. Rev.*, Oct. 1936). It is restricted to hydrostatic pressure transmitted to a tissue or organism completely immersed. Pressure applied locally on a part or by means of a gas introduces further complications, and so is not considered. The principal effects are reduction in volume, alteration in the velocity of chemical reaction and changes in viscosity. Other effects include changes in solubility, ionic dissociation and surface tension. In view of the incompleteness of our knowledge, generalizations can scarcely be drawn. It does seem, however, that relatively small pressures speed up physiological processes, perhaps in part due to the fact that decrease in volume involves a diminution in the spaces between molecules and a consequent increase in the collision rate between the reactants. Higher pressures bring about depression of activities and finally an irreversible polymerization of proteins and allied substances, and also the inactivation enzymes, toxins, antibodies and viruses. There is apparently a pressure-time threshold varying widely with different tissues or organisms below which the changes induced by pressure are reversed with decompression but above which the changes are irreversible. It is suggested that pressure, because of the ease with which it can be applied and controlled, may be a valuable aid in attacking physiological problems.

Distribution of Coast Gorilla

IN describing four gorillas from the Sanga River region, collected by the George Vanderbilt African Expedition of 1934, Harold J. Coolidge, jun., discusses the question of the distribution of the species (*Proc. Acad. Nat. Sci. Philadelphia*, 88, 479; 1936). In contrast to the opinion of Dr. A. H. Schulze, he regards the mountain gorilla as a race (*Gorilla gorilla beringeri*) distinct from the coast gorilla (*Gorilla gorilla*); and as collateral support of this point of view, he instances the discontinuous distribution of the two forms. There would appear to be a forest belt, 650 miles broad, stretching from long. 17° E., the eastern limit of the known range of the coast gorilla, and long. 28° E., the western limit of the mountain gorilla, in which gorillas are absent. For although various statements have been made of the presence of gorillas in this area, critical examination of the records shows that, with the exception of four skulls collected in 1908 from Bondo on the Uelle River, no great importance can be attached to the evidence. The lack of evidence is the more striking when account is taken of the fact that no record has been forthcoming during the last thirty-five years of active hunting and exploration in this part of the Congo.

Morphology of Coleoptera

IN the *Smithsonian Miscellaneous Collections*, 94, No. 13 (1936) are two papers of special interest to students of this order of insects. Mr. W. H. Anderson, of the University of Maryland, contributes a comparative study of the labium in Coleopterous larvæ. In this paper special stress is laid upon the origins and insertions of the labial muscles and their importance in determining the homologies of the parts concerned. The composition of the labium is described in representatives of many of the more important families, and what is regarded as its typical formation is seen in the larvæ of *Byrrhus* and *Silpha*. The second paper is by Mr. Richard E. Blackwelder, of Stanford University, who discusses the adult morphology as displayed in the family Staphylinidæ. Practically all the exoskeletal parts are described and figured from representatives of ten out of the fifteen subfamilies. A comprehensive study within the limits of a single family, as in the present case, merits the attention of systematists as well as morphologists, and a number of anatomical parts are dealt with which present available characters of possible importance for taxonomic purposes. Both the above papers are well illustrated and provided with useful lists of the special literature concerned.

Genetical and Taxonomic Investigations in *Œnothera*

THE importance of combined cytological, ecological, genetical and taxonomic research is slowly but surely becoming recognized by botanists. A paper by Prof. R. Ruggles Gates in which field, cultural, and, to a less extent, laboratory investigations are combined, has recently appeared (*Phil. Trans. Roy. Soc. Lond.*, B, 226, 239–355; 1936) and is doubly welcome for the results given and as a further example of improving taxonomic methods. The paper is concerned mainly with the results of field investigations of *Œnothera* populations made in eastern Canada in 1932, and with the detailed analysis of the cultures raised from the seeds collected. Seventeen new species and fifteen new varieties are fully and carefully described and figured. Valuable notes are given on the ecology, genetical peculiarities, behaviour under cultivation, and, for some of the cultures, the cytology. Such studies have enabled the author to indicate south to north movements in several different lines, epharmonic responses to environmental conditions, and evanescent characters which appear only during a part of the flowering season. That the catenation of all the plants dealt with in the paper and cytologically investigated was found to be, without exception, a ring of 14 chromosomes, may be considered further evidence that the genus *Œnothera* is cytologically exceptional among plants. Nevertheless, the suggestions made as to the causes of the polymorphism found in Eastern North America also apply, with certain modifications, to other genera. Gene mutations are said to have been active in supplying the raw materials for specific differentiation. Crossing has also probably played a part in increasing the number of specific types, the hybrids breeding true because of catenation. Such new 'constant' types are morphologically of equivalent value to the older species. Parallel mutations have also occurred many times in the different species.

Virus Diseases and Cytology

Two short papers by Dr. F. M. L. Sheffield (*Ann. App. Biol.*, 23, 498 and 506; August 1936) consider the reactions of host-plant cells to attack by virus disease. The first paper confirms some earlier experiments by Prof. B. M. Duggar, that the spraying of virus extract upon an unwounded plant did not result in entrance of the virus. Actual injection of an infectious liquid into single cells only resulted in about ten per cent infection, thus suggesting that all cells of the host are not equally susceptible to virus attack. The second paper shows that virus does not produce inclusion bodies in the guard cells of a leaf of *Solanum nodiflorum*, though these bodies may appear in every cell over large areas of the epidermis. This fact has now been correlated with the absence of protoplasmic connexions between the epidermal and guard cells, thus providing circumstantial evidence that the spread of virus from cell to cell is along the plasmodesma.

Irish Fungi

DR. P. O'CONNOR has published a "Contribution to Knowledge of the Irish Fungi" (*Sci. Proc Roy. Dub. Soc.*, 21, No. 39; Sept. 1936). He has paid most attention to the rusts and smuts, the Ascomycetes, Phycomycetes and Fungi Imperfecti, but the Aphyllophorales, the Exobasidiales and Auriculariales of Rea's classification of the Basidiomycetes have also received attention. Nearly 350 species are recorded, frequently from numerous localities; the kind of spore produced by rust fungi is noted, and host plants are also listed. Several fungi are cited as new to the Irish flora, whilst *Cicinnobolus Plantaginis* on *Plantago maritima*, *Septoria Rubiae* on *Rubia peregrina*, *S. Saxifragæ* on *Saxifraga spathularis*, and *Rhabdospora lentiformis* on ash, are new to the fungus flora of the British Isles.

Alkaline Rocks of Chilwa, Southern Nyasaland

AT the meeting of the Geological Society of London on November 4, Dr. Frank Dixey delivered a lecture on the alkaline rocks occurring in the vicinity of Lake Chilwa. The types described comprise the following: syenite; volcanic vents infilled with carbonates and brecciated felspar-rock; hydrothermal rocks in the vents; nepheline-syenite; and swarms of associated dykes of solvsbergite, microfoyaite, phonolite and nephelinite. The period of activity is ascribed to about the end of the Lias or not very long afterwards. The series thus represents a hitherto unrecognized phase of Karroo or early post-Karroo igneous activity. The felspathic materials of the vents include a unique rock-type containing 70–78·8 per cent of orthoclase, but with a potash content of 13 per cent—an amount which is even higher than is normally found in orthoclase itself. The gneisses and other rocks surrounding the vents are all altered, and sometimes they are thoroughly impregnated by the felspathic intrusive, with production of types comparable with Brogger's fenite-tveitåsite series (Fen Complex, Oslo District). The limestones of the Basement Complex in southern Nyasaland and the overlying younger limestones are of negligible bulk compared with the carbonate-rock of the vents and are also of different composition. The sedimentary or metamorphic limestones are accordingly rejected as a source of the carbonate-rock of the vents, which is regarded as of very deep-seated or even of magmatic origin. An account of Dr. Dixey's field work and that of C. B. Bisset, accompanied by the results of a petrographical investigation by W. Campbell Smith, will be published as a Bulletin of the Geological Survey of Nyasaland.

Temperature Measurements in Oil Wells

UNTIL recent years, systematic measurement of well temperatures has been impracticable owing to lack of a suitable instrument and technique. M. Schlumberger, H. G. Doll and A. A Perebinossoff, in a paper presented for discussion at a meeting of the Institution of Petroleum Technologists on November 10, describe how these difficulties have been to a large extent overcome by the evolution of an extremely sensitive recording thermometer and technique for its operation. The instrument is capable of being run through all normal sizes of drill-pipe and tubing, has an accuracy of 0·1° C. and permits continuous logs to be traced at 15 cm. per sec. without noticeable time-lag. When run inside the well, it is in contact with the fluid contained therein and consequently measures the temperature of the fluid and not of the surrounding formations. It can be used in wells in thermal equilibrium with their surroundings and also in wells in thermal evolution with equally valuable results; also in both open and cased holes. Moreover, in a well where the exchange of surroundings is not limited to heat alone, it is capable of recording actual material flows of oil, gas or water into the well. The advantages of the instrument are, therefore, obvious, but factors such as bottom-hole effect in drilling wells, size of the hole, nature of the fluid in the hole, etc., complicate interpretation of temperature diagrams. Close co-operation between a surveyor having experience of temperature measurement and a field staff familiar with local conditions is the prime necessity for accurate interpretation of temperature records, and only in this way can the maximum aid be drawn from them.

Production of Artificial Radioactivity by Deuterons

J. J. LIVINGOOD and J. J. Livingood and G. Seaborg have recently described the results of bombarding a number of heavier elements with 5-million volt deuterons from the Lawrence cyclotron accelerator (*Phys. Rev.*, 50, 425; 1936). Zinc, antimony, ruthenium, bismuth, tin were bombarded with deuterons (currents up to 3·5 microamp.) and in every case β-radioactivity was produced. The complicated decay curves show that several radio-elements are formed in each case, and tentative nuclear reactions are suggested. In some cases the new active elements can be identified by comparison of their decay periods with those of the products of bombarding neighbouring elements with neutrons. In the case of tin, a chemical separation of indium, tin, antimony was made, and each of these was found to be associated with a characteristic activity. The case of bismuth is particularly interesting. since the product of the reaction

$$^{209}_{83}\mathrm{Bi} + {}^{2}_{1}\mathrm{H} \rightarrow {}^{210}_{83}\mathrm{Bi} + {}^{1}_{1}\mathrm{H}$$

appears to be identical with the radium E of the natural radium series. It has the expected decay period, and it was possible to detect the α-particle activity of the polonium (radium F) formed by a successive transformation. The α-particles had the correct range. This is the first case of the synthesis of a naturally occurring radio-element.

Protium – Deuterium Ratio in Water

SEVERAL attempts have been made to determine the ratio protium – deuterium (^{1}H:^{2}H) in ordinary water, and the results mostly fall into two groups, either near 5500 or near 9000. The ratio has again been determined by a method which involves no extrapolation and in which the final value is approached from both the light and heavy side (N. F. Hall and T. O. Jones, *J. Amer. Chem. Soc.*, 58, 1915; 1936). The authors believe that many of the discrepancies found rest upon inadequate correction for alteration in the oxygen isotope ratio (^{16}O:^{18}O) in the water used. They paid special attention to this. Surface water from a lake was freed from deuterium by repeated electrolysis with recombination of the electrolytic gases. When the *deficiency* in ^{18}O thus caused had been restored by carbon dioxide equilibrium against the original water, the density loss due to deuterium alone was 16·5 γ. The same water was electrolysed in stages and the electrolytic hydrogen burned in air. The *excess* of ^{18}O thus introduced was removed in the same way, and the density loss was again 16·5 γ. Control of oxygen isotope ratio was exercised by index of refraction measurements. With the value 1·1074 for the density at 25° of pure deuterium oxide (oxygen normalized) the protium – deuterium ratio in Lake Mendota (Madison, Wis.) surface water is calculated to be 6,400 ± 200, taking account of the non-additivity of volumes. This is in good agreement with G. N. Lewis's early estimate of 6,500. Using the ratio 6,400, Aston's recent determination of the physical atomic weights of the hydrogens, and the Mecke-Childs' conversion factor, the physical atomic weight of ordinary hydrogen becomes 1·0083 and the chemical value 1·0081.

Range of Loudspeakers

LOUDSPEAKERS are of value not only for domestic use with radio sets but also for other purposes. The paper on "The Appraisement of Loudspeakers" by F. H. Brittain, of the Research Laboratories of the General Electric Co., Ltd., the first half of which appeared in the *G.E.C. Journal* of November, is of both scientific and commercial value. Mr. Brittain begins by enumerating the common imperfections of electro-acoustic systems and then considers in detail the effect they have on the performance of loudspeakers used in connexion with domestic entertainment, with public entertainment such as talking films, etc., and with public address systems. If the sound originates in a studio, the sound waves of frequencies lying between 50 and 7,000 cycles are usually clearly transmitted. If the sound originates under less carefully controlled conditions, such as 'outside broadcasts', the frequency band may be much curtailed. In the case of reproduction from a gramophone record, the frequencies recorded lie between 200 and 6,000 cycles, after which there is a progressive reduction in output until about 40 cycles, when there is a complete cut-off. The frequency discrimination of radio receiving apparatus is nearly always well marked. When using broadcast receivers, owing to the closeness of adjacent stations, it is not usually possible to receive frequencies above about 7,000 cycles, and this is only attained under favourable conditions. At the low-frequency end the cost of the equipment at about 80 cycles makes it necessary to reduce the output. With the loudspeakers at present in use, the small size of the average table set makes reproduction of frequencies below 80 nearly impossible. Even with the latest sets fitted with special devices, the frequency band never exceeds about 10,000 cycles. Further causes of failure are described and the methods used for measuring them are indicated.

Changes in the Spectrum of the Star 25 Orionis

A STUDY of the spectrum of 25 Orionis by Helen Dodson (*Astrophys. J.*, 84, 180) forms a useful contribution to the literature of bright-line stars. She has measured 147 spectrograms, covering the period 1915–33, and has found periodic variations in velocity (from both absorption and emission lines), line width, line contours, and line intensity ratios (V/R) for the double hydrogen emission lines. The velocity changes from the hydrogen lines are nearly synchronous with changes in the V/R ratio, but the period is not constant—having decreased from 1817 to 1025 days. The amplitude of velocity changes from individual hydrogen lines increases for the later members of the Balmer series; but the phase is the same for each, although the V/R ratio shows marked differences of phase from line to line. The helium lines are exceptionally interesting owing to the fact that their changes (in velocity and contour), while definitely related to the central hydrogen line velocities, are conspicuously out of phase with the latter. This is the only difficulty in accepting McLaughlin's hypothesis of a rotating, pulsating, nebulous atmosphere, which would account satisfactorily for all the remaining features of this and other similar bright-line stars.

Some Chemical Aspects of Nutrition

THE thirty-fifth Bedson Lecture was delivered by Prof. J. C. Drummond on November 20 at Armstrong College, Newcastle-on-Tyne, on "Chemical Aspects of some Modern Nutritional Problems".

Prof. Drummond pointed out that animals are dependent on plants for certain compounds which they cannot synthesize themselves from potentially suitable material. Such compounds can be divided into two types: tissue-building stores, and what might be termed 'chemical lubricants', for example, vitamins and hormones.

Cystine is a good example of the former type. Animals cannot synthesize this important amino-acid even if provided with sulphur, in various forms, and closely related compounds not containing sulphur, for example, serine. However, they can use menthionine, and dithioldilactic acid, but not homocystine and cystineamine to replace a cystine deficiency. Persons suffering from cystinuria who are given menthionine excrete it as cystine only.

Vitamins A, B_1, C and D are examples of the second type. In dealing with the work leading to the synthesis of vitamin B_1, Prof. Drummond pointed out that alteration in the position of the methyl group in the pyrimidine ring leads to the formation of biologically inactive products.

Vitamin A has been shown to be a C_{20} compound closely related to the carotinoid pigments. Those carotinoids possessing a β-ionone ring and a suitable side chain act as precursors of the vitamin. β-carotene itself is probably quantitatively converted into it. It is remarkable that the molecule divides at the central double bond considering that polyene chains are usually susceptible to oxidative attack at various points. Certain birds can use xanthophylls as vitamin A precursors, whereas other animals cannot. This suggests that there may be more than one vitamin A.

Chemical studies of vitamin C (*l*-ascorbic acid) are fairly complete, and it is interesting to compare the antiscorbutic activities of various substituted ascorbic acids. *d*-Ascorbic acid is quite inactive, *d*-arabo-ascorbic acid possesses one twentieth the activity, while *l*-rhamno-ascorbic acid and dehydro-ascorbic acid are less active. The preparation of these synthetic products possessing activity raises the question of the possibility of the synthesis of compounds of greater antiscorbutic power than vitamin C.

Turning to vitamin D (calciferol), Prof. Drummond said that it is generally held that rupture of one ring of its sterol precursor takes place during irradiation with ultra-violet light. Vitamin D activity is not dependent on the presence of a double bond in the side chain. Recent work on the antirachitic substance produced by irradiation of 7.dehydrocholesterol and on the products formed when 7.dehydrostigmasterol and 22.dihydro.7.dehydrostigmasterol are similarly treated was reviewed. The relation between constitution and biological action is not yet clearly apparent. There are two views to account for the activity of the various compounds. Either it is necessary to provide substances capable of being broken down to simpler molecules, or compounds with the same carbon skeleton as vitamin D are required. The former gleans some support from the fact that compounds, very different in structure from those obtained from natural sources, are capable of producing œstrus. For example, *l*-keto-tetrahydro phenanthrene and certain dibenzanthrone diols have some activity. A more remarkable case is that reported by Prof. E. C. Dodds, who found that dihydroxydiphenyl is active.

The Part played by Skin-Friction in Aeronautics*

THIS paper, running to some forty-seven pages of closely printed matter, is a book in itself. It is illustrated by twenty-seven figures, and is in five parts; Part I deals with resistance due to skin-friction, on an empirical basis, the determinations of Froude and of the many workers who followed him being presented in the form of a logarithmic diagram, in which, as is usual, ordinates give values of the constant C_0 (as in the expression $R = C_0 \rho V^2 \times 2a$) and abscissæ give Reynolds' numbers from 10^2 to 10^{10}; these numbers, denoted by the symbol N_R, cover the whole range from that proper to laminar flow, to that which obtains for ocean-going liners. The author points out that it is not possible to reconcile the wide variations in known data and gives a graph as indicating the probable minimum under ordinary average conditions. After a general discussion, an example is taken in the *Graf Zeppelin*; the hull resistance is calculated on the basis suggested by Froude in the case of ships; the horse-power is deduced for a flight speed of 80 m.p.h. and is in approximate agreement with that declared. A second example is given.

Parts II and III give in an abridged form the author's cyclic or vortex theory (sometimes referred to as the Prandtl theory) of sustentation, describing the two methods of treatment adopted by him in 1907 and 1914 respectively, and proving their quantitative identity. The criterion is shown to be the 'peripteral area' which defines the quantity of air handled by an aerofoil or the wings of a machine in flight. According to both methods the peripteral area is shown to be equal to 0·78 of the square of the span; that is to say, the area of a circle having a diameter equal to the span. From this the aerodynamic resistance may be calculated making use of the Newtonian principle of the equality of *force* and *momentum per second*. Parts II and III, though not directly concerned with skin-friction, lead up to Part IV, in which it is shown that the theory of sustentation has to be used in order to institute a comparison between theory and experiment. In Part II certain propositions which were first enunciated in the author's "Aerodynamics" are given.

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* Synopsis of a paper by Dr. F. W. Lanchester, F.R.S., read before the Royal Aeronautical Society on November 12.

Part IV, which contains the gist of the whole paper, is devoted to a comparison instituted between theory and recent data furnished by experiments conducted in the compressed air tunnel at the National Physical Laboratory (Aeronautical Research Committee: Reports and Memoranda, 1627). The essence of the matter is that prior to the installation of this tunnel, it was not possible to conduct wind channel experiments at high Reynolds' numbers such as apply in the case of full-scale machines, and it had long been known or at least suspected that there is a great difference between high and low Reynolds' numbers. The extent of the agreement (or disagreement) was a matter of conjecture. *It is demonstrated that complete reliance may be placed on the predictions of theory under conditions of high Reynolds' numbers.* The examples taken for the purpose of investigation are aerofoils R.A.F. 48, Clark *YH*, and Göttingen 387; the results are given tabulated and as plottings.

In Part V it is shown that in contrast to the agreement found over a range of high Reynolds' numbers (namely, about 2×10^6 and upwards) theory can no longer be considered reliable. For the full-scale glider or sail-plane where the Reynolds' number is in the region of $1 \cdot 7 \times 10^6$, agreement is still good, but when the same methods are applied to the investigation of model aerofoils and gliders the discrepancies are shown to be considerable. The reasons for this are discussed.

In the four appendixes the more important matters are: A relation is established between the gross weight of an aeroplane and the Reynolds' number; and three diagrams are given, by the aid of which the Reynolds' number may be ascertained prior to design, if the projected gross weight and the aspect ratio are given. In Appendix III reference is made to the region of instability or uncertainty in the relations of C_0 to the Reynolds' number, illustrated by plottings due to Mr. G. Baker (1915) and Prof. Melvile Jones (*Rep. and Mem.*, 1199). Appendix IV is devoted mainly to the aerodynamics of flying at high altitude.

A Magdalenian Site of Southern France: The Cave of Isturitz[*]

IN continuation of the exploration of the palæolithic cave of Isturitz (Basses Pyrénées) by Dr. R. de Saint-Périer, of which the Magdalenian levels in the Hall of St. Martin have already been described (*Arch. Inst. Pal. Hum. Mém.*, 7; 1930. See NATURE, 128, 988; 1931), the Magdalenian deposits of the adjoining Great Hall, or Hall of Isturitz, as it has been named, have now been excavated; and it has become possible to take a general view of the Magdalenian culture of the site as a whole.

The Magdalenian deposits overlie Solutrean and Aurignacian levels, which are now being examined, without the intervention of any sterile layers. It is evident that both the Solutrean and the Magdalenian tribes established themselves here without any independent stratigraphic formation taking place. Both halls were occupied at the time the earliest Magdalenian deposits were laid down; but it is apparent that the occupation of the Great Hall was both longer and more intense than that of the Hall of St. Martin. Hearths, however, in the Great Hall are less frequent. A further difference is that while engraved plaques are exceptional in the Great Hall, though there art blossoms into great richness, in the Hall of St. Martin such plaques are numerous.

Although the age of the Magdalenian is that of the older Magdalenian of the Pyrenees, it is not, even at the base levels, the oldest stage of that culture. As is shown by the character of the lance-heads and certain of the engravings, these lower levels belong to Magdalenian iii, corresponding to Marsoulas. Above this is the culture of Magdalenian iv; but only in the Great Hall are found the harpoons, of which the evolved character points to a later occupation.

The most important period of occupation is Magdalenian iv, of which the chief characteristics are: a cold climate fauna, in which the horse is predominant, but a few retarded forms such as *Rhinoceros tichorhinus*, *Ursus spelæus* and *Hyæna crocuta* survive; and a lithic industry which is small and of mediocre execution, the various forms being not clearly defined and many implements being made from irregular and bad flakes. Burins are dominant. The bone industry is abundant, especially in the Great Hall. Many used bones show little sign of preparation for their purpose. The bone objects include needles, lance-heads of diverse types, *bâtons*, etc. A large number of the artefacts have been treated under a single classification as 'perforated'. The prototypes of harpoons found in the Great Hall already show signs of evolution.

The art forms of this period are here fully represented. They occur indiscriminately from bottom to top of the deposits of the period without distinction as to the level in which they are found. As already mentioned, the art of the Great Hall is richly developed both in the naturalistic form and in the conventionalized decorative motives. The naturalistic art in both sculpture and engraving shows remarkable powers of accurate observation of animal forms; while the conventionalized designs are clearly based on an equally accurate observation of the natural forms from which they are derived. One remarkable piece of engraving on bone represents a scene between a man and woman, of which the pose and composition depict graphically an expression of intense desire on the part of the male. The head of the woman and the lower part of the man are missing. The artist appears to have intended to represent the woman as thickly covered with hair over a great part of her body.

The abundance of the examples of this art in the Great Hall must account for the fact that, although much of it is of the highest quality, as a whole it is uneven and the choice of material is sometimes bad. The inferior may represent trial and practice pieces.

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[*] Archives de l'Institut de Paléontologie Humaine. Mém. 17. La Grotte d'Isturitz. 2: Le Magdalénien de La Grande Salle. Par Dr. René de Saint-Périer. Pp. 140+12 plates. (Paris: Masson et Cie., 1936.) 120 fr.

In the levels of Magdalenian v and vi the climate is still cold; but the horse is less abundant. For a time the reindeer is important and then gives way to the deer. Birds become abundant. There is no very marked change in the character of the stone industry; the bone artefacts show a characteristic 'fossil' in the form of a staghorn point with a forked base; barbed harpoons appear. Objects of art become scarcer; sculpture disappears, and the art form is reduced to simple graving. Both realist and decorative art weaken and are less varied.

In the material of this level, the Azilians made their hearth. The stone industry above the Magdalenian levels resumes the forms of the Aurignacian culture with characteristic delicacy and beauty of retouch. Circular scrapers determine the Azilian character of the culture, their evidence being confirmed by the harpoons, which become more and more evolved.

With the close of this period man's occupation of the cave, save for burial purposes, comes to an end.

The British Institute of Radiology

ANNUAL CONGRESS AND EXHIBITION

THE tenth Annual Congress and Exhibition of the British Institute of Radiology was held at the Central Hall, Westminster, on December 2–4, 1936. The arrangements differed to some extent from those of previous years, notably in the inclusion of a section of the exhibition devoted to physical research. Among the institutions represented in this section were St. Bartholomew's, the Royal Cancer and the Mount Vernon Hospitals, Radium Beam Therapy Research, and the National Physical Laboratory, while Dr. Russell Reynolds showed an X-ray cinematograph apparatus. The section showed clearly the close connexion between physical research, even modern atomic physics, and the medical applications of radiations of all types. The exhibit of radium beam therapy research was concerned with a study of induced radioactivity, the principal item being a Geiger counter connected to a cathode ray oscillograph, the screen of which is photographed on a 35 mm. ciné film operated by a mechanism so designed that the speed of motion of the film varies logarithmically with time. By the use of this device, the film moves quickly enough to record the rapid counts of a newly activated material but slows down as the activity decays, so that considerable economy in the cost of film results.

The Royal Cancer Hospital and the Mount Vernon Hospital had exhibits dealing with X-ray and radium dosage, their measurement and typical results. The apparatus used at the Royal Cancer Hospital to determine the gamma-ray output of radium in röntgens consists of accurately made air-wall ionization chambers connected to a Lindemann electrometer, while the Mount Vernon Hospital exhibit included a valve amplifier of the DuBridge type working in conjunction with air-wall chambers and used for exploring the fields round radium sources.

The St. Bartholomew's Hospital exhibit included a demonstration of a simple form of Geiger counter employing a neon lamp for measuring weak beams of gamma-rays and locating missing radium containers, and also a series of photographic films illustrating the paths of alpha- and beta-rays in celluloid and in photographic emulsions.

The National Physical Laboratory showed, *inter alia*, transparencies illustrating the apparatus used in the standardization of X-ray and gamma-ray dosemeters and in the testing of radium containers, sensitive dosemeters for the measurement of stray radiation, and various X-ray crystal photographs dealing with the structure of teeth, electro-plating, corrosion and fatigue in metals, etc. A further exhibit consisted of a model of a periscope for observing patients undergoing treatment with very penetrating radiations. The optical system comprises eight concave mirrors, but the system is so designed that, although the light beams fall on the mirrors at approximately 45° to their normals, there is negligible distortion and the image appears normal size and nearer to the observer than the object.

The X-ray cinematograph equipment shown employs an indirect method in which the image on a fluorescent screen is photographed on 35-mm. ciné film, which has an emulsion specially developed to have a high sensitivity to the light emitted by the screen. In order to reduce the strain on the apparatus and the X-ray tube, an ingenious switch is incorporated so that the tube is only excited during actual exposure. The ciné camera is of the conventional type, fitted with a special lens operating at *f*0·8.

The session of the Congress devoted to physical and technical papers consisted in a symposium on "The Measurement of Ionization Current". Dr. D. E. Lea described a valve amplifier for the measurement of ionization currents which shares with the Townsend compensation method the advantage that the collecting electrode of the necessary ionization chamber is always substantially at earth potential. The ionization current is passed into a condenser connected to the grid of an electrometer triode the output of which is connected to two further stages of valve amplification, with the result that, in normal settings, a change of voltage of one millivolt on the grid of the electrometer valve brings about a change of voltage of ten volts in the output of the amplifier. The variation in the output voltage is thus sufficiently great to permit the operation of suitable relays and counting mechanisms through the intermediary of a thyratron. For the measurement of weak beams of radiations the rate of variation of the output voltage can be found over part of the full scale of the output voltmeter. By suitable adjustments the sensitivity of the instrument can be varied over a wide range.

Dr. G. W. C. Kaye, Mr. W. E. T. Perry and Mr. D. E. A. Jones described a ballistic amplifier in which troubles due to slow drifts and zero unsteadiness are avoided by isolating the detecting galvanometer from the anode circuit of the valve by the use of a blocking condenser. The apparatus may be used in two ways. In the first, the grid of the valve is maintained at zero potential with respect to the filament by the operation of a suitable potentiometer, the balance being tested by short-circuiting the grid resistance. If the system is balanced, short-circuiting the resistance does not alter the grid potential and the (ballistic) galvanometer does not deflect. The second method depends on the fact that, with the system unbalanced, the magnitude of the ballistic throw is proportional to the ionization current and to the capacity of the blocking condenser.

Mr. T. B. Lane described a radiation integrator designed to measure the total quantity of radiation used in a given experiment. An ionization chamber is connected to the grid of an ordinary radio valve, in the output of which a thyratron is connected. The grid of the amplifying valve is given a considerable negative bias, which is reduced by the action of the ionization current until the valve operates the thyratron, which in turn operates a counting mechanism recording the number of units of charge liberated in the ionization chamber.

In closing the discussion, Prof. J. A. Crowther said he was inclined to doubt whether the various more or less elaborate amplifier and counting mechanisms in regular use to-day really do offer advantages over the older types of electrometer, which are inexpensive and reliable, and only have the disadvantage that their use requires some experimental skill.

The seventeenth Mackenzie Davidson Memorial Lecture was delivered by Dr. J. D. Cockcroft, on the subject of "High velocity positive ions. Their application to the transmutation of atomic nuclei and the production of artificial radioactivity". Dr. Cockcroft dealt with this subject in his usual lucid and fascinating manner, describing the early work on atomic transformations carried out with alpha-particles, the later work with canal rays, accelerated by potential differences of many hundreds of kilovolts, produced perhaps by the Van de Graaff static machine or the 'cyclotron' of Lawrence. Pointing out how, while earlier experiments only succeeded in transmuting light elements, a large number of heavy elements have now been transmuted, and in particular bismuth has been changed into radium E, having the same radioactive properties as the naturally occurring element. As an example of the biological significance of the effect, he mentioned the work of Hevesy, who, by injecting into plants and animals mixtures of ordinary phosphorus and radiophosphorus, has been able, by means of Geiger counters and otherwise, to detect the movements of the phosphorus in the plant or animal and explore with some accuracy the distribution of the element at any time.

Educational Topics and Events

Cambridge.—Miss H. G. Wanklyn (Girton College) has been appointed University lecturer in the Department of Geography and Dr. S. R. Nockolds (Trinity College) University demonstrator in mineralogy and petrology.

Oxford.—The electors to Dr. Lee's professorship of chemistry intend to proceed to the election of a successor to Prof. Frederick Soddy on January 16, 1937. It is the desire of the sub-faculty of chemistry that, if possible, a physical chemist be appointed. To this end some changes in the statute defining the duties of the new professor were proposed in Congregation on December 1 and after discussion carried. The main difficulty of the new proposal, brought out in the discussion, is that while the new professor is to be given the direction of both the Inorganic and the Physical Chemistry Departments, there is, in fact, at present no official University department of physical chemistry, the whole of the teaching, and much of the research, in this subject being done in college laboratories.

It is now settled that Lord Nuffield's benefaction of £2,000,000 to the medical school is to be paid in thirteen equal half-yearly instalments for the next six and a half years. Mr. W. M. Goodenough of the Radcliffe Hospital and Barclays Bank has been appointed chairman of the Trustees.

The twenty-fifth Annual Conference of Educational Associations will be held at University College, London, W.C.1, on January 4–11, under the presidency of the Right Hon. W. Ormsby-Gore, whose presidential address entitled "Some Educational Problems of our Colonial Empire" will be delivered on January 5 at 5 p.m. On January 7 at 5 p.m., a joint conference on "Problems of Education within the Empire" will be held, when the speakers will include Sir Firoz Khan Moon, the High Commissioner for India, formerly Minister for Education in the Punjab; Dr. S. F. N. Gie, South African Minister in Berlin, formerly Secretary for Education, Union of South Africa; Prof. G. V. Portus, professor of political science and history, University of Adelaide; Prof. C. A. Krug, professor of education, Mount Allison University, New Brunswick; Prof. F. Clarke, director, Institute of Education, University of London. Further information can be obtained from the Conference Secretary, 29 Gordon Square, London, W.C.1.

The Annual Conference of the Geographical Association will be held in the London School of Economics, Houghton Street, Aldwych, London, W.C.2, on January 5–7, under the presidency of Sir Josiah Stamp, whose address, "Geography and Economic Theory", will be delivered on January 7. A symposium on "Whither Population" will be held, when Prof. C. B. Fawcett, Dr. R. R. Kuczynski and Sir William Beveridge, among others, will speak. Among the lectures to be delivered will be one entitled "Problems of the North-East Coast", by G. H. J. Daysh, and one of the discussions announced is "Broadcast Geography Lessons" in which L. Brooks, Dr. H. Thomas, and others will speak. Further information can be obtained from the Secretary, Geographical Association, c/o Municipal High School of Commerce, Princess Street, Manchester, 1.

Science News a Century Ago

Lord John Russell and the University of London

The Times of December 13, 1836, contained a copy of the Charter of the University of London signed on November 28, together with the letter of Lord John Russell to the Earl of Burlington, dated December 1, and the Earl's reply dated December 9.

In his letter, Lord John Russell said: "I have the honour to transmit to your Lordship the charter of the University of London.

"His Majesty has been pleased to approve of the appointment of your Lordship as Chancellor, and of Mr. Lubbock as the first Vice-Chancellor of the University.

"I feel convinced that it is not necessary to recommend to your Lordship either a zealous attention to the interests of learning, or a constant regard to those principles of religious freedom, which have furnished motives for the Royal grant. . . .

"You may be assured that on my part also I shall esteem it an honour to co-operate in the advancement of an institution destined to confer the distinctions justly due to proficiency in literature, science or art, without imposing a test of religious opinions, or binding by the fetters of the 17th century the talent and merit of this present enlightened age."

Among the scientific men who composed the "one body politic and corporate" entrusted with the affairs of the University were Airy, Neil Arnott, Captain Beaufort, W. T. Brandl, Faraday, Prof. Henslow, Mark Roget, Sheepshanks, James Walker and many others eminent in medicine.

Opening of the London and Greenwich Railway

On December 14, 1836, the London and Greenwich Railway as far as Deptford was officially opened by the Lord Mayor of London amid great rejoicings. The construction of the long viaduct of brick arches had been regarded as a very great achievement. Engines had been at work on the line for some time, but on the day of the opening five trains travelled to and from London Bridge and Deptford. "Comparing the sensation which the traveller feels on this," said a writer in *The Times*, "as compared with other railroads, one may state, that owing, no doubt, to the fact that the whole road being over archways, there is a rumbling noise which is not heard on other roads. Much of this, however, is obviated by the construction of the carriages."

At a luncheon held at the Bridge-house Tavern in the afternoon, the Lord Mayor said: "The great object which the new railway would effect was that of economising time; the great characteristic of modern commercial life was the value set upon time." In their replies to the various toasts, the speakers referred to the gratifying prospects with which the railway commenced, the great benefits such undertakings conferred upon commerce and upon domestic trade and "the great accommodation which this individual channel of communication supplied to the City of London and the town of Greenwich".

The Optical Phenomena of Crystals

In a paper entitled "Further Observations on the Optical Phenomena of Crystals" read to the Royal Society on December 15, Henry Fox Talbot referred to the property of some crystals, similar to those possessed by the tourmaline, of analysing polarized light. If a drop of a solution of sulphate of chromium and potash in tartaric acid is placed on a plate of glass, evaporation soon yields filmy crystals which frequently have this property. The plumose crystals of boracic acid when crystallized from a solution of borax in phosphoric acid also possess this analytic power, and present very beautiful appearances when viewed with the polarizing microscope. Talbot said that he entertained the hope that it would be possible to obtain large and permanent crystals, which would possess the advantages of the tourmaline, without the inconvenience resulting from its dark colour.

Societies and Academies

Paris

Academy of Sciences, November 16 (*C.R.*, 203, 961–1036).

Emmanuel Leclainche: Notices on Sir Arnold Theiler and on Edoardo Perroncito.

Henri Douvillé: The shell of the lamellibranchs: its formation in *Ostrea edulis*.

Charles Goldziher: Logistic extension of the mortality formula of Makeham.

Bertrand Gambier: Surfaces of which the asymptotics of either system belong to linear complexes.

Paul Vincensini: Surfaces deformable with transformation of kinematically conjugated systems into conjugated systems.

Jean Dieudonné: Derivatives of rational fractions.

Pierre Humbert: The extension to prepotentials of Kelvin's theorem.

Sklenar: A new aviation motor.

Robert Esnault-Pelterie: Remarks on the preceding communication.

Jean Chazy: Advances of the node and perihelion of a planet under the action of a circular ring.

Bernard Kwal: Quantic mechanics and the principle of relativity.

Pierre Vernotte: The theoretical dimensions of the cellular vortices of Bénard.

Gaston Dupouy: The utilization of the ballistic galvanometer as a null instrument.

André Lallemand: The application to photography of a method allowing the energy of the photons to be amplified. The application of an electric field to accelerate the photo-electrons.

Ernest Esclangon: Remarks on the preceding note. The method is important astronomically, especially in the fields of photometry and spectroscopy.

Jacques Rabinovitch: The magnetic rotatory polarization and magnetic double refraction of solutions of β-naphthol and of β-methylnaphthalene.

Léon Capdecomme: An arrangement allowing the vertical illuminators of microscopes to transmit rectilinear polarized light of any azimuth.

Maurice Curie: Phosphorescent glass. The influence of crystallization. Two specimens of zinc borate containing a trace of manganese oxide were prepared, one almost wholly crystalline, the other vitreous. The crystalline specimen showed strong and durable phosphorescence, the vitreous specimen almost none.

Henri Guérin: The melting points and densities of the tribasic alkaline earth orthoarsenates.

Etienne Canals and Pierre Peyrot: The fluorescence of some pure substances. Nine highly purified hydrocarbons showed no trace of fluorescence. Of all the pure substances so far examined, only oxygen compounds are fluorescent.

Jean Bureau: The hydrated magnesium nitrites.

Pierre Sue: The constitution of the hydrated alkaline niobates.

André Michel: Study of the solid solutions of ferrous sulphide with sulphur, selenium and arsenic.

Hubert Forestier and Mlle. Myriam Graff: The reduction of boric anhydride by manganese. Manganese reduces boric anhydride at a temperature below 1,000° C. forming a ferromagnetic boride (MnB).

Roger Testut: The formation of chromium carbides. By heating chromium powder with excess of carbon, two definite carbides are obtained, Cr_3C_2

and Cr$_3$C$_2$. The excess of carbon can be removed by heating in oxygen at 900° C., since neither of these carbides is oxidized below 1,000° C.

Charles Emile Brazier: The comparison of pyrheliometers. Two pyrheliometers measure the same physical magnitude only if, other things being equal, their apertures are exactly the same.

Roger Ulrich: Correlation between the elongation of the fruit and the development of the seeds in the wallflower, *Cheiranthus Cheiri*. The length of the fruit is proportional to the number of seeds, and this is not due to any mechanical action of the young seeds, since there are frequently large intervals between the seeds. It would appear that the seeds in the course of development exercise a stimulating influence on the growth of the pericarp.

Jean Beauverie: Studies in experimental cytology: the chromoplasts of species of *Ranunculus*.

R. Brunet and A. Jullien: The comparative architecture of the heart in some gastropod molluscs.

Robert Weill: The existence of polypoid larvæ in the cycle of the Trachymedusa *Olindias phosphorica*.

Philippe Joyet-Lavergne: Attempt at the valuation of the power of oxidation catalysis in the living cell. The reagent utilized for the study of oxidation processes in the living cell must fulfil two conditions; it must penetrate the cell without causing injury, and the colour changes brought about by oxidation must be appreciable. Alkaline solutions of cobalt sulphate or chloride have been found to be suitable for this study.

Pierre Nicolle: Physiological variations of the reticulocytary proportion in the course of gestation, during lactation and after ablactation in the rabbit.

Alexandre Lipschütz: A typical and destructive growth of the uterine glands after experimental ovarian interventions.

Boris Ephrussi and Morris Henry Harnly: The presence in different insects of substances intervening in the pigmentation of the eyes of *Drosophila melanogaster*.

Domingo Mauricio Gomez: The physical characteristics of the vessels, circulatory yield and law of decrease as a function of time of the arterial pressure.

Paul Durand, Paul Giroud, Edouard Larrive and André Mestrallet: Virulence of the fluids in the *maladie des porchers*.

Amsterdam

Royal Academy (*Proc.*, 39, No. 8, Oct. 1936).

L. S. Ornstein: Scattering of neutrons in matter (2).

J. G. van der Corput: Generalizations of Carleman's inequality.

F. M. Jaeger, J. A. Bottema and E. Rosenbohm: Exact measurement of the specific heats of metals at high temperatures. (26). Specific heats and the electrical resistance of cerium. *ibid.* (27). The specific heats and the electrical resistance of lanthanum.

A. H. Blaauw, Ida Luyten and Annie M. Hartsema: The limits of the ability to flower and of the growth of the iris bulb (2*a*).

H. M. de Burlet and A. Kooman: Manifestation of the duplex character of the semicircular canal system in the ontogenesis of the labyrinth of vertebrates.

O. Posthumus: Affinities of the Osmundaceæ with *Grammatopteris* and *Asterochlænopsis* and with Zygopterideæ in general.

G. F. C. Griss: The conformal differential invariants of a covariant symmetrical tensor of the fourth rank in the binary region.

J. A. Barrau: Casts of points, rays and planes.

W. Bleeker: Meteorological observations during the three Dutch Karakorum expeditions.

L. Algera: Influence of temperature treatment on carbohydrate metabolism, respiration and morphological development of the tulip (2).

M. A. van Overeem: A sampling apparatus for aeroplankton.

Tan Sin Hok: Contribution to our knowledge of the Lepidocyclinides.

G. H. R. von Koenigswald: First communication on a fossil hominid from the Early Pleistocene of East Java.

A. Thiadens: Rudistids from southern Santa Clara, Cuba.

J. Ariëns Kappers: Brain – body weight relation in human ontogenesis and the *indice de valeur cérébrale* of Anthony and Coupin.

G. Revesz: The psychoanalytical impulse theory. A discussion of Freud's work with an attempt to test its consequences and confront it with normal psychological experience and general biological facts.

Rome

Royal National Academy of the Lincei (*Atti*, 23, 459–536; 1936).

F. Enriques: Characteristic property of irregular algebraic surfaces and infinitely close curves.

G. Abetti: Height of the chromosphere in 1935 and the course of the solar cycle.

M. Betti and E. Lucchi: Anomalies in the dissociation constant of some halogenated organic acids.

G. Rovereto: Particular continental facies of the Ligurian Oligocene.

G. Barba: Repetition of a class of functions.

S. Cherubino: Reduction of matrices to canonical form (1).

S. Cinquini: Non-linear functional equations in the analytic field.

S. Minetti: Holomorphous functions admitting of two exceptional finite values, and the behaviour of a holomorphous function in the neighbourhood of an isolated essential singular point (1).

L. Toscano: Powers of a matrix of the second order.

M. Manarini: Vectorial homographies with kinematic applications in S_n spaces (1). Axials and dilatations.

C. Tagliacozzo: A theorem on elastic coactions.

P. Caloi: Two new types of seismic waves in the light of a theory of Somigliana.

G. Goidànich: A species of *Phytophthora* causing rotting of the collar in the tomato.

L. Marotta: Experiments with root apices isolated in culture.

G. Bergami: Liberation of a substance similar to acetylcholine from the cut surface of the nerve during physiological excitation.

G. Peretti: Oxidation-reductions in the small intestine and in the liver of the albino rat during intestinal absorption.

V. Zagami: Behaviour of the glycogen of the heart under the action of insulin.

A. Galamini: Contribution to the comparative study of anaphylaxis (1). Alimentary anaphylaxis and subdiaphragmatic vagotomy (2).

A. Basile: Contribution to the study of the fine structure of striated muscular fibre under normal and pathological conditions (3). Regressive processes of the components of cross-striation.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, December 14

Royal Geographical Society, at 8.30.—Owen Lattimore: "The Mongol Landscape and People".

Tuesday, December 15

Eugenics Society, at 5.15—(at the Linnean Society, Burlington House, London, W.1).—"Voluntary Sterilisation—the Work of the Past Year". Speakers: Wing-Commander A. W. H. James, M.P., Dr. Caroline Maule and J. Verney Quilliam.*

Wednesday, December 16

Geological Society of London, at 5.30.—Dr. K. S. Sandford: "Recent Advances in the Knowledge of the Geology of Northern Central Africa".

Royal Society of Arts, at 8.—Sir William Bragg, F.R.S.: "The Development of Crystal Analysis" (Sir Henry Trueman Wood Memorial Lecture).

Friday, December 18

Royal Institution, at 9.—Lord Rayleigh, F.R.S.: "Optical Contact".

Official Publications Received

Great Britain and Ireland

Department of Scientific and Industrial Research Report of the Fuel Research Board for the Year ended 31st March 1936; with Report of the Director of Fuel Research. Pp. x+217. (London: H.M. Stationery Office.) 4*s.* net. [2411

Index to Supplements to the Geographical Journal: Recent Geographical Literature Supplements, Vols. 1–4, Nos 1–41, 1918–1932. Compiled by order of the Council. Edited by the Librarian. Pp. 470. (London: Royal Geographical Society; Edward Stanford, Ltd.) 16*s.*; to Fellows, 12*s.* [2511

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1698 (1956): Wind Tunnel Tests of the Characteristics of Wing Flaps and their Wakes. By K. W. Clark and F. W. Kirkby. Pp. 26. 3*s.* 6*d.* net. No. 1702 (1929): The Cowling of Cooling Systems. By R. S. Capon. Pp. 23. 3*s.* 6*d.* net. No. 1703 (1061): Full Scale Experiments at High Incidences with IIIF Seaplane. By A. E. Woodward Nutt. Pp. 22+2 plates. 3*s.* 6*d.* net. No. 1705 (1930): Variation of Exhaust Gas Temperature along the Tail Pipe of a Moth Aircraft, and the Effect of a Simple Silencer By A. W. Morley. Pp. 9+2 plates. 2*s.* net. (London: H.M. Stationery Office.) [2511

Absorption of the Unemployed into Industry: Discussions between the Minister of Labour and Representatives of certain Industries. (Cmd. 5317.) Pp. 10. (London. H.M. Stationery Office.) 2*d.* net. [2711

Copper for Bus-Bar Purposes. (C.D.A. Publication No. 22, 1936.) Pp. vi+161+28 plates. (London. Copper Development Association.) [2711

Cinematograph Films Act, 1927. Report of a Committee appointed by the Board of Trade. (Cmd. 5320.) Pp. 41. (London: H.M. Stationery Office.) 9*d.* net. [3011

The British Institute of Radiology. Year Book, Session 1936–1937. Pp. 94. (London: British Institute of Radiology.) [3011

Memoirs of the Cotton Research Station, Trinidad. Series B: Physiology. No. 9 Further Studies on Transport in the Cotton Plant, VI: Interchange between the Tissues of the Corolla. By E. Phillis and T. G. Mason. Pp. 679–697. (London: Empire Cotton Growing Corporation.) 2*s.* 6*d.* [112

Amgueddfa Genedlaethol Cymru: National Museum of Wales. Twenty-ninth Annual Report, 1935–36, presented by the Council to the Court of Governors on the 23rd October 1936. Pp. 47. (Cardiff: National Museum of Wales.) [112

The Association of Special Libraries and Information Bureaux. Report of Proceedings of the Thirteenth Conference held at Balliol College, Oxford, September 18th to 21st, 1936. Pp. 136. (London. Association of Special Libraries and Information Bureaux.) 5*s.* [212

Other Countries

Industrial Research Bureau. Bulletin No. 1: Bibliography of Industrial Publications published in India from 1921. Pp. iii+257. 4.6 rupees; 7*s.* 3*d.* Bulletin No. 2: A Survey of the Indian Glass Industry. By E. Dixon. Pp. ix+39+9 plates. 14 annas; 1*s.* 6*d* Bulletin No. 3: The Effects of Annealing Procedure on the Tensile Properties of Arsenical Copper Bar. By E. F. G. Gilmore. Pp. 11+3 plates. 8 annas; 10*d.* (Delhi: Manager of Publications.) [2311

Soologiese Navorsing van die Nasionale Museum, Bloemfontein Deel 1, Stuk 3 en 4: The Endocranial Cast of the Florisbad Skull—a Correction; The Significance of the Bushman Skull. By Dr. T. F Dreyer. Pp. ii+21–32. (Bloemfontein: Nasionale Museum.) [2411

Egyptian Government: Ministry of Public Works. Annual Report for 1924–1925. Part 1. Pp. xi+153 20 P.T. Part 2. Pp. xi+236. 20 P.T. Annual Report for the Year 1925–1926. Part 1. Pp. xiii+178. 20 P.T. Part 2 Pp. xi+230. 20 P.T. Annual Report for the Year 1926–1927. Part 1. Pp. v+194. 20 P.T. Part 2. Pp. xii+236. 20 P.T. Annual Report for the Year 1927–1928. Part 1. Pp. vi+166. 20 P.T. Part 2. Pp. xiv+283. 20 P.T. (Cairo: Government Press.) [2411

U S. Department of the Interior: Office of Education. Bulletin, 1936, No. 2: Young Children in European Countries in the Present Economic and Social Period. By Mary Dabney Davis. Pp. x+108. (Washington, D.C.. Government Printing Office.) 15 cents [2411

Bulletin of the American Museum of Natural History. Vol. 70, Part 2: The Marine Fishes of West Africa, based on the Collection of the American Museum Congo Expedition, 1909–1915. By Henry W. Fowler. Pp. 607–1493. (New York: American Museum of Natural History.) [2611

Proceedings of the American Academy of Arts and Sciences. Vol. 71, No. 3: Ecological Relations of Ponerine and other Ants to Termites. By William Morton Wheeler. Pp. 159–244. 1.35 dollars. Vol. 71, No. 4: Uncertain Inference. By Ronald Aylmer Fisher. Pp. 245–258. 45 cents. Vol. 71, No. 5. The Respiratory Metabolism of the Chimpanzee. By John M. Bruton and Francis G. Benedict. Pp. 259–326. 1.20 dollars. (Boston, Mass.: American Academy of Arts and Sciences) [2611

Imperial College of Tropical Agriculture: Low Temperature Research Station. Memoir No. 4: Studies in Tropical Fruits. 1: Preliminary Observations on some Aspects of Development, Ripening and Senescence, with Special Reference to Respiration; 2: Observations on Internal Gas Concentrations in Fruit. By C. W. Wardlaw and E. R. Leonard. Pp. 632–676. (Trinidad: Imperial College of Tropical Agriculture.) [2611

The Imperial Council of Agricultural Research Miscellaneous Bulletin No. 10: Diseases of Sugarcane and Methods for their Control. By L. S. Subramaniam. Pp. iv+31+ii+22 plates. (Delhi: Manager of Publications.) 1.14 rupees; 3*s* 3*d.* [3011

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series B, No. 21: A New Method and Apparatus for determining the Average Length and Fineness of Cotton Hairs. By Dr. Nazir Ahmad and C. Nanjundayya. Pp. 22. (Bombay: Indian Central Cotton Committee.) 8 annas. [3011

Publications of the Dominion Observatory, Ottawa. Vol. 12. Bibliography of Seismology. No. 10 (Items 3042–3133). April, May, June 1936. By Ernest A Hodgson. Pp. 195–216. 25 cents. No. 11 (Items 3134–3266). July, August, September 1936. By Ernest A. Hodgson. Pp. 217–238. 25 cents. (Ottawa: King's Printer.) [3011

Department of Commerce and Industries: Fisheries and Marine Biological Survey Division. Investigational Report No. 6: The Reproduction, Embryology and Metamorphosis of the Cape Crawfish (*Jasus lalandii*) (Milne Edwards) Ortmann. By Cecil Von Bonde. Pp. 25+12 plates. (Pretoria. Government Printer.) 1*s.* [112

Denkschriften der Schweizerischen Naturforschenden Gesellschaft. Band 71, Abh. 4. Zum Zodiakallicht-Problem. Von Hch. Meyer-Buhrer. Pp. ii+71–118+17 plates (Zurich. Gebruder Fretz A.-G) [112

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 38. Part 2: Der Einfluss der Eierbehandlung mit Zentrifugierung auf die Vererbung bei dem Seidenspinner, 1. Über experimentelle Auslosung der polyploiden Mutation, von Eisaku Kawaguchi; Artificial Insemination of *Bombyx mori*, by Seinosuke Ômura; Structure of the Testis and the Intratesticular Behaviour of the Spermatozoa, by Seinosuke Ômura. Pp. 111–181+3 plates. (Tokyo. Maruzen Co., Ltd.) [112

Geofysiske Publikasjoner utgitt av det Norske Videnskaps-Akademi i Oslo. Vol. 11, No. 3: Measuring of Auroræ with Very Long Base Lines. By Carl Størmer. Pp. 16+2 plates. 3.00 kr. Vol. 11, No. 5: Remarkable Aurora-Forms from Southern Norway. By Carl Størmer. Pp. 19+18 plates. 7.50 kr. (Oslo: Cammermeyers Boghandel.) [112

Field Museum of Natural History. Botany Leaflet No. 19. Old-fashioned Garden Flowers. By Donald Culross Peattie. Pp. 32. 25 cents. Geological Series, Vol. 6, No. 15: The Internal Structure of the Ear in some Notoungulates. By Bryan Patterson. Pp. 199–228. 40 cents. Technique Series, No. 4: Clearing and Staining Skeletons of Small Vertebrates. By D. Dwight Davis and U. R. Gore. Pp. 16. 35 cents. Zoological Series. Vol. 20, No. 15 The Distribution of Bidder's Organ in the Bufonidæ. By D. Dwight Davis. Pp. 115–126. 15 cents. Vol. 20, No. 16: Notes on Bahaman Reptiles and Amphibians. By Karl P. Schmidt. Pp. 127–134. 15 cents. Vol. 20, No 17: Guatemalan Salamanders of the Genus Œdipus. By Karl P. Schmidt. Pp 135–166. 50 cents. Vol. 20, No 18: Notes on Snakes from Yucatan. By Karl P Schmidt and E. Wyllys Andrews. Pp. 167–188. 25 cents. Vol. 20, No. 19: Preliminary Account of Coral Snakes of South America. By Karl P. Schmidt. Pp. 189–204 15 cents. Vol. 20, No 20: Notes on Central American and Mexican Coral Snakes. By Karl P. Schmidt. Pp. 205–216. 25 cents. Vol. 22, No. 2: Secondary Sex Characters of Chinese Frogs and Toads. By Ch'eng-Chao Liu. (Publication 368.) Pp. 113–156+12 plates. 50 cents. (Chicago: Field Museum of Natural History.) [312

Catalogues, etc.

A Selection of English Classics, Modern Bindings and New Books suitable for Presentation. Pp. 32. (London. Bernard Quaritch, Ltd.)

Diary for 1937. Pp 32+32+32 maps+Diary. (Bonnybridge. John G. Stein and Co.)

Motion Picture Projection Lenses and Condensers (Catalog E-16.) Pp. 16. (Rochester, N.Y.: Bausch and Lomb Optical Co.)

Books recently purchased at the disposal of the Library of the late Dr. J. A. Fuller-Maitland, consisting mainly of Poetry and Belles-Lettres, also an interesting collection of books about Eton College, and a number of volumes on Botany, Conchology, Entomology, Geology and Ornithology. (Catalogue No. 251.) Pp. 25. Books, Manuscripts, etc. (Catalogue No. 252.) Pp. 12. (London: Dulau and Co., Ltd.)

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Kingship and Kinship

FROM him to whom much has been given, much shall be required. The moving words with which on the night of December 11 Prince Edward took leave of his people, his subjects no longer, closed a great career of public usefulness, upon which strong hope for the future had been founded. That valediction, however, stands for far more than that. It marks the end of an epoch in which the relationship of the British Crown to the people has been peculiarly intimate and personal. It is true that the events of that momentous period of stress, which opened on December 2, have left the monarchy unshaken ; it is even strengthened ; but it would be idle to claim that it is unchanged. With the proclamation of His Majesty King George VI on December 12, a new era begins.

In the history of kingship, as has been shown by recent research, the well-being and virility of the king is identified with the prosperity and fertility of land and people. It is not without significance, perhaps, that it is precisely among the descendants of those peoples who relied most on the qualities of their king or chief as leader, the conquering Nordic peoples, to use a convenient descriptive nomenclature, that kingship has been most enduring. Yet if the king is the fount of honour, the leader in war, and in peace the source of law and order, as well as the supreme overlord of land and people, it is not in the sense of absolute monarchy in which Louis XIV claimed *l'état, c'est moi*. Britain, fortunate in this as in other matters affecting the liberty of its people, early won affirmation of the principle, which had governed the early kingship—even as now it regulates the powers of the paramount chief in parts of tribal Africa—that the king holds power in virtue of a trusteeship for his people and must rule in concurrence with his and their councillors. It is this principle, with many vicissitudes and obscurations, which runs through the weft of British constitutional development and the growth of self-consciousness in the people. It attained the full measure of imperial democracy in the Statute of Westminster of 1931, and first found opportunity for full expression, bitter though it was, in the tragedy of December 1936.

Events which in other days might well have given rise to revolution have passed without disturbance. That it has been possible for a great and unanimous volume of public opinion to crystallize without delay over the vast distances of the Empire is due in no small measure to the resources which science has placed at the disposal of our rulers in cable and wireless, aided by the newspaper press. It marks a new phase in the growth of democracy. But also it imposes a special responsibility on the new monarch.

It has been pointed out again and again in recent years that the King-Emperor is now the only link which binds together the independent nations which form the British Commonwealth. The new monarch has been acclaimed as "the people's King". This title confers upon him a great trust, but it lays upon him also a heavy burden, as guardian of the honour and integrity of his people. By his personal character and his sense of responsibility he will win the loyal support of his subjects in helping him to bear it. Now that the British Commonwealth of Nations has shown that it is no loose aggregate, but a closely knit unity, if of diverse parts, each of those parts will look to its king as its special representative, for whose services as arbiter, and as the interpreter of the constituent elements one to another, it will be prepared to pay with ever-ready loyalty.

General Science for Secondary Schools

THE science masters of Great Britain have hitched their wagon to a star; but, as men of science, they have selected the star with deliberate judgement and have satisfied themselves that the couplings are trustworthy. The interim report* on the teaching of general science just published by a sub-committee of the Science Masters' Association (after adoption by the general committee) is indeed characterized by the union of admirable ideals with sound good sense, and must be regarded as among the most weighty and most interesting of recent pronouncements on educational policy. There has long been on foot a movement to change the elementary part of the school science curriculum from its traditional, intensive and formal habit to a broader and more human shape; to substitute, in fact, a scheme of 'general' science for the rudiments of one or two branches of academic science hitherto constituting the usual course followed by School Certificate candidates. The terms of reference of the sub-committee were as follow:

> "To consider the problems presented to teachers in Secondary Schools by the introduction of courses in General Science as a constituent of general education, and to make specific suggestions about: 1. The aims to be kept in view. 2. The basic principles of the subject, an appreciation of which should be inculcated. 3. The material to be included in such courses. 4. Methods of development and treatment of the material. 5. Time-table requirements at different stages."

The report (1) summarizes the growth of this movement from its inception in 1915–16 to the appointment of the present sub-committee in 1935; (2) considers the aims of science teaching; and (3) suggests and interprets a syllabus of general science, with a special note on the biological section.

It is natural to turn first to the committee's views upon the aims of science teaching, for the curriculum and treatment to be adopted must obviously depend upon the ultimate objective. The report observes that the numerous reasons urged to justify the inclusion of any subject in the school course can be roughly classified under the three headings of (*a*) utilitarian or vocational, (*b*) disciplinarian, and (*c*) cultural; and the committee proceeds at once to make the important point that the preparation of technical experts cannot be considered as one of the functions of a school. We should have liked to see even greater emphasis given to this fundamental principle, which applies not only to the School Certificate stage but also to the two years afterwards spent in specialist studies by many boys and girls at school. We believe—and are confident that the vast majority of schoolmasters agree—that it ought to be no part of the business of a public or secondary school to train pupils for such professional examinations as the First M.B. The proper place for professional or technical training is the university or technical institution; and though parents may find it economical, and the university or institution convenient, to thrust a steadily increasing portion of such training upon the schools, the effect upon secondary education, already sufficiently serious, is likely in the long run to be extremely detrimental. On the other hand, the pre-preparation of experts is one of the schoolmaster's legitimate tasks, and, as the committee wisely remarks, "this can best be achieved by broadening the syllabus; for it is at school that particular talents are discovered and their development fostered. Many a potential specialist, in the life sciences especially, has been lost to the world by the narrowness of the teaching at school". The committee is too timid—or too polite—to add what should nevertheless be said in the plainest and most uncompromising English: that if the teaching at school is narrow, the fault is chiefly due to the stranglehold of the external examination system maintained by examining bodies under university control.

Vocational preparation, then, is relegated by the committee to a subordinate position, and this action is justified not merely on general grounds, but also because a purely vocational curriculum "presupposes a static, unchanging society" and because "the occupations of the people exhibit such amazing diversity that it is impossible to cater specifically for more than a small fraction". Where such a fraction is in practice catered for, the school authorities would do well to ask themselves whether they are not subsidizing some of their pupils at the expense of others.

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* The Teaching of General Science. Science Masters' Association Interim Report of the Sub-Committee appointed in 1935. Adopted by the General Committee in 1936. (London: John Murray, 1936.) 2*s.* 6*d.* net.

Upon the second claim advanced in favour of the teaching of science in schools; namely, that it develops "certain powers of clear and vigorous thinking, of coherent and logical deduction, of exact and accurate observation", the committee discreetly adopts an attitude of reserve, accepting —or at least not disputing—the experimental evidence "that the possibilities of transfer of training are much smaller than had formerly been supposed". It is, however, a little disconcerting to find that the committee next draws the quite unwarranted conclusion that school science syllabuses should not include "any matter whatever which is taught *only* for the sake of the training it gives". Dr. Arnold's remarks on such a capitulation would have been pleasurable hearing; but since it would probably be impossible to isolate any topic the value of which is purely disciplinary, the committee perhaps penned this sentence tongue in cheek. The committee is, on the contrary, wholly serious in its insistence upon the cultural aim of science teaching, urging that "the peculiar intellectual glory of the Western peoples has been the creation of a Natural Science which is far in advance of that of earlier times", and that no one "can now be considered truly cultured, no one can be considered as having felt the European spirit at its best, if he has never had his imagination stirred by that great adventure of ideas on which we are engaged: the scientific exploration of natural phenomena". These are noble sentiments finely expressed; they represent the true spirit in which science should be taught.

The committee feels that the cultural and subsidiary aims of science teaching may best be achieved by arranging courses in as liberal a manner as possible, and by designing them to cover a wide range; but it is not blind to the difficulties which general science has to encounter. The details of the practical problem have therefore been attacked with courage, with skill, and, we think, with a considerable degree of success. In constructing an 'ideal' syllabus the committee adopted three criteria: (1) the selected material should call forth activity on the part of the pupils, (2) every item in the syllabus should lead to the understanding of fundamental scientific principles, and (3) the syllabus should provide a field suited to the cultivation of those habits, interests and sentiments which are fundamental to science. For the systematic way in which these criteria were applied, and for the ingenious method employed to frame a scheme in which each criterion was fully respected, reference must be made to the report itself; but the syllabus as a whole is so constructed as to help the pupil toward an intelligent understanding of his immediate environment, his own body being the central figure in it.

A particularly welcome feature of the scheme is that the committee, all the members of which have had wide experience of science teaching, abandons the pursuit of "breaking down the barriers between the special sciences" (a phrase which the members admit to have puzzled them), and frankly observes that the division of science into three main branches is both convenient and logical. The syllabus is accordingly divided into three sections, dealing respectively with physics, biology and chemistry, but the lines of demarcation are not emphasized, and the root of each section lies in the common experience of average pupils. The time which the committee suggests as adequate for the course is 451 periods of 45 minutes plus 29 periods for revision, that is, a total of four periods a week for four school years. This allowance—which is accompanied on the syllabus-charts by suggestions as to the number of periods to be allotted to each individual topic—appears to be ample, and it is probable that sets of more intelligent pupils would be able to get through a good deal more than the printed course. If so, the additional material might suitably consist for the most part of chemistry, to which the committee has assigned only 95 of the 451 periods, as against 197 to physics and 159 to biology.

This reduction of the chemistry section of the syllabus is, we feel, the weakest part of the scheme, and the committee itself is apparently not here sure of its ground. No doubt the chemists of the Science Masters' Association will see to it that this one blemish in an excellent—and obviously workable—course of general science is removed before the interim report becomes the final report. In the meantime, Mr. J. A. Lauwerys (convener), Mr. C. L. Bryant (chairman) and all the members of the sub-committee must be congratulated upon having brought a most exacting task to a very satisfactory conclusion. They have shown that elementary science in our schools can be vastly improved, and, more than that, they have shown how the improvement may be effected. Since the main criticism of general science in the past has been that it is impracticable, the present report may become a landmark in the history of scientific education.

Metallurgical Text-Books

(1) An Introduction to Physical Metallurgy
By L. R. Van Wert. Pp. xi+272. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 18*s*.

(2) The Principles of Physical Metallurgy
By Prof. Gilbert E. Doan. Pp. ix+332. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 18*s*. net.

(3) Principles of Metallography
By Prof. Robert S. Williams and Prof. Victor O. Homerberg. (International Chemical Series.) Third edition. Pp. ix+313. (New York and London: McGraw-Hill Book Co., Inc., 1935.) 21*s*. net.

(4) An Introduction to the Metallurgy of Iron and Steel
By Prof. H. M. Boylston. Second edition. Pp. xxii+563. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 25*s*. net.

ALTHOUGH the science of metallurgy has been a subject of university rank in Great Britain for many years—actually since 1851, when the Royal School of Mines was founded—the development of metallurgical courses in the United States has been much more rapid, and has taken place along somewhat different lines. It has always been the policy in British universities to give major attention to the extraction, smelting and refining of iron and the non-ferrous metals, and recently a more or less justifiable barrage of criticism has been directed at university authorities for their comparative neglect of the physical and engineering aspects of metallurgy.

The major advances in metallurgy since the beginning of the century have been concerned with the treatment and alloying of metals subsequent to smelting, and with their fabrication and adaptation to use in the engineering industries, and clearly a rather different training is required for metallurgical students who will eventually be employed in the metal working and engineering industries than for those who will be concerned with smelting processes. Some steps have certainly been taken to correct this bias in British metallurgical training, but in the United States physical metallurgy has for long been given the attention it deserves. (At the Massachusetts Institute of Technology, for example, a four-year course in physical metallurgy is provided, although at the same time it is doubtful whether this course can adequately fulfil its purpose without at least some process metallurgy as a background.) The four books under review are representative of the text-books provided for American university students taking metallurgical courses.

(1) Dr. Van Wert has for some years past been responsible for lectures in physical metallurgy at Harvard University, where his students have consisted of a somewhat heterogeneous group of postgraduate mechanical engineers and metallurgists. In the course of his work he was brought to realize that there was no introductory text in physical metallurgy which was at once sufficiently specific and fundamental for those who were to continue in the subject, yet interesting and comprehensive enough for those seeking a general knowledge of metallurgy and whose active acquaintance with it would probably end with the course. The present volume was, therefore, prepared to fill the need.

Dealing first with the common properties of the metallic state and of pure metals, the author proceeds without delay to a discussion of equilibrium diagrams along the usual and orthodox lines (without, however, the tiresome intrusion of the sodium nitrate-water diagram). The major portion of the two chapters devoted to this subject are not unnaturally concerned with simple binary equilibria, but some fifteen pages are taken up with an introduction to the study of ternary systems. The succeeding chapter deals with the micro-constituents of alloys, recrystallization and grain growth. In the chapter on the properties of alloys, hardness curves of representative systems are juxtaposed with the respective constitutional diagrams to emphasize the dependence of properties upon composition and constitution—a useful method for bringing this relation home to engineering students.

The final chapter deals with mechanical and thermal treatment; quite a good outline is given of the mechanism of plastic deformation of single crystals and polycrystalline aggregates, and annealing is considered at some length.

The book is excellently printed and well illustrated with photomicrographs and diagrams.

(2) Three years ago Dr. Doan, who holds the position of associate professor of metallurgy in Lehigh University, collaborated with D. M. Liddell in writing "The Principles of Metallurgy", which covered both process and physical metallurgy. The demand for a separate text on physical metallurgy

has led to the appearance of the present volume. The subject has been approached from the point of view of classical physics, commencing with the states of aggregation of matter, and emphasis is laid throughout on the principles of the behaviour of metals rather than upon individual metals or processes. At the same time, the basic processes and problems involved in the working and use of metals are considered.

The book is divided into three parts, the first dealing with the physics of the metallic state and the deformation and annealing of metals. The second part is concerned with problems of constitution and structure in binary and ternary alloys, and is well illustrated with photomicrographs and constitutional diagrams. In Part 3, under the heading of "Metal Technology", the various working processes are discussed. It is naturally not possible to devote more than a few pages to individual processes, but a clear outline is given of metal-working operations and foundry practice. Throughout, principles are most clearly set out and the book should be of considerable value to students, and, for that matter, to metallurgists and engineers in the metal working and using industries.

(3) This volume, which comes from the Massachusetts Institute of Technology, is frankly intended to serve as an introduction to more advanced works, and to fill the needs of those students of general science and engineering who do not specialize in metallurgy but who will use it to a limited extent in their professional work. Greater emphasis is, therefore, laid upon the applications of metallography and the microstructure of commercial alloys than upon physico-metallurgical principles.

The first edition appeared in 1919, and the need for the present third edition testifies to the appreciation which the book has gained among those for whom it was designed. In rewriting and rearranging the text, the opportunity has been taken to include a considerable amount of new material on aluminium alloys, alloy and stainless steels, laboratory and X-ray methods, and corrosion.

An appendix gives a suggested outline for a laboratory course in metallography and a descriptive list of the more important books and periodicals dealing with physical metallurgy. A comprehensive set of tables gives etching reagents for all types of alloys.

(4) The dearth of reliable text-books on iron and steel manufacture is as serious from the point of view of the student and young technical worker as it is amazing when the great size and importance of the industry in Great Britain are considered. Boylston's "Iron and Steel" was welcomed on its first appearance in 1928, and it is not surprising that a second edition has been found necessary. The author has endeavoured not only to reach students but also to interest the men who work in steel mills in obtaining a better understanding of their profession. In the present edition a number of modern developments have been described; several changes in blast furnace practice are mentioned, such as 'slow-blowing' and 'fanning' of the furnace, and the Brackelsberg melting furnace for foundry work is described in some detail. The Byers-Aston process for producing wrought iron on a large scale is described, and due attention is given to modern electric furnaces. No mention is made of recent practice in strip-sheet rolling, but otherwise the mechanical treatment of iron and steel is well covered.

Mycological Researches

Researches on Fungi
By Prof. A. H. Reginald Buller. Vol. 6: The Biology and Taxonomy of Pilobolus, the Production and Liberation of Spores in the Discomycetes, and Pseudorhizae and Gemmifers as Organs of certain Hymenomycetes. Pp. xii+513. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1934.) 28*s*. net.

IN this, the sixth volume of his researches, Prof. A. H. R. Buller, who has recently retired from the chair of botany at the University of Winnipeg, gives the full account of three lines of investigation on which he has been engaged for many years: (1) the biology and taxonomy of *Pilobolus*, (2) the production and liberation of spores in the Discomycetes, and (3) pseudorhizæ and gemmifers as organs of certain Hymenomycetes: preliminary papers on the first two have been published.

The account of *Pilobolus* occupies 224 pages, and is the fullest we have of the genus, though it must be added that a good deal of it summarizes and comments on previous work. The species of *Pilobolus* are usually coprophilous and are characterized by the shape, somewhat like an inverted Florence flask, and by the apical black-walled sporangium being forcibly shot off. The genus has been known and frequently described since the time of John Ray. The main point of the present account is the explanation of the method of sporangial discharge, which was rightly attributed to the subsporangial swelling acting as a squirting apparatus by Link in 1809. Buller in 1926 put forward the hypothesis that the swelling also acts as an ocellus. When the incident rays of light strike the swelling obliquely, this acts as a lens, and the protoplasm which receives the spot of light sends a phototropic stimulus down to the protoplasm at the top of the stipe just beneath the base of the swelling. The top of the stipe, elongating more rapidly on the one side, bends until the spot of light reaches the base of the swelling, which ensures that the free end of the *Pilobolus* 'gun' is directed towards the source of brightest light. The hypothesis is attractive, but it can refer only to half a dozen or so species. The lens action of the swelling has been investigated in various ways, and shadow photographs were taken. A large number of clear construction diagrams are given, but these disregard the deviation which must arise from the presence of the excreted water drops. Experiments on spore discharge gave six feet as the maximum vertical height for *Pilobolus longipes* and a little more than eight and a half feet as the maximum horizontal range.

The veteran mycologist, W. B. Grove, has contributed a taxonomic account of the Pilobolidæ (*Pilobolus* and *Pilaira*). This is a revision of his monograph of 1884, and gives clear and concise diagnoses of the species, but one would scarcely look for a monographic study in such a volume: whether or not, however, there is no justification for giving a taxonomic diagnosis of a new species in English and Latin in the general body of the work, and a repetition of the English one in the systematic account where it is headed "*Pilobolus umbonatus* Buller, in his Researches on Fungi. Vol VI, pp. 177–78, figs. 81–84, 87–91 (1934)" and ends "Illustration: Fig. 105. Other illustrations in this volume: Figs. 81, 82, 83, 84, 87, 88, 89, 90, and 91". There are similar unnecessary details in many places, including the legends to the drawings

The observations on spore discharge in Discomycetes deal first with the 'puffing' off of clouds of spores, a phenomenon often recorded by the old mycologists. The asci in many species are positively phototropic, and curve towards the mouth of the apothecium, and puffing produces a blast of air. A chapter is devoted to "The sound made by fungus guns and a simple method for rendering audible the puffing of Discomycetes". This summarizes some of Prof. Buller's previous work on the different genera, and records the hissing that is sometimes heard when one opens a box containing species of *Helvella* or other large species such as *Discina venosa.* The simple method mentioned in the heading is disappointing—"when the fungus is close to an ear, the puffing can be heard even when the room is not quiet and one is talking to one's friends".

The last part of the book contains interesting observations on a number of fungi. First, 'rooting bases' or pseudorhizæ in *Collybia radicata, C. fusipes*, *Mycena galericulata*, and *Coprinus macrorhizus* are considered. Usually, as in *C. radicata,* the pseudorhiza is annual and unbranched, but in *C. fusipes* it is branched and perennial. It arises as a small primordium on the surface of a buried root, etc.—becoming differentiated first into primordial pileus and stipe, the latter then differentiating into the primordium of the stipe-shaft and the stipe-base (pseudorhiza); this latter elongates by intercalary growth and pushes the rudimentary stipe-shaft to the surface of the soil.

The last chapter describes *Omphalia flavida*, the cause of the American coffee-leaf disease. The fungus was first known as *Stilbum flavidum* Cke., but a little more than twenty years ago Maublanc and Rangel, placing affected leaves of the Loquat in a moist atmosphere, found that the 'Stilbum' first developed and then the much larger sporophores of an agaric, which they named *Omphalia flavida.* Ashby later proved in culture that the two were really connected. Ashby's work has been confirmed by the author, who gives anatomical descriptions both of the basidiospore form and of the so-called 'Stilbum', which is really a gemmifer with a solid pedicel (not hollow as described by Puttemans), and a terminal, multicellular gemma shaped like a door-handle and detached by the wind. The mycelium is luminous both in culture and in leaf-spots—the latter fact having apparently been recorded in a letter to NATURE so early as 1880 (22, 292). The similar gemmifers of *Sclerotium coffeicola* are referred to.

The volume is produced in the same format as the previous ones, and written in the same style with an abundance of illustrations. From the contents of the present volume, it would seem that Prof. Buller has been rounding off some of the observations he has made in the course of his studies, and it may be that it will be some time before another volume appears. The first volume was published in 1909, and mycologists are under a deep obligation to Prof. Buller for his steady and continuous work which has brought many new and unsuspected facts to light. The highest praise is due to him for never losing sight of the fungus as a living organism. J. RAMSBOTTOM.

In Search of Beauty

Polly and Freddie
By Sir F. W. Keeble. Pp. iv+275. (London and Toronto: William Heinemann, Ltd., 1936.) 10*s*. 6*d*. net.

SIR FREDERICK KEEBLE was born in 1870. He was educated at Alleyn's School, Dulwich, and Caius College, Cambridge. His botanical researches earned for him the degree of Sc.D. (Cantab.) and the F.R.S. In succession he has been professor of botany in University College, Reading (now the University of Reading), editor of the *Gardeners' Chronicle*, director of the Royal Horticultural Society's Gardens at Wisley, controller of the Horticulture Food Production Department of the Board of Agriculture, an assistant secretary of the Board of Agriculture, Sherardian professor of botany at the University of Oxford, director of Nitram, Limited, and the adviser in agriculture to Imperial Chemical Industries, Limited. His contacts have been those of an accomplished scientific worker held in esteem by his fellows, a writer, a civil servant, an Oxford professor, a director of one of the units of the great industrial merger, Imperial Chemical Industries, the husband of one of the great tragedy actresses of our time and the neighbour of some of the most distinguished contemporary poets, archæologists and scientific workers.

The author's own and the varied interests of his friends and associates could have provided him with abundant material for a chronological survey of men and matters which his facile pen, wit and urbanity could have embellished into a work which would have given the greatest pleasure to his wide circle of acquaintances. But he has deliberately discarded the conventional technique of the biographer and written an autobiography which is a mixture of fantasy, allegory and fact, calculated to appeal to children as well as adults, to scientific workers who can take a delight in brilliant and charming exposition of the subject matter of science as well as to that wider circle of readers who do not resent the intrusion of an explanation of the facts of Nature into a book which has its full measure of human interest.

Throughout the book are staged the boy Freddie and next-door neighbour big-girl Polly, whom the author has endowed with the patience, sympathy, charm and inspiring qualities of a gallery of fair women. To this dream Polly he declares he owes his outlook on his work and his fellows, and to his early memories of Freddie he attributes his desire to quicken the interest of the children of to-day in the beauties of Nature. These he unfolds in delightful studies of growth, fertilization, budding, the green marine worm, the amœba, fascinating commentaries on evolution and mutation, and an illustration of the quality of the man Pasteur by a description of his experiments on anthrax. This appreciation of Pasteur is the finest thing in the book, a copy of which should be in every home.

A. G. C.

Early Chemistry and Geology

A Dictionary of Assyrian Chemistry and Geology
By Dr. R. Campbell Thompson. Pp. xlviii+266. (Oxford: Clarendon Press; London: Oxford University Press, 1936.) 21*s*. net.

THE classification of objects was a favourite pursuit of Assyrian scribes, as is shown by the long lists preserved in Ashurbanipal's library at Nineveh. Such texts were generally bilingual, that is, both the ancient Sumerian and the later Babylonian names are given, and sometimes explanations are appended. Stones, earths and metals naturally take their place in these lists, and in the accumulation of miscellaneous texts in cuneiform writing now published there is much scattered information about these materials.

Dr. Campbell Thompson's book is devoted to the collection of this information in an intelligible order, to the examination of the evidence provided by the names and by the uses to which the materials were put, and to the identification of the stones, earths and metals intended. That task must have been very arduous, as anybody who refers to the book will readily see; it demanded not only the work of a lifetime on the Assyrian language and writing, but also a special study of early geology, chemistry and manufacturing processes. There are, for example, important texts describing the making of glass, in the decipherment and interpretation of which Dr. Thompson has himself played the principal part. With the help of experts on glass, he has determined the character of the constituents named, often for the first time, and has an ingenious explanation of the weights of some of the minor constituents mentioned, which is much in excess of the amounts that could actually be used.

The interest of this work for the early history of science will be obvious to those who realize how little there is left, for example, about what the Greeks knew of stones and earths and their uses. Dr. Thompson is able to bring evidence to show that the practical science of the classical period was, in certain matters, derived from the ancient East, and even that in certain cases names known to the Assyrians continued in use and were known to Pliny. In fact the book puts the study of these ancient texts on a new basis. Stones and pastes used as prescriptions in the medicine of quite early times were not always included for magical reasons; the chemical properties were known and also their physical effects. Some earths and stones were used for making paints. The commercial employment of vitriol and gall-nuts was understood. All who are interested in the development of man's use of matter will find this apparently unreadable book absorbing and indispensable.

Pioneer work of this kind must, of course, be subjected to criticism and correction as the years pass, as Dr. Thompson would himself desire. The identifications are admittedly in many cases only probabilities or possibilities, founded, as is the case of *aqua regis*, on slender evidence. There are many arguments and statements which will appear doubtful. It is surprising to read that Mesopotamian unburnt brick is generally yellow, or to find that the salt excrescence on ground and brickwork can be thought to have borne a name meaning "smoke". Instances of this kind could be multiplied. But however much we may differ from individual statements and conclusions, the value of the book remains unimpaired. It is a storehouse of most interesting information on an abstruse subject.

The Call of the Orient

The Quest for Cathay

By Brig.-General Sir Percy Sykes. Pp. xii +280 +17 plates. (London: A. and C. Black, Ltd., 1936.) 15*s*. net.

SOMEONE once said that "The struggle between Europe and Asia is the binding thread of History; the trade between Europe and Asia is the foundation of commerce: the thought of Asia is the basis of all European religions". With this trenchant observation in our minds, we can read "The Quest for Cathay" with even greater attention than if it were a mere story of exploration, in the annals of which it creates a brilliant and vital chapter.

Except for the first pilgrim-explorers such as Hsuan-Tsang—"the greatest of early Asiatic travellers"—the quest centres principally around that period between the mid-thirteenth and mid-fourteenth centuries, an era of the greatest importance in world-history, for it was then that the West first discovered the East. Here is romance indeed, the principal figures being the Friars Carpini and Rubruquis, and the merchant-adventurers—the Polo family. Although Sir Percy Sykes traces the whole story from the earliest penetration of Asia by Alexander the Great down to the arrival of the Portuguese and the Jesuits in the Far East, no less than eight chapters out of eighteen are devoted to the exploits of these travellers, and rightly so, for they do indeed embrace the bulk of the knowledge that Europe gathered about the Orient at that date.

The direct results of the tales these pioneers brought back was that there arose a sudden and impulsive desire in the West for direct contact with the East. Venice and Genoa rose to fame and opulence, but it was not until the fifteenth century that the great quest was set in motion, and many serious attempts were made to reach India and Cathay by way of the North-West Passage, along the Arctic shores of Siberia and by the Caspian route. The great adventures of Dias, Covilhao, Columbus, Cabot, Vasco da Gama, Magellan, Jenkinson and Frobisher were all undertaken with the same object: all had the same prize in view—the untapped wealth of the Orient. Finally, Portugal discovered the sea-route to China, and the author considers the quest ended. But surely, if Jenkinson, ambassador to Bokhara and Persia, was in search of Cathay, those early ambassadors from Muscovy to the Manchu Court should be included in the roll of fame. Russia may have been a bit behindhand, but the story of her push towards the East could have added a chapter or two of surpassing interest, and could have introduced material, unlike that in the rest of the book, not easily come by.

The author adds a personal note to the oft-told tales of these early pioneers, having followed in the footsteps of many of them. The volume is well illustrated, and wisely includes nine copies of early maps.

Economists and the Public:

a Study of Competition and Opinion. By Prof. W. H. Hutt. Pp. 377. (London: Jonathan Cape, Ltd., 1936.) 15*s*. net.

PROF. HUTT has obviously enjoyed the preparation of this book. There are few writers on economics or its applications in social and political problems from Adam Smith, J. S. Mill, Herbert Spencer and Ricardo to J. M. Keynes, J. A. Hobson, W. Lippmann, H. Levy, H. J. Laski, Bertrand Russell and others of our own day at whose teachings he does not direct some shrewd blows. The charge of anonymous criticism which he condemns in Prof. Pigou's "Theory of Unemployment" can scarcely be brought against Prof. Hutt, who rarely fails to specify exactly the writer or teacher responsible for the views he criticizes.

It would be unfair, however, to represent this book as purely provocative or destructive in its criticism. Quite apart from the merits of its able presentation of a case for the competitive system based on much sounder arguments than those of the political platform or press, it is a most stimulating book to all who are concerned with social and economic questions, and particularly with the way in which scientific thought can penetrate society and be integrated into action and policy able to control the destructive forces which threaten it to-day. What Prof. Hutt has to say about the influence of custom on thought, the corruption of opinion, on plausibility and its dangers, on liberty, the basis of authority in opinion, and the independence of university teaching has implications which are very far from being limited to those primarily concerned with economics.

The book is never dull or superficial, and the ideal of economic liberty with equality of opportunity which Prof. Hutt's study of the competitive or *laisser-faire* system leads him to uphold has claims on the attention of all who retain their faith in reason. It can be recommended to all scientific workers who are facing the social consequences of their work, if only for the indications of basic principles to be applied in their thought on such questions and of the pitfalls to be avoided. R. B.

The Book of the Aeroplane

By Capt. J. Laurence Pritchard. Third edition. Pp. x+254+24 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1935.) 7*s*. 6*d*. net.

CAPT. PRITCHARD has succeeded in putting into this comparatively small book almost everything that the general reader wants to know about the aeroplane. He is to be congratulated also on the clear and interesting manner in which he explains such things as the distribution of pressure on the wing of an aeroplane, the functions of the various component parts, the controls, the problems involved in obtaining high altitude, high speed and long range, and the ground organization on flying routes. Chapter iii, "How an Aeroplane Flies", is, in particular, a model of clear exposition.

The author of a book of this kind, dealing with a science which is advancing with startling rapidity, suffers from the handicap that his work must always be a little out of date, even on the day of publication. This, the third edition (1935) of a work first published in 1926, takes us down to the date of Miss Jean Batten's flight from Port Darwin to Lympne, April 1935. That is the last entry in the list of famous flights which is a valuable feature of the book. The reviewer was a little disappointed to find no mention of the present very elaborate weather forecasting service for aviation, in the chapters dealing with "The Great Airways of the World" and "Safety in the Air"; but that was the only fault he had to find with this very interesting and useful book.

Collected Papers of Charles Sanders Peirce

Edited by Charles Hartshorne and Paul Weiss. Vol. 6: Scientific Metaphysics. Pp. x+462. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1935.) 21*s*. net.

THIS valuable addition to the collection of Peirce's writings illustrates the extreme variety and creative power of the great American philosopher. Among the notable contributions contained in this volume are the series of articles which first appeared in the *Monist* and were so much appreciated by William James. These articles refer to the doctrines of Peirce on chance (tychism), on continuity (synechism) and on love (agapism). Around these articles, the editors have collected and published a wealth of notes, additions and studies ranging from logistics to telepathy, and showing the diverse interests of their author. This new volume will greatly assist the reader in forming an adequate judgment on Peirce's thought and on the historical background of contemporary logic and methodology. T. G.

Il nucleo atomico

Per Franco Rasetti. (Trattato generale di fisica a Cura del Consiglio Nazionale delle Ricerche.) Pp. ii+232+3 plates. (Bologna: Nicola Zanichelli, 1936.) 50 lire.

IN this book, readers of Italian should find a very convenient, up-to-date and trustworthy summary of the more important aspects of radioactivity and their theoretical explanation in terms of wave mechanics. It is particularly well illustrated, and the subject matter is set forth in a direct and pleasing manner. It should form a handy guide for quick reference; but, on the other hand, it does not contain those long lists of references and footnotes which make the works of English writers in this field so valuable. L. F. B.

Bird Flight

Written and designed by Gordon C. Aymar. Pp. xii+234. (London: John Lane, The Bodley Head, Ltd., 1936.) 12*s*. 6*d*. net.

THE main feature of this American book is the series of some two hundred 'action' pictures of flying birds by various photographers, including the author. Many of them have appeared before, but they make a remarkable collection, containing much of interest and much of beauty. The text is undistinguished: it gives a brief popular account under the heads of evolution, biology, migration and aerodynamics.

Engineering and Empire Development

IN his capacity as the head of the oldest and most famous engineering institution in the world, the president of the Institution of Civil Engineers occupies a position of undisputed authority, the realization of the character of which has led successive presidents to deliver addresses which, taken collectively, constitute a history of engineering. Some of these addresses have been confined to the particular branch to which the speaker has devoted his life, others contain surveys of many branches, while others again contain valuable autobiographical or biographical sketches. Few of the addresses are not without permanent interest, and some thirty years ago *Engineering* referred to the whole as being to the Institution "a heirloom left it by the many great men who helped so devotedly to build up the position of our Empire".

The addresses of Telford and Walker, who occupied the president's chair from 1820 until 1845, were short and were mainly concerned with the activities of the Institution itself, and the prototypes of the modern presidential address are those of Sir John Rennie in 1846 and 1847, and of Joshua Field, in the two succeeding years. Rennie's first address runs to more than one hundred pages in the *Proceedings*. It dealt with a multiplicity of things including bridges, tunnels, harbours, gas, water, railways, steam carriages, steam navigation and telegraphy and even touched upon mineralogy, geology and meteorology. It reviewed the vast development of engineering from the time Smeaton began work on the Eddystone Lighthouse down to 1846, a period of ninety years. Twenty years later, Sir John Fowler spoke of this address as "a history of engineering and a manual of engineering science". A still longer address was that of Sir William White who, however, confined himself entirely to the progress of naval architecture and marine engineering during the preceding half century, a field in which he himself had played a part second to none. But whether the addresses have been long or short, whether they have dealt with wide surveys or a single subject, they are nearly all excellent reading, and over and over again reference has been made to the many great works designed and carried out by British engineers both at home and abroad, whether in foreign countries or in the British Dominions. There were, therefore, numerous precedents for Sir Alexander Gibb's choice of the title "Engineering and Empire Development", for his address delivered on November 3.

Sir Alexander himself, it is almost unnecessary to say, has had experience in many branches of engineering. Born in 1872, he was a student of University College, London, and then a pupil under Sir John Wolfe Barry and H. M. Brunel. Between 1905 and 1917 he was engaged on the construction of the New Alexandra Dock at Newport, Monmouthshire and the Royal Naval Dockyard at Rosyth, and during the Great War was chief engineer for port construction for the British Armies in France and Belgium. As senior member of Sir Alexander Gibb and Partners, he has recently been responsible, not only for the Kincardine Bridge but also for the great Galloway hydro-electric scheme in south-west Scotland. Unlike many of his predecessors at the Institution of Civil Engineers, his principal work has been done at home, but in choosing the subject of his address, he was inspired partly by the address of Rennie and partly by the opportunity he had had of inspecting the great engineering works in the Dominions and Colonies, which in the last ninety years have wrought a change in conditions overseas similar to those wrought at home in the ninety years covered by Rennie's address.

The world before Smeaton's time, Sir Alexander said, had apparently stood still; suddenly there arose a body of great engineers who, in a few years, created a new era. This, he suggested, was a natural evolution from the more abstract discoveries of science due to such as Copernicus, Galileo, Kepler and Newton. H. R. Palmer, actually the first member of the Institution, had said that "the Philosopher searches into nature and discovers her laws and promulgates the principles upon which she acts The Engineer receives those principles and adapts them to our circumstances". From the outset, engineers thus looked upon themselves as the practical exponents, for the ordinary use of mankind, of the scientific knowledge won by men of science and mathematicians. The basis and justification of the existence of the engineer, and his contribution to civilization, exist in the fact that the application of science to practical use is in fact engineering. The engineer of Rennie's time was of the type visualized by H. R. Palmer, and it is the same type of man who in the ninety years since 1846 has changed the face of the whole world and created the British Empire.

Dealing in turn with canals, roads, bridges, railways, ships, ports, transport, agriculture, irrigation, water-supply, sanitation, etc., Sir Alexander referred to such achievements as the canals which make it possible for ocean-going steamers to penetrate half-way across the continent of America, the 1,000,000 miles of roads which serve the Empire, the 12,064-ft. long Lower Zambezi Bridge, one of the longest bridges in the world, the railways of Canada, India and Australia, the trans-oceanic trade in foodstuffs and the developments of ports It is of interest to note that Smeaton's old chart of the Clyde showed a depth of 42 inches at high tide near a point where the *Queen Mary* was launched in 1934. Striking effects have been achieved by irrigation. It was after the famine of 1865–67 that irrigation was started in India on modern lines Famines do not now occur in India ; shortage and scarcity exist at times, but the possibility of areas of the size and population of Great Britain being left without food owing to the failure of a capricious monsoon has long since been ended.

Whatever has been accomplished, however, "the opportunites of the future," said Sir Alexander, "are vastly greater than any that the past has offered, but frankly, I look with anxiety on the years to come. The machine . . . sometimes seems to be taking control. Inventions and developments succeed one another with bewildering speed, and there seems, unfortunately, to be no limit to the possible results of uncontrolled and misapplied ingenuity. In such circumstances no one can say where Engineering may lead us or what limit there is to the power of the engineer. One thing is certain, and that is that there must be control".

Finally, Sir Alexander appealed for more co-operation between engineers themselves, for the subordination of personal and independent views and feelings to a common policy. "I would like it to be possible for one broad policy to inspire and guide all classes of engineer. I would hope that in time there would arise a body of engineering opinion so weighty, so authoritative, so sure, so sane, that it would prevent waste of energy and misplaced enterprise, and would inevitably command attention in the politics and administration and life of our country and Empire."

Soil Drift in South Australia

THE advances being made by deserts into areas occupied by man, sand drift, and desiccation, are problems which have awakened interest in several parts of the world. At the present time they are under consideration in the Middle West of the United States of America, in West Africa and in South Australia.

Under the auspices of the Council for Scientific and Industrial Research of the Commonwealth of Australia an important monograph (Pamphlet No 64, Melbourne, 1936) on this subject entitled "Soil Drift in the Arid Pastoral Areas of South Australia" by Mr. F. N. Ratcliffe embodies the researches carried out by the author into this important matter. The history of the investigations are given in a foreword. During the year 1935, the minister in charge of the Council (Senator, the Hon. A. J. McLachlan) asked that consideration should be given to the possibility of undertaking any action to combat drift of soil in the arid and semi-arid parts of Australia. Mr. Ratcliffe, an officer of the Council, was deputed to undertake investigations in typical areas such as the northern portions of South Australia. It is stated that the publication of the report must not be taken to mean that the opinions expressed in it necessarily represent the considered views of the Council.

The problem of soil drift in Australia, says the author, is not, of course, confined to the area dealt with in the report. In order to shorten the period given to the investigations undertaken, the work was confined to the pastoral areas of South Australia. In other regions vegetations differing in type from, and in many ways more complex than, those described in the report would have had to be studied. On the whole, it is considered very unlikely that the problem in, say, western New South Wales would differ essentially from that in South Australia, although the details of the picture might not be quite the same.

The problem of soil drift and the deterioration of the pastoral country is a factor of very considerable importance to Australia's future, as is the case in certain other parts of the world. It is therefore, as the author states, very desirable, if not essential, that its nature and the difficulties which it presents should be properly appreciated by laymen and administrators as well as by scientific workers. Since the laws upon which a country is governed are the work of the administration, the burden of responsibility for a failure to recognize and then deal with a state of affairs often aggravated if not produced by man himself rests with the administrators. Mr. Ratcliffe presents a very clear picture of the existing conditions and position in the past of southern Australia. It is of interest to note that some of the photographs illustrating the pamphlet have a marked resemblance to parts of West Africa on the south Saharan borderland. It is impossible here to follow the author throughout his investigations, but they may be summarized.

Mr. Ratcliffe holds the theory that the soil drift in Australia is chiefly, if not solely in parts, due to the excessive utilization of the soil by man, chiefly stock; that, in other words, the drift is the result of the disintegration of the soil layers *in situ* into loose particles which thus produce in the end a desert; that these desert conditions are not produced, or even assisted to any material extent, by sand or particles blown from neighbouring desert areas. He admits that this latter is the theory of the local farmers, who speak of the 'encroaching sand' or 'encroaching desert'. The author apparently holds strongly to his theory of the local origin *sur place* of the sand or drift resulting from the gradual deterioration of the soil.

It is difficult to follow this theory. May there not be a certain amount of sand invasion on to good stock grounds from areas outside which are in various stages of degradation down to pure desert conditions—as, in fact, is well demonstrated in the Sahara? Is there any great or sharp distinction between areas containing what Mr. Ratcliffe terms soil drift in Australia and the lands in the immediate vicinity of the Sahara on which the soil is still capable of producing a vegetation of use to man and his animals, but which gradually becomes overlaid with an ever-thickening carpet of blown sand? Is not this a possible factor in Australia? It is difficult to credit the fact that in these deteriorating lands in South Australia the conversion to drift and aridity is practically entirely produced *sur place*, through the admittedly improvident actions of the occupiers of the land by excessive stock grazing and so forth.

The author, after a study of the literature on the problem of erosion elsewhere in the world, considers that "conditions in the Australian arid pastoral areas have no exact parallel elsewhere, and thus the problem of their deterioration must be tackled on its own merits". It is difficult to follow the argument. The resulting aridity leading up to desert conditions in several parts of the world is an outcome of the excessive activity of man and his wasteful utilization of the lands in question, with the inevitable result that the water supplies commence to become intermittent, and then cease, the spring water-level or the water-table sinking in the soil to a depth beyond its possible further utilization for his purposes. The ensuing conditions and their origin in modern times would appear to have a considerable similarity in the three regions of the globe already mentioned.

The remedies suggested by the author, with suitable modifications easily ascertainable in the region in question, appear equally applicable and called for in all. "Permanent pastoral settlement," says the author, "is only possible when the stocking is in equilibrium with the vegetation, and not merely exploiting plant capital"; and he urges the need for readjusting the stocking policy of the arid pastoral country. This is an equally pressing problem in parts of northern Nigeria and in the French Colonies bordering on the southern Sahara.

Geomorphology of the Irish Sea Basin

By Prof. J. Kaye Charlesworth

A MORNING session of Section C (Geology) at the meeting of the British Association at Blackpool was devoted to a discussion of the geomorphology of the Irish Sea Basin. Although the discussion brought out perhaps little that was new, it outlined the main features of the evolutionary development which, treated historically, may have a wider appeal.

The Irish Sea-basin had its beginnings in the remote geological past. The sediments of the geosynclinal sea, which during Lower Palæozoic times obliquely crossed the site of the present basin with shore-lines far beyond the present coasts to the north-west and south-east, were compressed into concertina and less acute folds at the close and elevated into a mountain system At this remote date, the Irish Sea-basin appeared if only in shadowy outline, and there emerged the rim of mountains of hard rocks that, save in the Mournes then unborn, more or less surround the sea of to-day and exhibit in the trend of their valleys, ridges and geological strike lines, the north-east south-west Caledonian direction. The release of pressure probably initiated the tectonic

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subsidence of the Solway Firth and its continuation south of Co. Down that subsequent movements were later to accentuate, and gave rise to cross fractures, such as those which opened the southern part of the North Channel and the depression of the Dundonald valley and Strangford Lough.

The Carboniferous Limestone sea which transgressed the Old Red Sandstone desert that followed these events was in some respects the prototype of the present Irish Sea; its waters, as attested by shingle beaches, washed against the foot of the mountains of Down, Wicklow and Wales, the Lake District and the Isle of Man. The deltaic conditions that followed and led up to the Coal Measure swamps, with the aid of erosion, largely evened up the basin, so that at the end of the Coal Measure period probably but little of the elevations was left projecting. The succeeding American or Hercynian folding once again emphasized old tendencies and revivified the relief by doming the mountains along the old lines, as in Wales and Wicklow and the Lake District, where some of the Carboniferous Limestone doming must date from this time, and by dropping the rocks down along the periphery and re-opening posthumously the Caledonian fault-lines that ran north-west south-east.

The marine regressions and transgressions which, with their erosion and deposition, constitute the Mesozoic history of the basin doubtless re-fashioned this and partially effaced its earlier features. The close of the era indeed saw a plain emerge from the Cretaceous sea that was almost devoid of relief, though it was probably warped upwards over the sites of the ancient uplands and downwards over the Irish Sea and the Solway and Cheshire basins. The end of the Cretaceous is a datum-line of the utmost importance, for the present drainage, except in the region of the Tertiary igneous rocks of north-east Ireland, had its inception on the land-surface that then came into existence.

The Tertiary witnessed a further stage in the development of the basin as we know it. It saw the intrusion of the granites of the Mourne and Carlingford Mountains, which belatedly take their place in the enclosing rim. The foundering of the North Channel probably along its whole length and the opening of the Carlingford depression are of this date. Most important of all, however, the basin was the theatre of intermittent uplift. Periods of rest and planation are recorded in a number of peneplains which are beautifully developed throughout the basin. These periods were separated by others of downcutting and rejuvenation of rivers and of broad warping along the old lines when Wales and the Lake District, for example, were greatly domed and the Irish Sea floor between them and the Isle of Man was equally depressed. The planations still preserved to us include levels at about 1,800 ft., 600 ft., 400 ft. and 200 ft. above sea-level and, less certainly, at other heights. They seem to be later than the Tertiary igneous cycle of north-west Britain, for they cut across the igneous rocks in north-east Ireland and elsewhere intersect the dykes which extend from them. The last of the plains, of early Pliocene age, rises into the Central Plain of Ireland and extends through Co. Down and the coastal plains of Wicklow and Anglesey and underlies much of Cheshire and the Machars of Galloway. It was succeeded by still further uplift which enabled the rivers to cut gorges, now for the most part 'buried' or submerged. Towards the close of the Pliocene a reverse movement 'drowned' the lowest valleys and admitted the sea to a coastline which is still traceable in numerous places.

The Ice Age, the last chapter of this morphological history, did much to modify the topography which it inherited. Its glaciers sculptured the uplands, converted their V-shaped gorges into U-shaped valleys, hollowed out their floors into lakes, widened their heads into cwms and gave to the basin its only fiord, Carlingford Lough. The ice deposited its load as boulder-clay, drumlins, moraines and sands and gravels that mantle the plains and mask the Lias and Chalk which form much of the solid sea-bottom. It transformed the late Pliocene gorges into 'buried valleys', both within and without the present coast, concealed the preglacial shore-line along most of its length, and converted parts of the sea-floor into dry land, as in the Cheshire Plain, Vale of Clwyd, northern plain of the Isle of Man and the isthmus beneath Stranraer.

After the dissolution of the ice-sheets, the incoming temperate flora provided the forests which clothed so much of the surface when the sea was 100 ft. or more lower than now. A rise of the sea, due to general eustatic changes and to local movements of the crust, inundated these 'submerged forests' and isolated Ireland and the Isle of Man from Great Britain.

This age-long and never-ending evolution still continues. Running water is slowly paring down the land and dumping its detritus into the sea. The sea itself is wasting away the shores and silting up the bays and estuaries, and on-shore winds are piling up the dunes. The unstable ground is slowly tilting southwards, as is shown by the submergence of an occasional prehistoric site along the coast of Co. Cork and by the recent fine levellings of the Ordnance Survey in England.

Racial Theory and Genetic Ideas[*]

By Prof. H. J. Fleure, F.R.S.

THE newer concept of species makes it possible to consider both the origins of mankind and a classification of mankind in a new light freed from the limitation of requiring the sterility of crosses as a test of specific difference. The fact that human migrations from early times have had a scale, a range and a rapidity unknown among animals is another biological point of the first importance. We may give up both the view that mankind originated from a single pair or from a small group and the view that the different groups of mankind originated separately from prehuman ancestors. Rather should we picture groups of beings on the threshold of a full human status, with probably differences within the group as well as between groups, scattered over a wide area as more or less mobile collecting and hunting societies forming a sort of human network over a wide area of the Old World, stretching at least through North Africa and south-west Asia. The persons in different parts of the network would probably differ, but almost any part might contain individuals similar in many characters to individuals in other parts. With development of desertic conditions in North Africa and Arabia bringing increasing settlement near rivers, some degree of isolation and a high degree of long-continued local intermarriage developed, and no doubt different variations, at least some of them adaptive, occurred in different regions, so that:

(*a*) A number of small remnants of diverse early types remained, sometimes perhaps degenerate, as pigmies of the African and south-east Asiatic forests, as blackfellows in Australia and so on.

(*b*) African, Papuo-Melanesian, eastern Asiatic and north-western groups in the Old World became distinct, while drifts to America from eastern Asia added another chapter to the story. These may almost be called sub-species.

Characters, even those used in discussing so-called race types, are nearly always both genotypic and phenotypic. Stature is closely linked with environmental factors; nose-form may have some such link, perhaps an indirect one. A penetration of characters from the north into the Congo Forest shows that stature diminishes, more rapidly than nasal index increases, along the zone of penetration. It is most probable that hot, wet conditions and poor food have prevented higher stature from persisting, but it has apparently been more difficult to alter nose-form, so we get an aureole of fairly narrow-nosed people of short stature around the wedge of narrow-nosed taller people projecting into the forest.

Shaxby has shown that skin pigmentation changes gradually from the Sudan to near the Arctic Circle, where Scandinavia yields the Nordic type, as it is called. Similar points might be made in respect of other characters. Thus the pattern of the main mass of mankind in the Old World may be said to be one of transitions in some respects between certain 'standards' in Africa, Europe, Eastern Asia, Papuo-Melanesia.

A scheme based on transitions more or less under environmental influences is, however, not much more satisfactory than a purely geographical classification; for we cannot but be impressed by the fact that almost every population consists of disparate elements that reappear or persist side by side in a population generation after generation. We cannot treat an ordinary population as a unit to be described by giving means and standard deviations for each character. Those figures often are mere abstractions. We need to try to see how bundles of characters are grouped together, what bundles occur and seem to be transmitted as entities, and how the proportionate numbers with different bundles vary from district to district. For they do differ, and we can understand this better if we remember that each of us had, in theory, 32,768 ancestors about the time of the discovery of America, and 1,073,000,000 about the time of the Norman Conquest. As marriage was largely localized, and few rural areas with persistent intermarriage had a population of 32,000 in the fifteenth century, we realize how much branches of genealogical trees must intertwine, and so how possible it is for an element, a group of characters, that got into a locality long ago, through a good number of individuals, to go on century after century in spite of some intermixture with individuals from outside, provided it has not to work against a Mendelian dominant. Needless to say, the bundle of characters need not be, and is not, exhibited by every member of the local group, nor is any claim made that all members of the group are of strictly localized descent. We are dealing only with proportions of a population.

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[*] Contribution to a joint discussion of Section D (Zoology) and Section H (Anthropology) on "Genetics and the Race Concept" at the Blackpool meeting of the British Association, on September 11.

Another necessary *caveat* is that the interpretation of differences between localities has to be done with great reserve unless we know from skeletons a fair amount about the back history of the district's population. Fortunately, as regards Egypt, we have the knowledge, from the work of Elliot Smith, Morant and others, that there has been a persistence of a bundle of physical characters from pre-dynastic days until ours. In Great Britain, in some areas once inhabited (*c.* 1900 B.C.) by the beaker-making people, the characters which distinguish their skulls are still found in certain cases among the modern population. In some areas of special isolation quite a number of people may carry and transmit a bundle of characters that seems associated with the very earliest population known from skeletal remains in Britain. The recurrence of these bundles is more than can be accounted for by any estimate of the probability of recombinations occurring in the course of intermixture; persistence seems the more likely hypothesis and the linkage of characters in a bundle is fairly obviously a feature.

We are, then, dealing with bundles of characters inherited more or less as such; diverse bundles often existing side by side. Even an interbreeding population, therefore, need by no means form a unit, and averages may mislead seriously. A pure race with essentially uniform bundles of characters in all its members probably does not exist; indeed, it is better not to use the term race at all in view of its painful misapplication in political discussions as well as of its inherent biological difficulties attached to the use of this word.

Obituary

Sir Edwin Deller

THE death of Sir Edwin Deller has robbed the University of London not only of a great administrative head, but also of a man beloved by all who knew him well. He died on November 30, from injuries received in an accident at the new buildings of the University in Bloomsbury.

Born at Paignton in 1883, the son of a carpenter, Edwin Deller left school at the age of twelve years to begin work as an office boy. Even in early boyhood he dreamed of a career in London, and as a youth he sought and found work there. After a period of other employment he entered the offices of the Kent Education Committee as a clerk, having chosen that position in preference to a better-paid post in a commercial house. He studied law in evening classes at King's College, University College and the London School of Economics, and graduated LL.B. with honours in 1911.

It was in 1912, at the age of twenty-nine years, that Deller first entered the service of the University of London, as secretary to the academic registrar. There he remained until his death, apart from war service in the Inns of Court O.T.C. and a short period in 1920 as assistant secretary to the Royal Society. He was invited to return to the University as academic registrar, and he held that office from the beginning of 1921 until his appointment as principal of the University in the autumn of 1929. In 1916 he gained the degree of LL.D. with a thesis on "The Liberty of the Subject".

Both as academic registrar and as principal, Deller served the University in times of exceptional importance. The period of his registrarship was one of great growth in the schools of the University, while his principalship covered the critical years, from 1929 onwards, in which new statutes came into operation and a new constitutional body, the Court, exercised centralized control over finance. Furthermore, his years as principal saw the arduous beginning of the vast building scheme in Bloomsbury. In both posts he was brilliantly successful; and it is difficult to believe that any other than he could have achieved an equal measure of success.

Endowed with vigorous health and blessed by a supremely happy home life with his wife and son, Deller brought to every task and to every occasion a wealth of energy, ability and human quality which made him an ideal administrator. He possessed in an extraordinary degree the power of radiating good humour and diffusing goodwill; of reconciling differences by discovering the measure of common purpose existing in apparently conflicting aims; and of going straight to the heart of a subject, often finding a clear solution where others had seen only an obscure problem. He delighted in working with scholars and men of science. Himself a man of wide culture, he shared their ideals and understood their ways. But he was equally at home with men of affairs, and indeed with all sorts and conditions of men. He gained to a most remarkable degree the affection, not only of members of his own staff, but also of countless colleagues in the university world at large.

Deller owed and acknowledged special allegiance and gratitude to three men with whom he was very closely associated in his work: to Sir E. Cooper Perry, principal officer of the University from 1920 until 1926, who was an outstanding influence in his life; to Lord Macmillan, chairman of the University Court; and to Mr. Harold Claughton, now clerk of the Court, and formerly secretary to the Senate. The delight of constant association with Deller in the work of the University was something which had to be experienced to be believed. One who experienced it for nearly three years recalls the daily talk with him (and one other colleague) about the work of yesterday and to-day, his irresistible sense of fun and extraordinary gift of sympathy, and his wise counsel and unfailing loyalty. It was easy to understand that in the Inns of Court O.T.C., where he had been a sergeant instructor, in the words of a comrade: "Recruits worshipped him, fellow N.C.O.'s loved him, officers valued and respected him".

In 1926 Deller visited the United States as the guest of the Laura Spelman Rockefeller Memorial. On his return he published under the title "Universities in the United States" some critical impressions which gained high praise in competent circles in America. He was deeply interested in American universities in relation to the community they serve; and the hospitality and friendship which he extended to visiting American scholars and administrators became proverbial. In 1927 he took a large part in the task of founding the British Institute in Paris; and up to the time of his death he served on the executive committee in London and on the educational committee, paying periodical visits to Paris and taking a keen interest in the progress of the Institute. He believed whole-heartedly in understanding and co-operation between France and Great Britain in general and between the universities of Paris and London in particular.

Many distinctions were conferred upon Sir Edwin Deller. One which he prized highly was his election as an honorary bencher of the Inner Temple in 1933. He was a fellow both of University College and of King's College. In 1932 he was made a Chevalier of the Legion of Honour "in recognition of his services in the cause of university relations between France and England". He was knighted in the New Year's Honours of 1935. T. F. S.

Prof. E. H. Kettle, F.R.S.

THE death of Prof. Kettle on December 1 is a serious loss to English pathology, coming as it has when he was at the height of his powers at the age of fifty-four years and when he had just got his department at the new British Postgraduate Medical School, London, well established and working productively. He was a London man, trained at St. Mary's Hospital, where he was afterwards on the teaching staff, going on to Cardiff in 1924, to St. Bartholomew's in 1927 and to his last post in 1934: he was elected into the Royal Society this year.

With Kettle goes one more of the disappearing race of general pathologists which the current specialization no longer produces, and he was an expert in bacteriology as well as morbid anatomy and ready to tackle any problem experimentally. Besides the ordinary contributions to knowledge which come from most laboratory workers, he will be remembered for suggestive work on the variation of the local inflammatory response to different bacteria and especially for his investigation, started originally with Dr. W. E. Gye, on the poisonous action of silica on the tissues and its relation to tuberculosis. This led him into the difficult field of industrial silicosis, which has in recent times turned out to be much more widespread and important than was at first supposed, and he showed clearly that it was the chemical character of the dusts rather than their mechanical irritation that determined the localization of tubercle bacilli which entered the body. Incidentally, he devised a very useful method of testing the potential danger of any industrial dust by animal experiment lasting a few weeks.

Hampered throughout life by a maimed leg and for the last ten years with recurrent and serious illness, Kettle never lost his buoyancy and his ready cheerfulness to teach his students and to guide young workers in the way they should go. He earned the respect of everyone and the affection of those who knew him well enough.

Rev. J. Gordon Hayes

THE Rev. James Gordon Hayes, Vicar of Storridge, near Malvern, died on November 21 in his sixtieth year. He devoted much attention to a critical study of the records of polar exploration and was the author of four outstanding books on the subject. In "Antarctica", published in 1928, he dealt with the natural features of the Antarctic continent and the journeys of explorers during the first quarter of the twentieth century. It was the result of a great amount of reading and gave an important comparison of the methods and results of modern explorers. This was followed in 1932 by a more distinctively historical work "The Conquest of the South Pole", designed as a continuation of Dr. H. R. Mill's "Siege of the South Pole" and showing deeper appreciation of the personal qualities of explorers than was apparent in the earlier work. The other two books, relating to north polar exploration, were "Robert Edwin Peary", an endeavour to show the improbability of that explorer having reached the pole, and "The Conquest of the North Pole", a well-balanced summary of Arctic exploration in the twentieth century.

Mr. Gordon Hayes, who had been a civil engineer before he entered the Church and had taken honours in history at Cambridge, was engaged on a work on Napoleon as a statesman at the time when the progress of his fatal illness put a stop to his labours. He was a tireless worker, an enthusiastic seeker after truth in all quarters, and a warm friend of all interested in polar exploration, by whom his cheery companionship will be much missed. H. R. M.

We regret to announce the following deaths:

Dr. J. K. Fotheringham, F.B.A., reader in ancient astronomy and chronology in the University of Oxford, on December 12, aged sixty-two years.

Sir Herbert Jackson, K.C.B., F.R.S., formerly director of the British Scientific Instrument Research Association, on December 10, aged seventy-three years.

Dr. A. A. Robb, F.R.S., author of works on aspects of relativity, on December 14, aged sixty-three years.

News and Views

John Maurice, Count of Bruhl (1736–1809)

THE bicentenary of the birth of John Maurice, Count of Brühl, recalls an interesting figure in the history of science in Great Britain in the eighteenth century. Born at Wiederau in Saxony on December 20, 1736, he studied at Leipzig, and at the age of nineteen years entered the Saxon diplomatic service and was sent to Paris. In 1759 he was transferred to Warsaw, and five years later, when but twenty-eight years of age, was appointed ambassador extraordinary to the Court of St. James. From the time of taking up his appointment in 1764, save for one journey abroad in 1785, he continued to live in England for the remainder of his life, and died at his house in Old Burlington Street, W.1, on June 9, 1809. He was devoted to astronomy, and effectively promoted its interests. Through his influence, von Zach, who was a tutor in his family in 1783, became an astronomer and assisted Bruhl in determining the latitude and longitude of Brussels, Frankfort, Dresden and Paris. He patronized the chronometer makers Mudge and Emery, wrote on time-keepers, was intimate with Herschel and delighted in transmitting abroad the discoveries made by him and others through the medium of Bode's "Jahrbuch". At his villa at Harefield about 1787, he built a small observatory, and a few years later equipped it with one of the first astronomical circles constructed by Ramsden.

Mr. A. B. MacDowall

A FREQUENT correspondent to NATURE about a generation ago was Mr. Alexander Baird MacDowall, who completed his ninety-third year on December 18. Mr. MacDowall was particularly interested in terrestrial and solar meteorology and the relationships between them, and most of his communications to these columns and to the Royal Meteorological Society dealt with this subject. The methods used by him, and some of the results, are typically illustrated in a small book published in 1895 with the title "Weather and Disease: a Curve History of their Variations". In this volume Mr. MacDowall showed, by means of graphs, the variations which certain elements of the weather and the mortality from certain diseases had undergone in the course of years. The mode of representation adopted by him was that commonly used at the time to illustrate the relation between two variables, the curves being subjected to a process of smoothing so as to record the averages of five or ten consecutive values.

IN a paper to the Royal Meteorological Society on April 21, 1897, Mr. MacDowall used this method of smoothed curves to make a comparison of weather statistics with the sunspot cycle, and was led to conclude that "In the climate of Western Europe there is apparently a tendency to greater heat in the summer half and to greater cold in the winter half near the phases of minimum sunspots than near the phases of maximum." Though the curve correspondences used by Mr. MacDowall and others to reveal periodicities have since been superseded by the periodogram and the statistical method of correlation, they were suggestive and represented a helpful stage in the understanding of meteorological relationships. Mr. MacDowall was a student at the Old College in High Street, Glasgow, under Prof. Thomson (afterwards Lord Kelvin), who influenced his whole subsequent career. After leaving Glasgow, he went to Berlin for a time and then voyaged to Australia and back in a sailing ship. He next settled in London and embarked upon a career of general journalism, working at the British Museum and the Patent Office. At that time he met Thomas Carlyle and became acquainted with D. E. Hughes, inventor of the microphone. In later years he has lived more or less in retirement and at present resides at Rothesay, Isle of Bute, where, in spite of his advanced age, he still retains active interest in scientific subjects.

Cultural Origins in Central America

NOTWITHSTANDING numerous attempts continued over a long period of years to trace the prehistoric civilization of Central America to its origins, the ancestral forms, especially of the culture of the Maya, remain obscure. It is now reported that a substantial advance towards a solution of this problem has been made by a joint archæological expedition to Yucatan of the Peabody Museum and the Smithsonian Institution of Washington, which has excavated a stratified site on the Ulua River, known locally as the "Beaches of the Dead". This site, the second only of the recorded stratified sites in this part of the world, lies on the fringe of the Mayan area. It has been known since 1929, when Mrs. Dorothy M. Popence was lowered by ropes into the channel which has been cut by the river through the deposits to collect skeletal material which had been washed out with potsherds and other debris from the culture-bearing strata. Dr. W. D. Strong, who is in charge of the expedition, now reports to the Smithsonian Institution the discovery at a depth of twenty feet of house-floors, refuse heaps and pottery fragments incised or painted in monochrome with designs which, though less elaborate, suggest an early Mayan type. Overlying this culture is a deposit of sterile clay, six and a half feet thick, and above this again is a deposit of burials and potsherds typically Mayan in character. The intervening cultural and chronological gap is partially filled by a culture from a site on the tributary Comayagua River, where an apparently transitional stage affords pottery of Mayan type that seems to shade into the "Beaches of the

Dead" style. On the evidence of its precedence in time and its similar but simpler character, it is suggested that the "Beaches of the Dead" type may be ancestral to the Maya style. Posthumous distortion has destroyed the evidential value of the skeletal material, beyond an indication of a general physical resemblance to the type of the Maya people.

Mosquito Control and Local Authorities

REFERENCE has been made in these columns on a number of occasions to the valuable work on mosquitoes and their control carried on by Mr. J. F. Marshall at the British Mosquito Control Institute, Hayling Island, Hampshire. The Institute was built and equipped by Mr. Marshall in 1925, and has become an important advisory and educational centre, which has been maintained almost entirely by him. Before he began his work, Hayling Island was infested with the salt-marsh mosquito and other species, but by dealing systematically with the breeding-places these pests have almost disappeared from the island. Experience has shown, however, that inspection and other control measures cannot be allowed to lapse if they are to be of practical value. This is evidently realized by the Havant and Waterloo District Council, which, in a Bill being presented to Parliament, includes a clause giving powers to the Council to "subscribe or contribute such sums as they may think fit to the British Mosquito Control Institute so long as that Institute shall remain established at Hayling Island and the Council shall consider its work contributory to the freeing of the district from mosquitoes".

HITHERTO, consent of the owners of property has had to be obtained to examine an area suspected to contain breeding places of mosquitoes or to deal with it suitably. The Bill mentioned above empowers the local council to take whatever action it may consider necessary for health's sake to inspect such areas or carry out measures of mosquito control. The clause relating to these powers reads as follows : "The Council may take all reasonable measures to make and keep the district free from mosquitos and with this object they may in particular (apart from any other measures)—(*a*) enter by their officers upon any premises which they have reasonable grounds for suspecting to be a breeding place for mosquitos and apply thereon any tests or examination for the purpose of discovering whether and to what extent mosquitos or their larvæ are there ; (*b*) require the owner of any premises upon which there is stagnant water or marshy ground which is a haunt or breeding place for mosquitos or contains the larvæ of mosquitos to drain the site of such water or such marshy ground to the reasonable satisfaction of the Council and to apply thereto such other treatment (if any) as the Council may reasonably prescribe." The inclusion of this clause in the Bill shows that the Council not only realizes the existence of mosquito pests but also the practicability of dealing with them by measures which have been successfully adopted during the past eleven years or so by Mr. Marshall as director of the British Mosquito Control Institute.

Exhibition of Electric Illumination

THE Science Museum is holding a Special Exhibition of Electric Illumination, which will remain open until April 25, 1937. Push-button demonstrations illustrate the principles involved in illuminating engineering practice, such as various types of reflection and transmission of light, reflection factors, effects of contrast, etc. Two full-sized rooms are devoted to decorative lighting and standard lighting system definitions. The great advances made in tungsten filament lamps are illustrated by exhibits showing the control now exercised during manufacture. The electric discharge lamp is dealt with in detail. Apart from examples of discharge lamps and their application to street lighting, industrial lighting and floodlighting, there are exhibits illustrating the cyclical form of the discharge and stroboscopic applications. All types from low-pressure tubes to water-cooled quartz tubes operating at 8,000° C. are shown. The phenomenon of luminescence, discovered by Crookes in 1879 and now applied to discharge lamps, is shown in considerable detail. By way of contrast, a concise historical exhibit illustrates the state of illumination technique through the ages. The exhibition has been arranged by Mr. W. T. O'Dea, of the Science Museum, with the assistance of the E.L.M.A. Lighting Service Bureau and an advisory committee under the chairmanship of Mr. C. Rodgers.

THE opening ceremony was performed on December 15 by Lord Rutherford, with Sir Henry Lyons, the chairman of the Science Museum Advisory Council and a past director of the Museum, in the chair. Lord Rutherford remarked that the subject is one which has interested him all his life. During the past ten years, there have been remarkable advances in illumination which, emanating as they have from pure science research undertaken in industrial laboratories, illustrate admirably the close relationship between science and industry. 80 candle-hours ten years ago cost the same as 300 candle-hours to-day, and this improvement happily comes at a time when it is really wanted in the cause of road safety. Some 25,000 hot cathode discharge lamps now illuminate 1,000 miles of road in Great Britain alone. With regard to modern developments in the application of the phenomenon of luminescence, Lord Rutherford said he hopes to live to see the time when we shall obtain light without filaments or electrodes simply by the conversion of invisible radiation. Mr. H. T. Young, president of the Institution of Electrical Engineers, in proposing a vote of thanks, mentioned the valuable educational work which can be done by such an exhibition ; it is expected that the exhibition will attract a quarter of a million visitors.

Modern Views on Infection and Disinfection

THIS was the subject of a Chadwick lecture delivered by Sir Weldon Dalrymple Champneys at Manson House, London, on December 9. Microbial diseases, he said, can be defined as a disturbance of health in man or other living things due to the presence of parasitic organisms, as a disturbance of the equilibrium between host and parasite unfavourable to the host. The reactions of any host to the presence of pathogenic organisms are numerous and complex, but are not mutually exclusive. Thus, the parasite may be rapidly killed by defensive mechanisms of the host's body, without giving rise to any symptoms of disease, or it may cause a local reaction known as inflammation. Fever is also a common result of infection, and tends to be a protective mechanism. Sir Weldon dwelt on the fact that a 'carrier state' may be established either following illness with apparent recovery without complete destruction of the invading parasite, or in consequence of a 'silent' infection without actual disease.

THE manner in which infecting parasites gain access to the body was then dealt with, the two commonest portals of entry being the skin and the nose and mouth. Infection may enter through the nose or mouth by the inhalation of infected droplets in the breath of patients or carriers, as with measles, influenza and others, or by swallowing infected food or drink, as in cholera and typhoid fever. The importance of the carrier state as a cause of cases or epidemics of infectious diseases was emphasized, and reference was made to the fact that different diseases may be caused by the same organism. For example, scarlet fever, tonsillitis, puerperal fever and probably acute rheumatism are all caused by various hæmolytic streptococci. In conclusion, Sir Weldon discussed measures of disinfection and prevention, and in regard to 'current' and 'terminal' disinfection, pointed out that treatment of infective material in the sick room during the patient's presence there ('current disinfection') is all that is necessary with most diseases. 'Terminal disinfection' after recovery or removal of the patient, upon which until recent years most reliance has been placed, is needless, and may be confined to the free use of soap and water with thorough ventilation.

Discoveries in Antarctica

A DISPATCH from the British Graham Land Expedition under the leadership of Mr. J. Rymill published in *The Times* of December 12 announces an important change in the map of Graham Land. In December 1928 Sir Hubert Wilkins in his flight over Graham Land reported the existence of two straits, Casey Channel and Stefansson Strait, in about latitudes 69° 45′ S. and 71° S. respectively, across the area known as Graham Land which previously was thought to be united to the Antarctic Continent. Between the two straits he mapped roughly the Finley Archipelago. The British expedition, sledging along the west coast of Graham Land, to lat. 72° S., long. 67° W., or ninety miles south-west of where Sir H. Wilkins turned, found no trace of these two straits and believes that low glaciers must have been mistaken for ice-covered straits. Thus Graham Land south of Crane Channel in the Antarctic Circle is restored to its former continuity with the continent. A further discovery of importance is that Alexander I Land, discovered by Bellingshausen in 1821 and sighted by Charcot in 1909, is not a small island but a large land area at least two hundred and fifty miles from north to south and separated from Hearst Land by an ice-filled cleft-like strait fifteen miles wide and 200 miles long. The expedition charted the eastern coast line of this island. The strait appears to be a fault feature with the eruptive rocks of Graham Land on the east and fossiliferous sedimentary rocks on the west or island side.

Hooker's Work on Lapachol and Related Compounds

THE yellow crystalline pigment lapachol, found in Bethabarra wood (from West Africa) as well as in several South American timbers, provided the late Dr. S. C. Hooker, the eminent American sugar technologist, with an absorbing problem in chemical structure which lasted a lifetime and has given us an admirable model of chemical research, based upon highly skilled technique, close observation, patience and careful deduction. The publication during the present year of no fewer than eleven posthumous papers by Dr. Hooker in the *American Chemical Journal* after a silence of forty years must have come as a complete surprise to organic chemists. But the work to which Dr. Hooker was so devotedly attached was interrupted by his long period of activity in industry. On his retirement in 1915, he resumed the problems which had remained untouched since 1896, and he was reluctant to publish prematurely the numerous results which he was able to collect in the last twenty years of his life.

HOOKER was born in Kent of British parents, but after studying in London under Japp and at Munich under Bamberger, with whom he undertook the investigation of retene, he migrated to the United States. His published work contains an account of the properties and structure of lapachol and of many closely allied compounds. Many of his results were obtained by close observation of minute samples under a microscope. Lapachol is a β-amylene β-hydroxy α-naphthoquinone, which undergoes isomerism with mineral acids into lapachone, involving ring-closure with the hydroxy-group and sometimes also change to the orthoquinone structure. But further structural changes of an unusual type are readily induced and we cannot fail to admire the skill with which he solved the problems of change of structure from the *p*-quinone to the *o*-quinone type, of the exact location of the double bond in the amylene group and of the mechanism of the process of oxidation, whereby the quinone-ring is first broken with elimination of carbon dioxide and then re-formed from the side-chain, in such a way that the next lower homologue of the original compound is formed. A memorial volume containing an obituary notice from the *Journal of the Chemical Society*, together with reprints of twenty-two memoirs from the same journal and the *Journal of the American Chemical Society*, has been edited by Prof. L. F. Fieser of the Converse Memorial Laboratory, Harvard University, to whom application may be made for copies.

Saints and Martyrs

In a lecture of this title recently delivered at the London Hospital and published in the *Lancet* of November 7, Dr. Donald Hunter, physician to the Hospital, remarks that the world to-day is too busy applauding successful military commanders, popular orators and authors to recognize that all its material advance has been achieved by men of science. He quoted numerous instances of scientific and medical men who were distinguished by having met dangers and often death for the sake of their work. In the first place he showed how our knowledge of toxic gases owed much to the self-sacrifice of pioneer workers, as in the cases of Gehlen, a Munich chemist, and Dr. K. C. Shierbeck, of Copenhagen, whose deaths in 1815 and 1920 respectively were due to arseniuretted hydrogen. In like manner, nitrous oxide proved fatal to Dr. S. R. Wilson in 1927, and hydrofluoric acid to Louyet and Nickles in 1869. In addition to numerous deaths among doctors and nurses due to attending patients suffering from acute infectious diseases, many laboratory workers have lost their lives in the investigation of certain dangerous tropical diseases, especially yellow fever, following experimental mosquito bites, as in the case of Lazear in 1900 and Walter Myers in 1901, pneumonic plague (T. C. Parkinson, 1909), verrugas (D. A. Carrion) and kala azar (W. R. Pirie). Numerous injuries and deaths from X-rays after many years of suffering occurred in radiologists before efficient means of protection were discovered, while it is not yet practicable to protect completely those who handle radioactive substances.

Work of the Meteorological Office

The annual report of the director of the Meteorological Office for the year ending March 31, 1936 (H.M. Stationery Office, 1*s*. net), describes the work done by that Office in its eighty-first year. Military operations are now so dependent upon the help of organized meteorology that an atmosphere of suspicion, merely, between European nations causes repercussions that affect the development of meteorology. In the year under review the Royal Air Force expanded: the Meteorological Office did likewise. Early in October 1935, an Overseas Division was formed to deal with Empire air routes, including the projected trans-Atlantic routes and the Empire air mail scheme. In addition, new stations were opened during the year at Aden, Khartoum and Gibraltar. As additional trained staff could not at once be produced to meet the emergency, the staff at headquarters and some out-stations in Great Britain had to be drawn on for service abroad, in spite of the general increase of work at home, which was augmented by the decision to carry out the scheme of grading and pay recommended by the Committee on the Staffs of Government Scientific Establishments presided over by Sir Harold Carpenter. These activities were not, however, allowed to prevent proper attention being given to two important conferences, the Empire Conference of August 1935 held in London and the International Conference of the following month in Warsaw. The Empire Conference met for discussion of research; the subjects for discussion were set out in sixty-eight memoranda. The International Conference was a gathering of directors of meteorological services, which among other achievements arrived at a uniform system of construction of synoptic weather maps—a valuable aid to international co-operation. The year's changes included also the setting up of an Overseas Division and the introduction in the official library on January 1, 1936, of a revised classification of meteorological literature based on that employed by the International Institute for Documentation.

Overhead Line Insulators

In a paper read to the Students' Section of the Institution of Electrical Engineers on November 30, Mr. C. H. W. Clark discussed the design, manufacture and testing of overhead line insulators. It is generally considered that 500,000 volts is the most economical pressure at which to transmit large quantities of electrical energy over long distances. The best material for insulating these lines has been found to be porcelain, as its insulating qualities remain practically the same when exposed to all weather conditions. It has low tensile strength but considerable compressive strength, and so most types of insulator are designed to utilize the porcelain in compression. Electrical failure follows a puncture through the porcelain or by 'flash-over' round its surface, which produces an arc short-circuiting the line. As puncture destroys the insulator, it is more serious than flash-over. Insulators are designed with a puncture voltage of about twelve times and a flash-over voltage of about six times the working voltage. Failures occurring in practice are usually due to lightning or to deposits of soot or sea salt on the insulator surface. Lightning affects the design of the transmission line rather than that of the insulators. Often no permanent damage is done by lightning flash-over. The problem of deposits on the surface of the insulators is a serious one and has not yet been completely solved, although many suggestions have been made for improving the standard types. For use near the sea, anti-deposit insulators have long, recessed, protected surfaces. For industrial areas, types with open exposed surfaces which can be cleaned by wind and rain have proved the best. For testing purposes, a percentage of the finished insulators are selected at random and tested for flash-over voltage both dry and in rain (produced artificially by a watering pot), impulse flash-over voltage, mechanical strength and electrical puncture.

Activities of the Imperial Agricultural Bureaux

The seventh annual report (1935–36) of the Executive Council of the Imperial Agricultural Bureaux has now been published (London: H.M. Stationery Office, 5*s*.). In view of the British Commonwealth Scientific Conference held in London this September, the volume is somewhat fuller than usual. Particular interest will perhaps be found in the individual reports of the several institutes and bureaux, where abundant illustration is afforded of the value now attached to them by the number and diversity of the inquiries sent from all parts of the Empire, quite apart from their regular work of preparing and distributing abstract journals. Research workers in South Africa, Queensland, Sierra Leone, Cyprus, Mauritius, Victoria, India, northern England and the Gold Coast have asked for and obtained assistance from the Mycological Institute in the identification of fungi. At the Entomological Institute, insects from every country in the Empire have been received for identification. Other bureaux have assisted in obtaining material for plant breeding work, in supplying seeds, in arranging for the analysis of foodstuffs; whilst the laboratory attached to the Imperial Institute of Entomology collected and sent to Canada nearly three million parasites to aid in controlling the insect pests which were attacking the forests in Quebec and the Maritime Provinces. In fact, the report marks for the seventh year the success of an Imperial service, organized on a co-operative basis and directly controlled by representatives of all parts of the Commonwealth.

Rock Gardening

THE art of growing plants among rocks disposed artistically is, perhaps, the highest form of gardening. It calls forth skill of an exceptional order, and provides a medium for expression of the highest sense of art. The Royal Horticultural Society and the Alpine Garden Society are therefore to be congratulated upon their very successful joint organization of a conference on rock garden matters, and an exhibition of tasteful grouping of alpine plants. The deliberations of this Conference, which took place at the Greycoat Street Hall on May 5–7, 1936, have now been published in book form by the Royal Horticultural Society ("Rock Gardens and Rock Plants." London: from the Office of the Society, Vincent Square, S.W.1, pp. 171, 6*s*. net, 1936). Mr. F. J. Chittenden has edited this report of proceedings. Practical considerations were well to the fore. The utilization of natural slopes and of flat sites, the cultivation of difficult alpine plants, methods of propagation, the use of an alpine house, and other problems, were discussed. The history of rock gardens was outlined, and a very pleasing international atmosphere was introduced by the speakers who described rock gardening in South Africa (Miss Stanford), in Quebec (Mr. Cleveland Morgan) and in Southern California (Mr. W. Hertrich). The impression gained from the volume is that the artistic side of rock gardening could scarcely be improved, and that present-day practice is enlightened and highly skilled. There are abundant indications, however, in the papers and in the energetic and constructive discussion which followed them, that there is a field where a sympathetic man of science, working upon rock-garden problems, might furnish great contributions to practice, and satisfy many botanical questions which must at present be left unanswered.

Forestry in British Honduras

THE report of the Forest Trust of British Honduras to the end of December 1934 (Belsize: Govt. Printer, 1935) shows some progress in forestry work after the severe experiences following the 1931 financial crisis. From the Colonial Development Fund grants were made towards forest development in the Colony. The chief of these grants was to provide the staff to undertake a forest resources survey of the country, provided that the local Government contributed towards the cost and that the officer seconded for the work was replaced on the executive staff by an additional officer. The step so taken furnishes evidence of a broad vision on the part of the officials forming the Forest Trust. The term 'research work' accorded to what is mainly ordinary stock mapping of a forest—the work, or part of it, of the trained forest officer—is rather out of place, if not misleading. The staff of the Department, consisting of three gazetted officers, is still too small to make any considerable advance in executive forestry work a possibility. It is not therefore surprising to find in the Report such remarks as "No new reserves have been created"; "No new demarcation work was undertaken"; and, in spite of the magnificent start made in the early years of this young Department, that "No sylvicultural work has been done since the completion of the mahogany improvements in 1931". The end of the year 1934, which appears very distant at the present day, seemed to show an upward tendency in a timber trade revival. It was estimated by the Trust that the export of mahogany, that magnificent forest product of the British Honduras forests, would not exceed five or six million board feet per annum in the immediate future, and that a large proportion of that export would be in lumber form.

Exhibition of Microscopes

MESSRS. W. WATSON AND SONS, LTD., held their fourth exhibition of microscopes at the Central Hall, Westminster, on December 7–11, when the manifold uses of the microscope were practically illustrated, and many different types of instrument were on view. Members of the Quekett Microscopical Club were helpful in explaining points of interest to the scientific microscopist and instilling enthusiasm for microscopy in the amateur. A large number of different microscopes, from the comparatively simple student's microscope to the more intricate type used for research purposes, was on view. Other apparatus being demonstrated included photomicrographic and other cameras, dyes and stains, dissecting instruments, micro-projectors, telescopes, and other optical instruments. Messrs. Chance Bros. supplied an exhibition of glass in various stages from the rough mass to the finished optical lens. Messrs. Kodak also had an exhibition, as also had Polarisers, Ltd. A catalogue of the exhibition forms a useful guide to scientific workers in the many branches of science in which the microscope is indispensable and also to the amateur microscopist. The catalogue can be obtained from Messrs. W. Watson and Sons, Ltd., 313 High Holborn, London, W.C.1.

New Tests for Milk

The Minister of Health has issued a pamphlet giving directions for carrying out tests to ascertain whether milks entitled to be called 'tuberculin tested', 'accredited' or 'pasteurized' comply with the prescribed standards for the bacterial content of such milks. These standards indicate the cleanliness and keeping qualities of the milk (Bacteriological Tests for Graded Milk (Revised Memorandum 139/Foods. London: H.M. Stationery Office. 3*d*.). Since June 1, 'tuberculin tested' milk has taken the place of 'certified' and 'Grade A (Tuberculin Tested)' milks; and 'Accredited Milk' that of 'Grade A' milk. In place of the previous 'plate-count' test, a new test, the methylene blue reduction test, will be applicable to these milks from January 1, and as before, there is a test for the presence of coliform bacilli. Pasteurized milk, whether 'tuberculin tested' milk or not, must comply with a 'plate-count' test. Full directions are given for carrying out these tests, and the pamphlet also explains how samples should be collected.

Marine Boring Animals

The damage which may be done to submerged structures of both wood and stone by marine boring organisms is a subject of not only general interest but also of extreme economic importance. In 1919, therefore, the Trustees of the British Museum caused a general account of the habits and life-histories of these organisms to be prepared which, it was hoped, would prove useful to both zoologists and marine engineers. This hope has been amply fulfilled, and the Trustees have now issued a revised edition of the pamphlet incorporating the additions to our knowledge of marine borers which have been made since the publication first appeared (Marine Boring Animals injurious to Submerged Structures. By W. T. Calman. Second edition; revised by G. I. Crawford. British Museum (Natural History), 1936. 1*s*.).

Announcements

At the annual meeting of the Royal Agricultural Society of England held on December 9, the Right Hon. Walter Elliot, a former Minister of Agriculture and now Secretary of State for Scotland, was presented with a certificate and badge of honorary life governorship of the Society. In the report presented at the meeting it is stated that the Society's Gold Medal and honorary membership for distinguished services to agriculture has this year been presented to Sir William Cecil Dampier. For some years Sir William has devoted his energies to the organization and development of agricultural research. He was the first secretary of the Agricultural Research Council and steered that body to success through its early difficult years.

An important experiment in the prevention of malaria, according to the Soviet Union Year Book Press Service, was recently carried out by the Sanitary Department of the Central Asiatic Military District. Before the autumn manœuvres, every soldier was given a dose of acraquinine for several days, and although the manœuvres took place in malaria-infested districts and there were cases of bites by malaria-carrying mosquitoes, not a single case of malaria occurred.

The Royal Statistical Society offers the Frances Wood Memorial prize, value £30, for competition in 1937. The prize is offered for the best investigation, on statistical lines, of any problem affecting the economic or social conditions of the people. Further information can be obtained from the honorary secretaries of the Royal Statistical Society, 4 Portugal Street, W.C.2.

Erratum.—In the note on p. 1003 in Nature of December 12, Sir Robert Mond should have been described as president of the French Society of Chemical Industry and not as "past-president".

Applications are invited for the following appointments, on or before the dates mentioned:

Technical officer at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (December 26).

Civilian engineer in the War Department—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (December 31).

Principal of Newport Technical College—The Director of Education, Education Offices, Charles Street, Newport, Mon. (December 31).

Assistant in the Art and Ethnographical Department of the Royal Scottish Museum, Edinburgh—The Director (December 31).

Research assistant in botany in University College, Exeter—The Registrar (December 31).

Assistant physicist in the Royal Cancer Hospital (Free), Fulham Road, London, S.W.3 (January 1).

Lecturer in chemistry, botany and zoology in the Technical College, Doncaster—The Secretary (January 2).

Head of the Chemistry Department of the Derby Technical College—Clerk to the Governors, Technical College, Green Lane, Derby (January 9).

Lecturer in native administration in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, London, W.C.2 (January 15).

Research worker in nutrition in the Medical Research Department of the Government of India—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (January 15).

Metallurgist for work on alloy steels and metallurgist for work on non-ferrous alloys in the Mond Nickel Co., Ltd.—The Manager, Research and Development Department, The Mond Nickel Company, Ltd., Thames House, Millbank, London, S.W.1.

Physical chemist to the Printing and Allied Trades Research Association—The Director of Research, 10 Robin Hood Court, London, E.C.4.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1060.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Liquid Crystalline Substances from Virus-infected Plants

STANLEY[1] has described the preparation of a crystalline protein possessing the properties of tobacco mosaic virus from the sap of infected tobacco and tomato plants. The crystals were small needles made by precipitation with acid ammonium sulphate. We have confirmed these results, but have found that by further purification the protein in neutral aqueous solution can be obtained in liquid crystalline states.

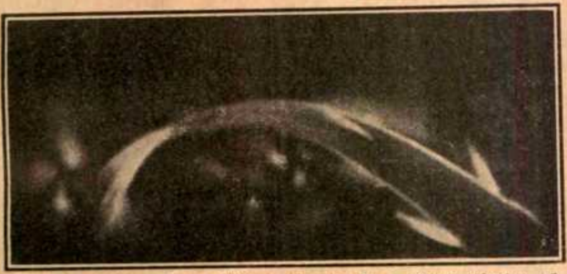

FIG. 1. Wake of a goldfish swimming in a dilute solution of protein from infected sap (observed between crossed nicols). *Photo by Ramsey and Muspratt.*

The sap of tobacco and tomato plants infected with strains of tobacco mosaic virus, after clarification by centrifuging, contains five to ten times as much protein as sap from similarly treated uninfected plants. This extra protein can be precipitated from dilute salt solutions at around pH 3·4 and from neutral solutions with from 10 to 12 per cent ammonium sulphate. The protein in uninfected sap is not precipitated under these conditions. Using these properties, 1–2 gm. of protein can be isolated from a litre of sap; the yield varying with the age of the infected plant and the duration of infection. No enzyme preparation has yet been found which can attack the protein at an appreciable rate, and some impurities can be conveniently removed by incubation with trypsin.

We have worked with three strains of tobacco mosaic virus, those causing common tobacco mosaic, aucuba mosaic and enation mosaic. No gross chemical or physical differences have been found between the three proteins isolated, but each reproduces its characteristic disease when inoculated to susceptible plants. Differences in detail, which will be described in a later publication, have been noticed. Solutions of the protein are antigenic, and the antisera produced in rabbits give specific precipitates with 1 c.c. of solution containing 10^{-7} gm. The three proteins are serologically related. Plants inoculated with 1 c.c. containing 10^{-9} gm. usually become infected, and occasional infections have followed inoculations of 10^{-11} gm.

These proteins, when precipitated with acid and dried, have the usual analytical figures: C 51 per cent, H 7·1 per cent, N 16·7 per cent. The sulphur contents vary from 0·2 to 0·7 per cent and there is 0·5 per cent phosphorus and 2·5 per cent carbohydrate. The last two constituents can be isolated as nucleic acid of the ribose type from protein denatured by heating. Neutral aqueous solutions of the proteins are almost colourless and faintly opalescent. The protein sediments in a centrifugal field of 23,000 times gravity at about 5 mm. per hour and is deposited as a very viscous layer containing up to 30 per cent of dry matter. Highly purified protein solutions, if stronger than 2 per cent, separate into two layers on standing. The lower layer, which may be water clear, is liquid crystalline. The birefringence depends on the concentration, but may rise to 0·002. The upper layer shows, on gentle agitation, the phenomenon of anisotropy of flow. This was noticed by Takahashi[2] in clarified sap. We have, however, been unable to confirm his later claim that the effect could be observed in healthy tobacco sap. The orientation will persist for several seconds in purified solutions, but if the solutions are impure or dilute the persistence is much shorter. This effect is illustrated in Fig. 1, where the wake of a goldfish swimming in a dilute solution is clearly shown; the cross of isocline will be noticed in the eddies.

Solutions can readily be orientated by electric currents, but not by magnetic fields of 6,000 gauss. The lower layer orientates itself by flow like the top layer and also tends to orientate parallel to glass or air surfaces. On flowing through small capillary tubes it can be thrown into a state of reversed spiral vibration[3]. When small portions of lower layer are in equilibrium with the top liquid, they appear as spindle-shaped bodies (see Fig. 2) which are characterized by an approximately constant meridional curvature. Large spindles are consequently nearly spherical and small ones practically linear. On standing there appear holes, filled with top liquid, of

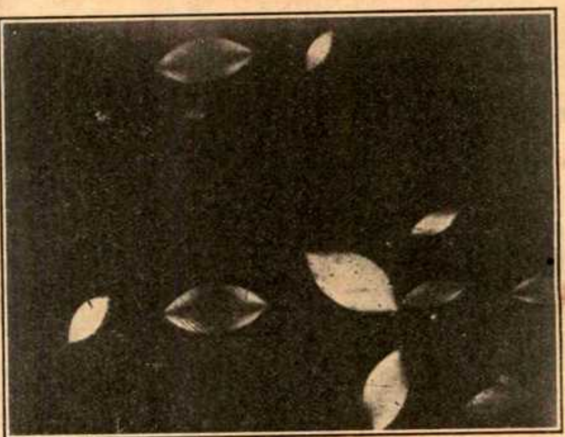

FIG. 2. Highly purified protein from infected sap, when stronger than 2 per cent, separates into two layers on standing. If there is very little of the lower layer, it arranges itself in spindles. Photographed between crossed nicols, × 30.

precisely the same spindle shape. All these phenomena indicate the presence of long fibres.

If any of these liquids be allowed to dry, a film forms on the surface consisting of three sharply distinguishable layers. The first formed is an extremely soft gel well orientated and with much higher birefringence, 0·007, than the liquid. The outer part of this wet gel shrinks by 50 per cent and forms a layer of higher refractive index, but lower birefringence, 0·003. Finally, on placing in air, extensive cracks appear in this dry gel and it becomes translucent and rather feebly doubly refractive. The dry gel is usually well-orientated but in certain conditions shrinks longitudinally to give a herring bone pattern, which indicates that little longitudinal shrinkage of the fibres themselves takes place.

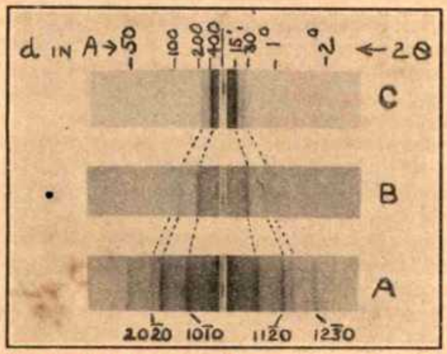

FIG. 3. X-ray patterns of dry gel (*A*), wet gel (*B*) and 13 per cent solution (*C*).

The X-ray patterns of these different forms show remarkable similarities and differences. For the large angle scattering there appears to be little difference, except in general intensity, between patterns given by all the different forms from the top liquid, orientated by flow in a Lindemann glass capillary, to the dry gel and the 'crystals', from ammonium sulphate solutions. This pattern is therefore entirely due to the protein molecules themselves and may be called the intramolecular pattern. It appears to have about the same order of complexity as that produced by feather keratin, with a repeat unit in the fibre direction of 3 × 22·2 ± 0·2 A.

Near the centre of the photographs, spots were observed which varied from one preparation to another. A camera of 40 cm. length was constructed employing an X-ray beam of copper-$K\alpha$ radiation with an angular width of 3′ and capable of showing spacings up to 1,200 A. All the intermolecular pattern so far observed lies in the equatorial plane, that is, refers to the relative sideway positions of the rod-like molecules. The dry gel gives the most definite pattern (Fig. 3) showing five lines (see table) corresponding to the first five possible reflections of a hexagonal close-packing with intermolecular distance of 152·0 ± 0·5 A. The wet gel gives three distinct lines which seem to correspond to hexagonal close-packing with intermolecular distance of 210 A., but this varies slightly with the composition. The bottom layer liquid gives a pattern of three lines; two sharp lines the position of which depends on concentration, indicating a mean molecular distance ranging from 300 A. to 470 A., and a diffuse line at a spacing of 100 A. which is independent of the concentration and is thus plainly of intramolecular origin. The pattern of the liquid suggests that there exists a quasi-regular Debye-Hückel arrangement of parallel rod-like charged molecules in the solution. The sharp difference between the wet and dry gel can best be explained at the present stage by postulating somewhat triangular molecules that fit together in two ways, containing different amounts of water. The reflection at 100 A. supports this hypothesis. So far it has proved impossible to get any indication of intermolecular reflections in the other directions of the molecule, though any regularity of less than 1,200 A. would have been detected. This suggests strongly that the arrangement is regular only in cross-section and that no molecular sheets are formed.

OBSERVED INTERMOLECULAR SPACINGS IN ANGSTROMS.

h k i l	$10\bar{1}0$	$11\bar{2}0$	$20\bar{2}0$	$12\bar{3}0$	$30\bar{3}0$
Dry gel: obs. calc.	131·8 131·8	75·75 76·00	65·90 65·90	49·75 49·75	43·5 43·9
Wet gel	188	106	93		
Liquid: 23 per cent 13 " "	300 397	175 225			

From the results already gained, it is legitimate to make certain conclusions as to the nature of the protein molecules. First, the molecules seemed to be identical in cross-section. Secondly, each molecule has quasi-regular structure and thus may be considered to be built up of sub-units of approximately the same character. The physical properties of the substance can best be explained by postulating rod-shaped molecules. The minimum cross-section area of these is 20,100 sq. A. for the dry gel. The molecular length is more uncertain. The extreme character of the orientation phenomena and the X-ray data point to a minimum length of not less than ten times the width, or greater than 1,000 A. This gives a minimum molecular weight in reasonable agreement with Svedberg's[4] estimate of 17 × 10^6, though there is nothing to show that the lengths of the molecules are uniform.

These results have a certain intrinsic interest, but this would naturally be greatly enhanced could it be shown that these rods are in fact virus particles. This conclusion seems to us both reasonable and probable, but we feel that it is still not proved, nor is there any evidence that the particles we have observed exist as such in infected sap.

Note added Dec. 3.

Wyckoff and Corey have published[5] an X-ray study of the ammonium sulphate crystals of tobacco mosaic and aucuba protein. Their measurements of the intramolecular spacings obtained with unorientated material agree with ours, notably the lines they record at 11·0, 7·44, 5·44 and 3·7 A. correspond to our measurements of the planes (0006, 9, 12, 18) respectively.

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Nov. 17.

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[1] *Phytopathology*, **26**, 305 (1936).
[2] *Science*, **77**, 26 (1933).
[3] van Iterson, *Proc. Roy. Akad. Wetensch.*, **37**, 367 (1934).
[4] *J. Amer. Chem. Soc.*, **58**, 1863 (1936).
[5] *J. Biol. Chem.*, p. 51, Nov. 1936.

Natural Selection

IN NATURE of November 21, Prof. E. W. MacBride states that "Ordinary fluctuating variations which can be graphically represented on a 'curve of error' are certainly not inherited". He bases this statement on the work of Johannsen on pure lines of beans, and of Agar and Jennings on clones of *Simocephalus* and *Paramecium*. He does not mention the fact that Johannsen[1] found clear evidence that such variations are inherited within a mixed population of beans.

Variations of human stature "can be graphically represented on a 'curve of error' ". So can those of human intelligence as measured by the intelligence quotient. Most geneticists are convinced by the work of Pearson and others that such variations are to a large extent inherited. If, as Prof. MacBride holds, they "are certainly not inherited" there can, of course, be no objections to the breeding of the feeble-minded.

If Prof. MacBride is unconvinced by the work of Pearson and Johannsen, I fear that it is futile to ask him to consider that of Gonsalez[2] and Timoféeff-Ressovsky[3], both of whom have described mutant forms of *Drosophila* which are more viable than the normal type in the environments studied by them. Others, however, may take the work of these authors more seriously.

Prof. MacBride goes on to state that "The common flowering plant *Calceolaria* is a native of Mexico and produces bright yellow flowers. As all are aware, gorgeously coloured varieties of this flower are cultivated". A distinguished botanical colleague informs me that 173 species of the genus *Calceolaria* are listed in the "Index Kewensis", of which the great majority are not found in Mexico. They include species with yellow, white and purple flowers. Most, if not all, of the garden varieties have arisen by hybridization. There is no record of mutation within the genus. Hence the fact that, when garden varieties escaped from cultivation in India, only yellow-flowered forms survived, is entirely irrelevant to the topic of mutation. It may be an example of the universally admitted fact that some species of a large genus are better adapted than others to a given environment.

I should be the first to admit that a strong case may be stated against the evolutionary efficacy of natural selection. But such a case must, if it is to be effective, be based on a full acquaintance with the facts.

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[1] "Elemente der exakten Erblichkeitslehre", p 156 (1913)
[2] *Amer. Nat.*, **57**, 289 (1923)
[3] *Z. indukt. Abstamm. u. Vererb*, **66**, 318 (1934).

IN NATURE for November 21, there appears a letter from Prof. E. W. MacBride in which he attempts to demonstrate that natural selection is not an agent in the evolution of mimetic resemblances. It is perhaps open to question how far statements of personal opinion on evolutionary mechanisms are worth making or answering, unless they are sufficiently detailed to include an analysis of the evidence and reasoning upon which they are based. However, Prof. MacBride's letter contains certain definite errors and misconceptions relating to genetics, and these require correction lest they should gain credence among readers not versed in that subject.

In the first place, it is not correct to state that "Ordinary fluctuating variations which can be graphically represented on a 'curve of error' are certainly not inherited". Even on the most superficial consideration, probably few would agree that the offspring of short or of tall parents may expect to attain the same average stature: and human height in a reasonably homogeneous population is an excellent example of variation falling within a normal curve of error. The fallacy of such a contention can, however, be demonstrated conclusively, for a positive correlation is found to exist between the heights of parents and offspring. Furthermore, the substantial equality of the correlation between the heights of the progeny and of their male and female parents respectively, demonstrates that the inheritance here involved is bi-parental. Finally, the important fact that the F_2 is more variable than the F_1 generation in such a cross shows that we are dealing with particulate, that is Mendelian, inheritance; not with a blending system. The human species cannot, of course, be used to establish this latter point. Reference may, however, be made to much work on such characters in other forms, as that of Castle (1922)[1] on weight, or ear-length, in rabbits.

It is remarkable that Prof. MacBride supports his contention, that "fluctuating variations" are not inherited, by reference to a series of experiments which prove the contrary with particular clearness. This is the work of Johannsen on "pure lines" in beans. Two components may, of course, control the variation of an organism: the hereditary material and the environment. That due to the former is said to be genotypic; that due to the latter, phenotypic. By interbreeding for a number of generations, a "pure line" can be established, in which genotypic variation is practically eliminated. Selection for any characters within such a line is therefore unavailing, since almost all the variation is environmental. It is to this fact, presumably, that Prof. MacBride refers. He has, however, failed to inform his readers that Johannsen was able to establish *a number of distinct pure lines having different average seed weights* (the character which he investigated): thus clearly establishing that the fluctuating variation concerned is under hereditary as well as environmental control in the species which he studied.

Several other points in Prof. MacBride's letter require comment. We now distinguish between the terms 'sports' and 'mutations'. A mutation is the inception of an heritable variation. A sport is any deviation from the normal. This may be due to mutation, or to other causes such as a rare recombination of factors. An overwhelming majority of mutations are disadvantageous: but this does not bar the very types which we study in genetic experiments from representing the kind of changes used in evolutionary progress. Indeed it is precisely what we should expect on this view. Even the more lowly organisms must in reality be rather delicately adjusted. Any random change in their control will consequently very rarely result in harmonious working. Occasionally, however, we may expect it to do so, and this is what we find: as the chromosome doubling which gives fertility to a sterile hybrid (Haldane, 1932)[2], or the single dominant in the moth *Gonodontis bidentata* Cl., which produces a melanic form hardier, and capable of emerging at a lower temperature, than the typical insect (Bowater, 1914)[3].

Mutations may be induced by heat and X-rays, from which Prof. MacBride deduces that they are degenerative changes produced by agents of destructive nature. He does not, however, mention that reverse mutations back to, or towards, the normal are also produced *by these means* (Timoféeff-Ressovsky, 1934)[4]: the agencies which inflict the wound in some instances, heal it in others! Actually, such observations show us that mutations, normally occurring in many directions, are merely increased in frequency by heat and X-rays.

We may well suppose that, in the vast majority of instances, the type best fitted to natural conditions is that occurring in Nature. Furthermore, it is a commonplace of genetics that if domesticated strains are allowed to cross, the normal allelomorphs, separated by artificial selection, may be brought together, reproducing the wild-type condition. Simple Mendelian control of flower colour in *Calceolaria*, and natural selection favouring the wild-type, are all that is needed to explain the interesting instance of "reversion" quoted by Prof. MacBride.

E. B. FORD.

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[1] W. E. Castle, Carnegie Inst. Wash., Publ. No. **320** (1922).
[2] J. B. S. Haldane, "The Causes of Evolution" (London, 1932).
[3] W. Bowater, *J. Gen.*, **3**, 299–315 (1914).
[4] N. W. Timoféeff-Ressovsky, *Biol. Rev.*, **9**, 411–457 (1934).

Evidence for Linear Units within Protoplasm

IN his contribution to the "First Report on Viscosity and Plasticity", H. J. Jordan[1] has quoted only the measurements by W. Seifriz on protoplasm in 1924. But L. V. Heilbrunn does not find any conclusive evidence for elastic behaviour, apart from those cases where definite fibrillar elements can be observed in the protoplasm. In some recent papers, I have demonstrated the anomalous flow of protoplasm[2] and determined certain values interpreted as moduli of dilatability, transversal contraction and gliding[3]. Both the anomalous behaviour of protoplasm under varied shearing stresses and its elasticity are dependent on a structural organization of protoplasm not with respect to its grosser parts such as the nucleus, but in regard to the actual chemical molecules of which it consists[4]. So the next task was to find any substantial evidence for fibrillar or linear units within the protoplasm submitted to a stress along a definite axis.

My deformation apparatus[5] consists of a capillary, a water manometer, and a tube with an india-rubber aspirator bulb, the three being united by a *Y*-tube. The protoplasm is sucked up into the capillary. At right angles to the axis of the capillary, a beam of parallel, plane polarized light passes with its optic axis at a given radius through the flowing protoplasm. After crossing the space below the objective, the light passes through the microscope and the analysing nicol. As the light is rendered telecentric by two diaphragms, only beams which run parallel, or almost parallel, to the axis of the microscope can enter the ocular.

In the former experiments, I have used the naked cells obtained from the liquefying pericarps of berries, or other plant cells obtained by means of experimental denudation. With the behaviour of these I have compared cells present in saliva (resembling leucocytes) obtained from the human mouth. Now I have likewise accumulated data using living eggs of freshwater molluscs, such as *Unio* and *Anodonta*, which are useful on account of their frequency and large size. After being isolated from the branchiæ of adult animals, the eggs were immersed in the ovary liquid.

The phenomenon observed between crossed nicols agrees with the assumed structure of protoplasm. If we permit the protoplasm to flow through the capillary, a system of many-coloured interference veins appears parallel to the capillary direction. With increasing speed of flow the interference lines disappear. Near the capillary axis, the flowing speed is greater than near the wall, so the coloured strips here are unrecognizable. The interference veins disappear after the eggs are placed in distinct buffer solutions of increasing hydrogen ion concentrations. In interpreting the results of experiments with eggs of different *p*H, it must be remembered that cells often act much like amphoteric colloids having an iso-electric point[6].

Summing up the results, we cannot be sure that the results obtained are quantitative. To anyone who has surveyed the whole field, however, there can be no question but that in all types of protoplasm hitherto used, fibrils or linear units are really present, although only visible if the protoplasm is flowing through a capillary.

A detailed description of the experiments will be given in a paper being published next year[7].

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Nov. 12.

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[1] H. J. Jordan, First Report on Viscosity and Plasticity, p. 214, 221 (Amsterdam: Noord-Hollandsche Uitg.-Maatsch., 1935).
[2] H. H. Pfeiffer, *Physics*, **7**, 302 (1936).
[3] Pfeiffer, *Cytologia*, **6**, 329 (1935). *Protoplasma*, **26**, 372 (1936).
[4] W. Seifriz, Protoplasm, 246, 261. (New York and London: McGraw-Hill, 1936.)
[5] H. Pfeiffer, *Protoplasma*, **23**, 210 (1935).
[6] H. Pfeiffer, *Trans. Faraday Soc.*, **29**, 822, 833 (1930).
[7] H. Pfeiffer, *Festschr. K. Fujii*, in the press (Tokyo, 1937)

Mechanism of Chemical Reaction in the Electric Discharge

IN view of the apparent renewal of interest in chemical reactions taking place under the influence of the electric discharge, I venture to put forward the following suggestions, which have not so far been published although frequently expressed at colloquia.

The close proportionality often found, for example, by Dr. Keith Brewer and his collaborators[1] between rate of reaction and current flowing in the outer circuit, has led to theories that positive ions are themselves the reacting bodies, clusters being formed, especially where more than one molecule of reaction product is obtained for each positive ion. Now although mobility data leave no doubt that surrounding molecules can exert a retarding effect upon an ion, to produce an effect which may formally be expressed in terms of ion-clusters, there is complete lack of both spectroscopic and positive ray evidence as to the existence of the reasonably stable aggregates which the theory necessitates. Moreover, it is not likely that the chemical properties of $N_2{}^+$, for example, will be the same as those of N_2, while a process such as:

$$N_2{}^+ + O_2 \xrightarrow[e]{} 2NO + 325 \text{ Cal.}$$

is so highly exothermic as to be incapable of giving the large yields, referred to ion-concentration, which have been reported. This same argument holds for many other reactions, since the ionization potentials concerned are generally of the order of 15 v.

If, however, we are prepared to regard the ions as forerunners of the true reactive species, with further reservations as to the accuracy of measurement of ion-concentration, the above-mentioned proportionality may be explained, as well as the onset of reaction, when controlled electrons are used, at the lowest ionization potential[2]. Once ions have been formed, a variety of processes may occur which cannot be observed while the current is purely electronic. Such processes are:

(*a*) ready dissociation, for example, of N_2^+ and H_2^+, to give the reactive atoms[3];

(*b*) genesis of excited states which may also be reactive or give rise to reactive bodies;

(*c*) formation of fast neutral bodies by the electron interchange reaction

$$A^+ + B \rightarrow B^+ + A,$$

where A^+ and B^+ are the primary and secondary ions[4];

(*d*) production of similar high-speed species by the escape of an ion, after undergoing cathodic neutralization, with a considerable fraction of the kinetic energy which is acquired, while moving in the charged condition, under the influence of the applied fields[5];

(*e*) kinetic activation of molecule by ion, as a knock-on effect[6].

To indicate only some of the apparent advantages of this theory, processes (*c*), (*d*) and (*e*) can account for the influence of cathode material occasionally observed[7], as well as the production of several molecules of reactant for each ion present[1].

In another communication, shortly to be published elsewhere, these views will be further developed and shown to provide a ready explanation for the electrical synthesis of nitric oxide, treated, as is suggested, as an essentially thermal process.

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of the Royal Institution, London.
Nov. 12.

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[1] Willey, summary at Faraday Society's conference upon Free Radicals, 1933

[2] Carcss and Rideal, *Proc. Roy Soc*, A, **115**, 684 (1927); Wansbrough-Jones, *ibid.*, A, **127**, 511 (1930)

[3] Smyth, *Rev. Mod. Phys*, **3**, 347 (1931).

[4] Kallman and London, *Z. phys Chem*, **28**, 207 (1929)

[5] Compton, *Phys. Rev*, **36**, 706 (1930), Oliphant and Moon, *Proc Roy Soc*, A, **127**, 373 (1930).

[6] Kennard, *Phys Rev*, **31**, 428 (1928)

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Continuous Absorption Band of Rubidium in the Presence of Foreign Gases

A NEW absorption band has been observed, with a Hilger E_1 glass spectrograph, on the shorter wavelength side of the second member of the rubidium principal series, in the presence of neon, helium, hydrogen or nitrogen. The position of the band depends on the nature of the foreign gas admitted into the absorption tube, which was kept at around 250° C. A pressure of a few centimetres of mercury of the foreign gas was sufficient to make the band appear distinctly. Fig. 1 is a sample spectrum taken when neon gas was present in the absorption tube of rubidium vapour, and Fig. 2 the corresponding microphotometer curve.

The bands due to other foreign gases are more diffused than that due to neon. All of them are partially superposed with the broadened line $5S$–$6P_{3/2}$. The wave-lengths of the maxima of these bands and their widths are given below:

Foreign gas	λ	Width
Ne	4194·5 A.	16 A.
N_2	4183·0	24
He	4182·5	35
H_2	4178·7	38

These bands have certainly nothing to do with those due to polarization molecules of rubidium observed by one of us[1], for the latter do not appear below 300° C. In fact, when the absorption tube was heated to 350° C. without addition of any foreign gas, we observed a band at 4188 A. This band was also observed without change of position, together with the new absorption band due to neon, when the latter was present as the foreign gas with a partial pressure nearly equal to that of the rubidium vapour.

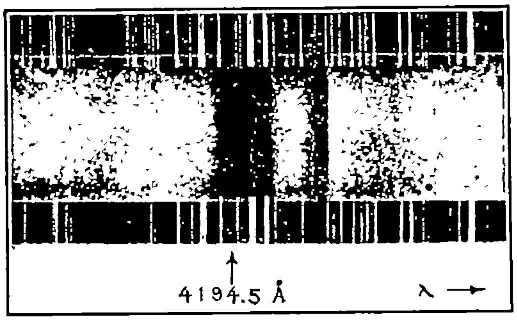

FIG 1.

The narrow continuous band of potassium in the extreme red recently observed by T. Okuda[2] is probably of similar nature. The presence of hydrogen would be necessary for its appearance.

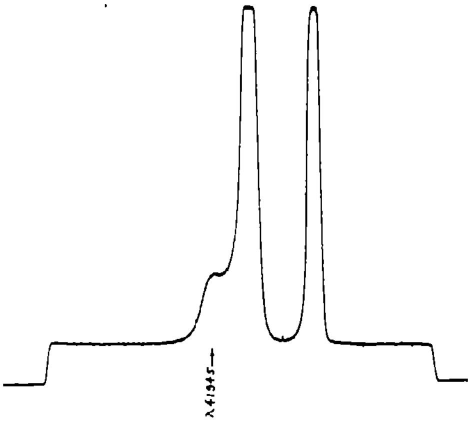

FIG 2.

The existence of these diffuse bands may be explained as due to the inverse process of what has been observed by O. Oldenberg[3] in the fluorescence of mercury vapour with addition of rare gases, the absorption being produced by a rubidium atom at the moment of a collision with a foreign gas atom.

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CH'EN SHANG-YI.

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Peiping. Oct. 23.

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[1] Ny Tsi-Zé et Choong Shin-Piaw, *J Phys. et le Rad.*, **6**, 203 (1935).

[2] T Okuda, NATURE, **138**, 168 (1936).

[3] O. Oldenberg, *Z Phys*, **47**, 184 (1928); **51**, 605 (1928); **55**, 1 (1929).

Peking Man

REFERRING to the notes published in *The Times* on November 20 and 28, concerning the recent discovery of two skulls of *Sinanthropus*, I am writing to confirm the fact that the information contained in these notes is correct. (*The Times* has since published, on December 8, an article announcing the discovery of still another skull. The information contained in this later article is now confirmed by letters of Dr. Young and Mr. Chia just received; but I am awaiting further information for details of this fifth skull.)

Since the untimely death, in 1934, of my friend Dr. Davidson Black, the honorary directorship of our Cenozoic laboratory and the investigations of anthropological materials obtained by the laboratory have been carried on by Prof. F. Weidenreich, whose replacement of Dr. Black was recommended by Sir G. Elliot Smith.

In 1935, Dr. W. H. Wong, director of the National Geological Survey of China, of which our laboratory is one department, sent me to Europe expressly to study the Quaternary geology, human palæontology, and Palæolithic industry in Europe, under the personal direction of Prof. H. Breuil. The work in excavation at Choukoutien is carried on by Mr. L. P. Chia, who was appointed by the director of the Geological Survey of China as field director, as successor in my former post. This young Chinese scientist, Mr. Chia, is carrying on his research with patient skill, as a result of which he was rewarded on October 22 by the discovery of a lower left jaw with five teeth well preserved.

On November 16, to the surprise of scientific circles, Mr. Chia discovered two more skulls of *Sinanthropus* in addition to the two skulls which I found on the same site years ago. This site is turning out to be really a treasure house for human science. It is much to be hoped that Prof. F. Weidenreich will be given the three year grant for which he has applied to the Rockefeller Foundation in order to carry on such vital scientific research.

Concerning these two latest skulls, a letter from Père Teilhard de Chardin says, "Two crushed, but largely preserved *Sinanthropus* skulls have been found, some three metres above the Lower Cave and only a short distance from the front of your own excavation, North Wall. The skulls, without any limb bones, were close to each other, and have no lower jaws. The bases of the skulls are missing, as usual. There are one adult male and one adult female. The male specimen will be soon reconstructed, and is more complete than the skull No. 1 all around the calvarium, with even a part of the molar bone preserved. It is difficult so far to appreciate how complete the female skull will turn out to be, but it has at least several parts well preserved: the mastoid area (perfect), a part of the upper maxillary (above the molars), etc. The characteristics are typical, as in skull No. 1, but accentuated. The skulls were found in a place practically barren of bones and implements in a matrix sandy and brecciated in places." A later letter from Mr. Chia adds that the skulls, although badly crushed, will be easily reconstructed, since the fragments were found close together and the breakages are very sharp.

I would like to express my sincere appreciation for the sympathetic co-operation of English scientists, and my gratitude to the Rockefeller Foundation, which has, since the beginning, granted us all the financial support necessary for carrying on our research. In addition to the excellent leadership of Dr. W. H. Wong, director of the National Geological Survey, and Dr. C. C. Young, director of the Peking office of the Survey, we owe much to the co-operation of foreign scientists: Prof. Weidenreich, an excellent and experienced German anthropologist, by whose intensive studies our knowledge of early man in China is being extended and brought to the notice of scientific workers everywhere; and Père Teilhard, the well-known French geologist, whose wide experience has enabled us to carry on work in keeping with recent progress in geological science.

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Effects of Chemical Combination with Oxygen and Fluorine on the $K\alpha_{1,2}$-Doublet of some of the Lighter Elements

IT is well known that the $K\alpha_{1,2}$-doublet from the elements 12 (Mg) to 17 (Cl) is influenced by chemical binding, apparent, for example, through its displacement towards shorter wave-lengths. Earlier measurements I have made[1] with the elements 12 (Mg), 13 (Al) and 14 (Si), which were carried out with special regard to the effects from oxygen and fluorine on the $K\alpha_{1,2}$-doublet, have recently been extended by measurements with sodium. No conclusive evidence of any displacement in either direction could be found. These and previous results are summarized in the accompanying table; the measurements on the oxygen compounds of phosphorus, sulphur and chlorine were made by Lundquist[2].

Atomic number	Emitting atom	Maximum valency (p)	Displacement δV (volts)			
			oxygen binding		fluorine binding	
			obs	calc.	obs.	calc.
10	Ne	0	—	0	—	0
11	Na	1	0·01	0·03	0·03	0·06
12	Mg	2	0·14	0·13	0·20	0·22
13	Al	3	0·31	0·30	0·52	0·50
14	Si	4	0·56	0·53	0·92	0·90
15	P	5	0·81	0·82		
16	S	6	1·18	1·19		
17	Cl	7	(1·62)	1·62		

Calling δV the displacement in volts towards shorter wave-lengths and p the maximum valency of the emitting atom, the following equations are found:

Oxygen binding: $\delta V_O = 0{\cdot}033\,p^2$

Fluorine binding: $\delta V_F = 0{\cdot}056\,p^2$; $\delta V_F/\delta V_O = 1{\cdot}68$.

The values of δV calculated from the above equations are given in the fifth and seventh columns of the table, the observed values in the fourth and sixth columns. The discrepancies are well within the experimental errors. The value given for chlorine within brackets refers to the displacement chloride – perchlorate. Provided the equation holds good also for an extrapolation, one would infer from the result that the displacement chlorine – chloride must be very small indeed.

With elements belonging to the second horizontal line in the periodic system the disturbing atom, oxygen or fluorine, is seen to produce a displacement of the $K\alpha_{1,2}$-line which appears to increase as the square of the maximum valency. Considering the highly complicated interaction between the ions or atoms entering into a chemical compound, the simple nature of the relationship just stated is remarkable. Since the above equations were found empirically from measurements, they must be assumed to represent only a first approximation to the exact relationship.

N. G. JOHNSON.

Physical Institute,
University,
Lund.
Nov. 4.

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[1] *Z. Phys*, **102**, 428 (1936).
[2] *Z. Phys*, **102**, 768 (1936).

Mechanism of Carbohydrate Oxidation

SOME new facts have been found suggesting that the first stage in the biological oxidation of carbohydrate is its conversion to glucose-6-phosphoric acid (or Robison ester), which is oxidized[1] to 6-phosphogluconic acid. Dehydrogenation by a specific dehydrogenase co-enzyme system yields 6-phosphoketogluconic acid, probably the 2-keto acid, which is then decarboxylated. In animal tissues, where there is evidence[2] that decarboxylation is oxidative, phospho-arabonic acid would result. Yeast carboxylase, which converts keto-acids to aldehydes, would yield arabinose phosphate, as recently suggested by Lipmann[3]. Further oxidation to the 3-carbon systems would then consist in a repetition of these reactions.

Respiration of brain slices (guinea pig, rat) is supported by addition of glucose and, to a lesser extent, of glucose monophosphate, but not by 6-phosphogluconic acid, gluconic acid or 2-ketogluconic acid. After destruction of the cells by grinding with sand, oxidation of glucose is no longer appreciable, but that of glucose-monophosphate, 6-phospho-gluconic acid, gluconic acid and 2-ketogluconic acid is clearly evident. These facts are explicable as follows: (1) the entry of glucose into the cell is accompanied by its phosphorylation; (2) in all the above substances, phosphorylation is the physiological mechanism of their activation; (3) primary oxidation products of carbohydrate are unable to penetrate the cell, whether phosphorylated or not.

Evidence that in yeast gluconic acid is attacked only when phosphorylated is provided by a study of the specific phosphohexonic dehydrogenase. The existence of this enzyme in Lebedew fluid, indicated by the work of Lipmann[3], is proved by its isolation from this source by precipitation with acetate buffer at *p*H 4·6. The washed enzyme may be kept in the dry state. It is active only after addition of both Warburg oxidation co-enzyme (0·04 mgm.) and yellow enzyme, when the oxygen uptake with 6-phosphogluconic acid at 37·5° is theoretical for dehydrogenation to ketogluconic acid. A ketone fixative (0·1 *N* hydrogen cyanide) is necessary, otherwise the reaction ceases after 30 minutes, as with animal lactic dehydrogenase[4]. Co-zymase, active in the lactic system, is inert; gluconic acid is not attacked whichever co-enzyme is used. Purified Warburg *Zwischenferment* contains little of this enzyme, which it closely resembles. Addition of carboxylase[5] causes further oxidation and evolution of carbon dioxide equal to the oxygen uptake. Since this work was completed, a preliminary note by Warburg and Christian[6] has appeared, in which they obtain further degradation of phosphohexonic acid by an apparently different enzyme preparation, hence the publication of this work in its present form.

Both dehydrogenase systems are insensitive to cyanide. In the ground-up brain $M/500$ hydrogen cyanide inhibits reversibly 80 per cent of the oxygen uptake with hexose monophosphate or phosphohexonic acid as substrate. It is concluded that, in biological oxidation of carbohydrate by this system, indophenol oxidase and cytochrome participate. Theorell[7] has shown that H-transport via yellow enzyme – cytochrome can occur. The above experiments suggest that this may be the actual mechanism of carbohydrate oxidation *in vivo*. As yet our attempts[8] to reconstruct the system from heart indophenol oxidase, cytochrome *c*, and the above enzymes, have resulted only in an inhibition of oxidation; other links, possibly cytochromes *a* and *b*, may also be necessary. These experiments are being continued.

I am greatly indebted to Prof. O Warburg for generous gifts of his enzyme and co-enzyme preparations.

F. DICKENS.

Cancer Research Laboratory,
North of England Council,
British Empire Cancer Campaign,
Royal Victoria Infirmary,
Newcastle-upon-Tyne.
Nov. 26.

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[1] Warburg, Christian and Griese, *Biochem. Z.*, **282**, 157 (1935).
[2] Weil-Malherbe, NATURE, **138**, 551 (1936); *Chem and Ind.*, **55**, 838 (1936).
[3] Lipmann, NATURE, **138**, 588 (1936).
[4] Green and Brosteaux, *Biochem. J.*, **30**, 1489 (1936).
[5] Axmacher and Bergstermann, *Biochem. Z.*, **272**. 259 (1934).
[6] Warburg and Christian, *Biochem Z*, **287**, 440 (1936).
[7] Theorell, NATURE, **138**, 687 (1936).
[8] Dickens and Weil-Malherbe (unpublished).

Chemical Nature of Citrin

IN a previous note (Rusznyák *et al.*) one of us reported on the isolation and physiological activity (vitamin nature) of the crystalline flavone fraction of lemon juice. The substance, being different from other known flavones, was termed 'citrin'.

Further work has shown citrin to consist of mixed crystals of two different dyes, one being hesperidine (m.p. 261°), the other an eriodictyol glucoside. Hesperidine forms the major part of citrin. The great reactivity and the colour reactions of citrin are due to the eriodictyol glucoside. Citrin contains no free eriodictyol. This substance can be isolated only after complete hydrolysis.

According to its formula, eriodictyol is but a demethylated hesperetine This makes it probable that both glucosides constituting citrin are but two forms of the same flavanone glucoside. Eriodictyol glucoside was not found in any considerable quantity in unripe oranges, which, however, contain great quantities of hesperidine. This makes it probable that the eriodictyol glucoside is formed from hesperidine by demethylation on ripening of the fruit.

This research is being sponsored by the Josiah Macy Jr. Foundation, New York.

V. BRUCKNER.
A. SZENT-GYÖRGYI.

Inst. Org. and Med. Chem.,
Szeged.
Nov. 21.

Spiral Structure of Chromosomes in *Osmunda*

THE accompanying photographs (Fig. 1) show the kind of results which are being obtained by application of Sax's method[1] for spiral structure to the meiotic chromosomes of the Royal Fern (*Osmunda regalis*). Both photographs represent gemini at the metaphase of the first division of the spore mother cells; Fig. 1(*a*) is a photomicrograph of a pair of chromosomes united by a single sub-terminal chiasma, Fig. 1(*b*) is a photomicrograph of a pair joined by two chiasmata, one at each end. Both show major spirals of about five coils per chromosome, the two chromatids in each chromosome being in close contact, except at the chiasmata, and occupying the same spiral path.

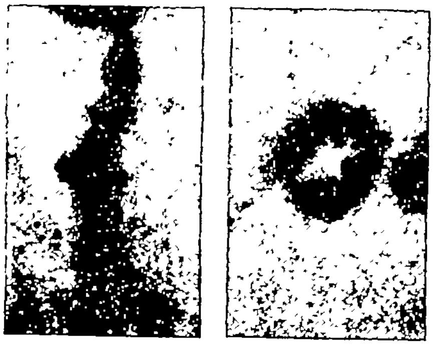
a *b*

FIG. 1. Photomicrographs of single gemini at the first meiotic metaphase in *O. regalis*, from smears stained in gentian violet. ×4000.

Spiral structure promises to become a cytological phenomenon of very considerable theoretical importance, for it may be a clue to a structural explanation of salient features of chromosome behaviour. For this reason it is particularly desirable that the initial facts should be established beyond dispute, and one of the most essential of these is to ascertain the universality or otherwise of the phenomenon. With few exceptions, the published figures refer to monocotyledonous plants belonging to a relatively small number of families, namely, Liliaceæ in *Lilium*[2,3], *Fritillaria*[4], *Trillium*[5,6], *Tulipa*[7], etc.; Comellinaceæ in *Tradescantia*[8,9], *Rhœo*[1], *Zebrina*[10]; Alismaceæ in *Sagittaria*[11]. Among dicotyledons, details are available for *Lathyrus*[12] and *Vicia*[1] with unfigured verbal reference to a few other genera. Similar verbal reference without figures has been made for one gymnosperm, namely, *Cryptomeria japonica*[10]. A significant widening of the field is thus effected by the addition of *Osmunda* to the list, a plant classed as a relatively primitive vascular cryptogam and with a fossil record extending back to the Carboniferous period.

Fuller details for the Osmundaceæ will be given elsewhere.

Botany Department, I. MANTON.
University of Manchester.
Nov. 21.

[1] Sax, *J. Arnold Arboretum* (1935)

[2] Kato and Iwata, *Mem. Coll. Sci*, B, Kyoto Imp. Univ. (1935)

[3] Iwata, *ibid.* (1935)

[4] Darlington, *Proc. Roy. Soc.*, B, (1935).

[5] Huskins and Smith, *Ann Bot.*, (1935).

[6] Matsuura, *Cytologia*, etc. (1935).

[7] Upcott, NATURE, **135**, 957 (1935).

[8] Fujii, Report Jap Assoc Advan. Sci., (1926) Kuwada and Sugimoto, *Bot. Mag*, Tokyo (1926) Kuwada, *Bot. Mag*, Tokyo (1926 and later) Sakamura, *Bot Mag.*, Tokyo (1927), etc.

[9] Nebel, *Z. Zellforsch.*, (1932), and others.

[10] Shinke, *Mem. Coll Sci Kyoto Imp Univ.*, B (1930).

[11] *ibid*, (1934).

[12] Maeda, *Bot. Mag.*, Tokyo (1928)

Feeding Habits of Stick Insects

THE observations[1] from the Notre Dame Training College, Glasgow, on the eating of dead cellulose by *Carausius*, are very interesting in view of our experience at Strand School, where we have kept stick insects for upwards of twenty-five years, incidentally, without having detected a male.

Ours are fed on green privet, but on occasion, we have tried them with the golden variety, and, while some would eat it quite readily, others refused to touch it, though we never found any difficulty in starting them on it straight from the egg.

We have records of the insects devouring their sloughs, and on one occasion I saw one eating the front legs and antennæ of another insect which had assumed the akinetic condition in which, as is well known, they lose all sense of feeling. This seems worth recording, as it illustrates how a new habit might be formed through the miscarriage, as it were, of a protective device.

SIDNEY T. E. DARK.

Strand School,
London, S.W.2.
Nov. 21.

[1] Carmela Hayes, NATURE, **138**, 886 (1936).

Genetics in the Universities

THE essence of a satisfactory course in cytology and genetics is that it should be treated as a branch of biology, rather than as something taken from botany added to something taken from zoology. In a word, the course should be given by a cytologist and geneticist. A composite course shared between a botanist and a zoologist, however sympathetic their co-operation, would be likely to reveal incomplete fusion and to result in overlapping, although admittedly it would be vastly preferable to the two separate and entirely uncorrelated courses often given at present.

The subject matter of cytology and genetics is sufficiently homogeneous yet distinct from other branches of biology (and of sufficient importance) to warrant treatment by a specialist. In a university like that of London, in which I happen to be specially interested, it is unreasonable to expect that every constituent college should possess such a specialist on its botanical or zoological staff, and the obvious solution would appear to be for the University to organize courses dealing with aspects of cytology and genetics from among its teachers as a whole, rather than to leave it to each individual college to provide such courses.

The University of London is in process of acquiring a new central building and now would seem to be an appropriate moment to consider whether the centralization of courses on special aspects of biology should not be attempted, not only on behalf of overworked teachers who are compelled to cope with aspects of their subject on which they cannot speak with authority, but also for the sake of degree students who waste more time in hearing the same subject-matter reduplicated in different courses of college lectures than they would do in attending a coherent course at a common centre.

W. NEILSON JONES.

Bedford College for Women,
University of London.

Aptitudes of the Bantu

THE aptitude of the Bantu when brought into contact with new ideas is sometimes almost startling. One cannot foresee whether he is likely to display remarkable aptitude or stark incapacity. A question, for example, that psychologists might investigate is why the average African native can quickly learn to handle a complicated agricultural tractor or compressed air drill, while the most sophisticated of them seem quite incapable of running a small country store (or general shop) on their own account.

Ten quite ordinary natives in Salisbury, Southern Rhodesia, were induced, as an experiment, to attend classes in Red Cross work and recently sat for their examinations, as first-year candidates. There were five subjects: (1) hæmorrhage control; (2) slings or dressings; (3) fractures; (4) drowning or asphyxia; and (5) transport.

For (1) hæmorrhage control, one got full marks and the average was 76 per cent. For (2) slings and dressings, every candidate's average was 80 per cent. For (3) fractures, two got full marks and the average was 80 per cent. For (4) drowning, and asphyxia, two got full marks and the average was 83 per cent. For (5) transport, six got full marks, three 90 per cent and one 80 per cent.

For the whole examination the best man scored 94 per cent and the lowest 80 per cent.

Judged by any standards, this is a remarkably fine performance and, by the way, also reflects great credit on the Rhodesian Red Cross authorities.

F. M. C. STOKES.

41 Talbot Road,
Highgate, N.6.
Nov. 23.

Some New Phenomena produced by Sound Vibrations

Acoustic jets and liquid diaphragms.

USING as a source of sound the singing tube recently shown by me to the Physical Society[1], I have obtained some effects at the interface between a shallow layer of liquid and the gas above it, which do not appear to have been previously described[2].

A glass tube, two or more feet in length, about one inch in diameter, and open at both ends, is slightly curved in a vertical plane so that it may hold a shallow layer of water, oil, or other liquid. When one end of this tube is brought sufficiently close to an open end of the singing tube, one or more liquid diaphragms may suddenly be formed right across the tube. The positions and behaviour of these liquid diaphragms vary with their thickness. Diaphragms five or more millimetres thick are covered with a ripple pattern and appear to be still. Thinner diaphragms erupt a stream of liquid or droplets from both surfaces, while still thinner diaphragms disintegrate in an explosive manner soon after their formation. The formation and breakdown of the liquid diaphragms is often accompanied by 'tides' in the liquid simulating the seiches observed on lakes. The addition of powdered mica to the liquid permits the formation of a semi-permanent membrane across the tube which persists after the sound is cut off

A sonic amplifier and pendulum maintained by sound vibrations.

A short length of glass tubing, closed at one end by a stretched thin rubber diaphragm, when slipped over the end of a sounding Knipp's tube[3], re-enforces its note for a relatively wide range of positions. A position can be found in which a slight touch on the diaphragm stops the sound. If the bob of a bifilar pendulum be allowed to impinge on the diaphragm when it is in this sensitive position, the vibrations of the pendulum may be maintained and the noise of the impacts exalted to the tappings of a drum.

A frequency demultiplication factor exceeding one hundred may easily be obtained with the system.

F. L. HOPWOOD.

Medical College,
St. Bartholomew's Hospital, E.C.1.
Dec. 8.

[1] Meeting of Phys. Soc., Oct. 23, 1936.

[2] Robinson and Stephens, *Phil. Mag.*, Ser 7, 17, 27, have studied the effects of sound waves on soap films.

[3] C. T. Knipp, *Phys. Rev.*, Dec 1918.

Adjustable Resonators and Orchestration

THE description of the Hammond organ by Sir James Barrett in NATURE of August 15 (p. 297) prompts the physiologist to ask why orchestration does not yet employ the method of the adjustable resonator so important in human speech and song. A very slight alteration in the calibre of the supralaryngeal passages will make a profound difference in the quality of the voice, as every singer knows. In a few instruments of minor importance there can be found a series of resonators, but these are incapable of change. A good violin player can, by alteration of pressure and of bowing, make some adjustments in the resonance, but the range of such is small compared with the human voice.

One can picture the orchestra of the future placed on a huge resonator with electrically worked pistons, bulkheads and dampers. The conductor, it is true, would have one more score to direct with eye and baton. When on this topic, may I ask if experiments have been made to construct acoustic membranes for reception or emission on the principle of the mammalian ear-drum?

W. A. OSBORNE.

University of Melbourne.
Oct. 12.

Directions of Homogeneous Auroral Arcs

THE Oxford University Arctic Expedition 1935–36 wintered in North-east Land at 80° 23′ N., 19° 31′ E., where single photographs of the homogeneous auroral arcs were taken in order to determine their direction. The photographs were reduced by the method used by Wesoe[1] and Stormer[2]. Persistent cloudiness prevented many photographs being made, but the average of fourteen measurements was 73° E. of N. for the region 80° N. to 76° N., 15° E. to 40° E. The individual determinations were 84°, 78°, 65°, 68°, 91°, 65°, 66°, 70°, 73°, 67°, 70°, 95°, 85°, 48° E. of N.

I wish to express my thanks to Dr. Harang, who reduced the photographs at the Auroral Observatory, Tromsö, and gave us much assistance.

R. A. HAMILTON.

Merton College,
Oxford.
Nov. 27.

[1] The Norwegian North Polar Expedition with the *Maud*, 1918–1925. Scientific Results, 1, No. 6 (Bergen, 1928).

[2] *Geof Publ*, **4**, No. 7 (Oslo, 1926).

Nitrogen Fixation with Cow-Dung

WHEN freshly collected cow-dung (containing 0·368 per cent nitrogen and 7·5 per cent carbon) is mixed with soil and exposed to sunlight daily for six hours in dishes, nitrogen fixation is observed. Thus the nitrogen content of a mixture containing 500 gm. soil and 100 gm. cow-dung rose from 0·0905 per cent on July 27 to 0·14 per cent on November 4, 1936.

In field trials, when 25 tons of cow-dung were added per acre, the total nitrogen was increased from 0·052 per cent to 0·061 per cent in a month. When the same amount of cow-dung and 25 tons of molasses were added per acre in fields, the total nitrogen was increased from 0·053 per cent to 0·07 per cent in the same time. Hence cow-dung, which is used as a manure for its content of nitrogen, potash and phosphate, has been found to supply to the soil not only the nitrogen it contains, but also it can add nitrogen to the soil from the nitrogen of the air by fixation. The cellulose and pentosans present in the cow-dung undergo oxidation on the soil surface and liberate the energy necessary for nitrogen fixation.

N. R. DHAR.
S. K. MUKERJI.

University,
Allahabad.
Nov. 9.

Points from Foregoing Letters

BY further purification of the crystalline protein preparation having the property of producing the mosaic virus disease in tobacco plants, F. C. Bawden, N. W. Pirie, J. D. Bernal and I. Fankuchen have obtained solutions which (in concentrations greater than 2 per cent) separate into a lower liquid crystalline layer and an upper layer showing optical anisotropy when flowing. The liquids form gels on drying. X-ray investigations show a common pattern corresponding to a 'repeat unit' of 3 × 22·2 A. in the crystal, liquid and gel stage; other features of the X-ray pattern indicate hexagonal close-packing in the gel stage and parallel, charged, rod-like molecules in solution. The authors estimate their length to be greater than 1000 A. and their width about one tenth of that length. This corresponds with a molecular weight agreeing with Svedberg's estimate of 17×10^6. It is not yet conclusively proved, however, that these are actually the 'virus' particles.

Prof. J. B. S. Haldane and also E. B. Ford criticize several of the statements made by Prof. E. W. MacBride when discussing the mechanism of natural selection. Both authors give examples of inheritable variations which can be graphically represented on a 'curve of error', and they claim that the return of the garden variety of *Calceolaria* to the wild type is irrelevant to the topic of mutation.

When protoplasm (for example, cells from human saliva, eggs of freshwater molluscs, liquefying pericarp of berries) flowing through a capillary is observed between crossed nicols, a system of many coloured rings appears parallel to the capillary direction. This, Dr. H. H. Pfeiffer states, is in accordance with the hypothesis of a fibrillar structure of protoplasm.

To explain the close proportionality between the flow of current and the rate of chemical reaction in certain cases of electric discharge, for example, in the formation of NO from nitrogen and oxygen, it has been suggested that positive ions are the reacting bodies. Dr. E. J. B. Willey states that the hypothesis that the positive ions are forerunners of the 'reactive species' explains a larger number of observed facts.

A continuous absorption band observed in rubidium vapour in presence of certain gases (neon, helium, hydrogen or nitrogen) is described by Ny Tsi-Zé and Ch'en Shang-Yi. The position of the band varies with the gas. The authors suggest that the absorption is produced by a rubidium atom at the moment of collision with a foreign gas atom.

Dr. W. C. Pei, who was until recently in charge of the excavations at Choukoutien and is now studying in France, writes to confirm recent reports of new discoveries of material relating to early man in China at the well-known site at Choukoutien (see NATURE, Dec. 12, p. 1004).

A table showing the displacement of the $K\alpha_{1,2}$-doublet in the X-ray spectrum of the lighter elements (magnesium to chlorine), when they combine with oxygen and with fluorine, is given by Dr. N. G. Johnson. The displacements appear to increase as the square of the valency. In the case of sodium the evidence for displacement is not conclusive since owing to its smallness it falls within the experimental error.

Evidence is brought forward by Dr. F. Dickens suggesting that the early stages in the oxidation of carbohydrate are hexose monophosphate, phosphogluconic acid and phospho-ketogluconic acid, the latter being decarboxylated by different routes in animal tissues and in yeast. Phosphohexonic dehydrogenase has been isolated from yeast; it converts phosphogluconic acid into the corresponding keto-acid, and for this it requires Warburg oxidation co-enzyme and yellow enzyme to complete the dehydrogenase system. In the biological oxidation of carbohydrates by this system, indophenol oxidase and cytochrome probably take part, since oxidation of hexosephosphate and phosphohexonic acid by brain tissue is strongly and reversibly inhibited by cyanide.

'Citrin', a physiologically active constituent of lemon juice having vitamin properties, consists, according to V. Bruckner and Prof. A. Szent-Gyorgyi, of a mixture of hesperidine and eriodictyol glucoside.

Photomicrographs showing spiral structure of chromosomes in the spore mother cells of the Royal Fern (*Osmunda regalis*) at the metaphase stage of the sexual nuclear division (meiosis) are submitted by Dr. I. Manton. Similar structures hitherto described have belonged mainly to monocotyledonous plants.

Sidney T. E. Dark records that the common stick insect (*Carausius*), while occasionally refusing to change its food plant, will sometimes inadvertently eat other stick insects in the immobilized (akinetic) condition even in the presence of plenty of its normal food.

Prof. F. L. Hopwood describes the formation of liquid diaphragms in a partly filled bent tube under the influence of sound vibrations, and also a simple sound amplifier consisting of a short glass tube with a thin rubber diaphragm slipped over the end of a Knipp's tube.

Research Items

Origins of the Russian Population

IN discussing the evidence for a pre-Aryan element in the population of southern Russia, Dr. A. Bachmakoff compares conditions in prehistoric France, where, notwithstanding the evidence of Cæsar, there is reason to believe that the Veneti were a pre-Aryan people, possibly related to the Picts, while in the south the Ligurians and Basques represent two branches of a race which may have extended from the Pyrenees to the Atlas (*Z. Rassenkunde*, 4, 2). In south Russia there is evidence for the existence of a similar pre-Aryan or Japhetic element, upon which the Aryans impinged about 1500 B.C. North of lat. 50° were impenetrable forests inhabited by Finns, but south of this line in the steppe country was a special kind of pre-Aryan population, which appears to be related to that of the Circassians (Kimmerians) of the Caucasus. The Aryans first impinging upon this population were Scyths or Iranians. The Slavs did not move before the Christian era, although it is possible that there were Slavs around Kiev, who were known to the Greeks in 450 B.C. These Proto-Slavs, however, remained quiescent for a thousand years. The effect of this Japhetic element on the Aryans can be estimated at two epochs—first on the Scyths in antiquity, and secondly on the Slavs in the Middle Ages. The first question to be decided is that of the Kimmerians. It would appear that they were a branch of the Circassians, who settled on the banks of the Kouban. They seem to be persistent in Anatolia from the time of the Hittites. The evidence for the existence of this race as a principal element in the substratum of the Russian population is mainly linguistic. The name "Tcherkesses" is found in Kiev. Little Russian names end in *-ko* instead of *-off*. The suffix *oukh*, which appears in Russia, is of frequent occurrence in various forms in names in Asia Minor in antiquity, and there is also evidence for it in Elamite, Mitanni and Proto-Hittite.

Rock-Drawings and Paintings of the High Plains, U.S.A.

IN the course of seven seasons' work, the Archæological Survey of the South-Western High Plains area instituted by the Anthropological Department of the University of Colorado, on the initiative of Prof. E. B. Renaud, recorded a large number of rock-paintings and drawings in Wyoming, South Dakota, Colorado, Arizona and New Mexico, particulars of which have been given from time to time in the reports of the Survey. In the recently issued eighth annual report, Prof. Renaud has brought together and collated the evidence given in these reports, now mostly out of print, and has prefaced the summary description of sites and recorded examples with a general appreciation and discussion of this regional manifestation of aboriginal art, which is not without interest for European archæologists, more especially as it approximates in its conventionalization of representations of the human form to certain phases of the art of the Stone Age in Europe. No very high antiquity is to be assigned to this High Plains art. The cave paintings of the Cimarron Valley, in which representations of the human form with characteristically square shoulders are outlined in red paint, have been assigned tentatively by Dr. A. V. Kidder to the Basket Maker culture, with a possible antiquity of some three thousand years; but as was shown quite conclusively by an inspection made when the Survey was at work in New Mexico in 1929, this group stands outside the field of High Plains art. Subject, style and technique in High Plains art corroborate the chronological evidence afforded by the superposition of paintings and drawings one upon another on the rocks and stones upon which they are found, while the representation of the horse indicates that all but the oldest class cannot be prior in date to 1680–90. As regards the significance of these paintings and drawings of human and animal forms and conventional signs, some are obviously phallic, while others equally clearly show relation to the symbolism of religious belief. The remainder appear to record tribal or personal events, or the occurrence of game and water-holes nearby.

Study of Airmen's Reactions

AN apparatus for listening to the beating of an airman's heart and recording it to the ground, where it can be reproduced on a sound film, has recently been devised by the Medical Aviation Department of the Soviet Civil Air Fleet. The apparatus will enable the physician to study the condition of an airman without having to accompany him in his flight, and also to ascertain the effect of different altitudes on the human heart. The apparatus resembles a small laryngophone or osteophone, and is fixed to the airman's chest above his heart. It is connected with a radio transmitter in the cockpit, which transmits the impulses to a special receiver installed in the ground laboratory, where it is recorded on a ribbon for reproduction on a sound film.

Food of Passenger Pigeon

ALTHOUGH the passenger pigeon has been extinct for many years, the stomachs, with food-contents, of eleven individuals have recently been discovered in the collections of the U.S. Biological Survey (according to a report circulated by Science Service, Washington, D.C., Oct. 21). The food materials were examined by Phœbe Knappen, who records that nine tenths of the items were of vegetable origin, the remaining tenth of animal origin. Acorns formed the greatest part of the food, next came oak-galls, followed by fruits of the pokeberry, a common weed, and grains of wheat. It is suggested that the predominance of acorns and oak-galls points to the disappearance of the primeval forests of North America at the hands of the woodman, as sharing with the activities of hunters, in the extermination of this once abundant bird.

Bee-Keeping in India

ATTENTION may be directed to the appearance this year of a third edition of the bulletin on bee-keeping by Mr. C. C. Ghosh, published by the Imperial Council of Agricultural Research, India (Mis. Bull. No. 6. Delhi: Manager of Publications. 3*s*. 3*d*.). This brochure has helped to stimulate bee-keeping in India besides being used in several other countries. In the present edition not much change has been deemed necessary beyond the incorporation of some new facts about enemies and the hives of the Indian bee, together with the addition of some fresh illustrations. It may be added that while the native Indian bee is easily kept, its yield of honey is much smaller than that of the hive bee in Europe.

Japanese Brachyura

Two papers on crabs from Japan have appeared (*Sci. Rep. Tokyo Bunrika Daigaku*, Section B, 2, Nos. 37 and 39; 1936). The first, by T. Sakai, "Report on the Brachyura collected by Mr. F. Hiro at Palao Islands", describes a large number of species, chiefly inhabitants of coral reefs, mainly from Kororu Island and Iwayama Bay, but some forms usually inhabiting the muddy or sandy shores are also included. There are 36 species belonging to 24 genera, one of the species, *Chlorodopsis* (*Cyclodius*) *palaoensis*, belonging to the Xanthidæ being new to science. Several of these had not been recorded before from Japanese waters. Good photographs are given of a number of forms, but we look forward with interest to the promised work "Crabs of Japan" in which coloured figures are to be published. The second paper, by K. Koba, "Revision of the Specific Name of a Crab as a Second Intermediate Host of *Paragonimus westermani* in Formosa", corrects the identification of the crab *Potamon* (*Geotelphusa*) *obtusipes* (Stimpson) which was found by Nakagawa in 1915 to be the intermediate host of a trematode *Paragonimus westermani* (Kerbert) from the Sintiku District of Formosa. The crab is now determined to be *Potamon* (*Potamon*) *rathbuni*, and the author gives a revised description of the species with figure.

Copepods from the Great Barrier Reef

THE systematic account of the pelagic Copepoda, by Mr. G. P. Farran, is now published (British Museum (Natural History) Great Barrier Reef Expedition 1928–29. Scientific Reports, 5, No. 3. Copepoda. 1936). Further work on habitat, relative abundance, and seasonal and vertical distribution will follow in a separate paper. The species fall into three groups: the reef forms which have their centre of distribution in the shore waters of low salinity, though also often found outside the reef, the open epiplankton, and the deep-water fauna. Of these the first group has been well sampled, but the second and third are not so complete. The greater number belong to the Calanoida—53 from the open sea with 3 new species and a new genus, 37 from deep water with 8 new species and a new genus, and 30 (or 31) from the coastal waters with one new species. The new genus *Tanyshinus* is formed for the new species *T. naro* from the open sea. Its systematic position is in the neighbourhood of *Spinocalanus*, *Mimocalanus* and *Monacilla*. In *T. naro* the rostrum consists of a single stout point with no trace of rostral filaments. As *Monacilla tenera* has a 2-pointed asymmetrical rostrum with one of the points much stronger than the other, it is suggested that a single rostral process might arise by the suppression of the smaller point. The second new genus, *Scolecalanus*, from deep water, is formed for the two new species *S. galeatus* and *S. lobatus*. There are only seven species belonging to the Harpacticoida, the remaining forms being members of the Cyclopoida, chiefly from the open sea. One new genus from deep water is formed for the new species *C. parva*.

Development of the Cotton Hair

ON this subject, Dr. F. M. L. Sheffield has recently published a note of considerable interest (*Empire Cotton Growing Rev.*, 13, No. 4; 1936). This note makes it clear that a state of affairs exists in the outer coat of the developing cotton seed in the early days following fertilization, which has not been sufficiently considered when attempts are made to generalize on these developmental processes. As growth proceeds in the expanding ovule, naturally cells of the epidermal layer continue to multiply and divide, but these dividing cells are interspersed among other cells or cell groups, which are rapidly expanding into hairs, so that fully differentiated and meristematic cells are ultimately interspersed. Dr. Sheffield directs attention to this unusual state of affairs and contrasts it with the apical meristem or the cambium, though it will be recalled that in the cambium there are usually ray cells interspersed between the long cambium initials which are clearly in a different state of differentiation. Hair production in early stages of leaf development is probably also associated with similar appearances in the epidermal sheet. Dr. Sheffield concludes that the amount of variation, associated with hair development, occurring from cell to cell of a single seed and from seed to seed within a single boll is greater than the differences in development between varieties or even between Old and New World types of cotton. Cell divisions were seen in the epidermis of Sakel cotton seeds up to the tenth day after pollination and probably occurred later than this—but the general trend of these observations is to minimize the significance of the exact length of time for which cell divisions were seen and to stress the great variety of conditions of cell development to be found over the surface of the seed.

Gas Storage of Apples

IN view of the increasing interest of commercial growers in gas storage methods, a recent paper by Kidd and West (*J. Pom. and Hort. Sci.*, 14, 3, 276; 1936) is deserving of attention. The experiments described were carried out with Cox's Orange Pippin apples at the Ditton Laboratory over a period of three years. It was found that low-temperature breakdown increased in severity with increasing carbon dioxide concentration, but did not occur at temperatures above 34° F. Fruit stored at 34° F. in September reached the end of its storage life by the end of October whatever the storage atmosphere. Brownheart, which appears early in the storage life, developed most severely in high carbon dioxide atmospheres (15 per cent) and was accentuated by low oxygen, whilst 'core flush' or browning in the core region increased with increasing oxygen concentration. Very little fungal rotting occurred, and this seemed unaffected by the composition of the atmosphere. In general, for long-period storage, minimum wastage from the above causes was obtained with an atmosphere containing 2·5 per cent oxygen and 5 per cent carbon dioxide at 34° or 39° F. The same atmosphere, at 37·5° F. and 39° F., also proved best for the development of the characteristic Cox flavour, which is only fully apparent after the fruit has been removed from store and kept in air at room temperature for a few days. Development of good yellow ground colour was favoured by high temperature and high oxygen concentration, whilst retardation of softening appeared to be due to the effect of carbon dioxide.

Whilst there was some variation in different seasons, it was concluded that the maximum storage life of Cox's Orange Pippin (about seven months) was obtained at 39° F. in an atmosphere containing 2·5 per cent oxygen and 5 per cent carbon dioxide. These conditions cannot be obtained by simple controlled ventilation, but require some means of removing the excess carbon dioxide. It is worthy of note that disastrous results followed the storing of ripe Worcester Pearmain apples along with unripe Cox's, the storage life of the latter being reduced almost to one third, due to the stimulating effect of ethylene evolved by the Worcesters.

Distribution of Earthquakes in the Kwanto (Japan) District

Since the great Kwanto earthquake of September 1, 1923, a network of thirteen seismological stations has been arranged in the district round Tokyo. The quarterly Seismometrical Reports issued by the Earthquake Research Institute give a list of all the earthquakes that were sensible in Tokyo, with, in most cases, the position of the epicentre and the depth of the focus. Two interesting papers, in which the distribution of these earthquakes is considered, are included in a recent *Bulletin* of the Institute (14, 420–426, 427–437; 1936). In the first, Mr. T. Nagata examines the distribution of the foci in two regions in which they are chiefly clustered, the northern part of Tokyo Bay and along the Rivers Kinugawa and Tonegawa. During the years 1924–30, the foci in the former region lay as a rule at depths of 70–80 km.; but, during the years 1931–35, there were few foci at a greater depth than 60 km., showing that the instability produced in the lower part of the crust by the Kwanto earthquake of 1923 is gradually diminishing. In the second region, the earthquakes were most frequent at depths of 40–50 km. in both intervals. Messrs. N. Nasu, T. Hagiwara and S. Omoti deal with the same subject. By projecting the foci in five sub-regions on vertical planes, it is shown that the distribution is funnel-shaped, and that there are two sources at depths of more than 100 km., one below Kumagaya and the other beneath the northern part of Sagami Bay.

Effect of Hydrogen on Photo-electric Cells

In a paper read to the Physical Society on November 27, Dr. N. R. Campbell and R. S. Rivlin continue the investigations on the effect of hydrogen on the time lag of argon-filled photo-electric cells, the results of which were published in previous papers to the Society. In a paper read last April, the proportion of hydrogen required to produce the decrease in time-lag was left undetermined as it was thought that elaborate apparatus would be required. It has been found that the problem can be solved very simply and with sufficient accuracy by using a Pirani gauge. The gauge is of the simple type in which a constant potential difference is maintained across the bridge, and the out-of-balance current is read. The experiments show that all that is necessary is to attach such a gauge to the cell, fill it with argon to a suitable pressure, and carry out the tests by adding or withdrawing hydrogen and plotting the results. When the pressure of the argon in the cell is about 0·2 mm., the effect of introducing a small proportion of hydrogen into the argon, keeping the voltage constant, is to decrease the magnification and decrease the time lag. Both these effects increase rapidly as the amount of hydrogen is increased up to about 2 per cent by volume. The rate of increase then falls off and becomes negligible at about 6 per cent. The exact variation of the effects with hydrogen is complicated and depends on the nature of the cell. It is pointed out that the effects were correlated with hydrogen free in the cell, and that it is conceivable that the direct cause was hydrogen adsorbed on the cathode in an amount which is in equilibrium with the amount free in the cell.

Aetylcholine containing Heavy Hydrogen

It is well known that the pharmacological activity of choline is very greatly increased by acetylation. It is announced in a communication to the Editor by Prof. H. Erlenmeyer, H. Lobeck and Prof. K. Fromherz, University and the Roche Research Laboratories, Basle, that replacement of the hydrogen in the acetyl group by heavy hydrogen yields a product the action of which on the frog's heart is indistinguishable from that of acetylcholine itself, but is about thirty per cent less active on the blood pressure and on leech-muscle. Details of the work are to be published in *Helvetica chimica Acta*.

Ignition of Explosive Gases

G. Mole (*Proc. Phys. Soc.*, 48, 857) has put into a quantitative form the theory of Finch and his collaborators that ignition and self-propagating combustion of an explosive gaseous mixture are determined by the building up of a suitable concentration of excited molecules. A differential equation is set up for the activation and deactivation of molecules. The solution shows that the mixture can remain in equilibrium indefinitely unless a source of activation greater than a critical value is applied. When such a source is applied, an explosion begins after a calculable time The igniting power of a high-frequency source of activation, for example, an electric spark, can be calculated as a function of frequency, and from comparison of this result with experiment, the average life of an activated molecule of carbon monoxide is found to be about 0·4 microsecond.

Thin Metallic Films

Up to the present, it has been found that metallic films only a few atoms thick show no electrical conductivity, and that the resistivity of films many atomic layers thick is much higher than that of the bulk metal. A. C. B. Lovell (*Proc. Roy. Soc.*, A, 157, 311) has succeeded in depositing films of rubidium on pyrex glass which show conductivity when the number of atoms deposited is less than that for a complete monatomic layer The films were deposited by evaporation on a surface which had been cleaned by prolonged heat treatment in high vacuum. The films show a decay of conductivity with time, but this decay became slower with low temperature and thicker films. A film of 40 A. thickness was completely stable at 90° K. The thickest films (up to 90 A.), though still invisible, carried currents up to 0·5 amp. and obeyed Ohm's law, the current density being at least 10^6 amp./sq. cm. The variation of resistivity with temperature and film thickness agreed quantitatively with a simple theory of the shortening of the mean free paths of electrons by collision with the boundaries of the film. The decay of the conductivity of the film with time may be qualitatively explained by the aggregation of the rubidium into islands under surface tension forces. The presence of traces of impurities on the surface influences these surface tension forces and leads to a rapid break-up of the film (see also Nature, 137, 493; 1936).

Wave Forms of Atmospherics at Madras

MR. C. V. RAJAM, writing from the Presidency College, Madras, reports observations on the wave-form of atmospherics received in Madras (13° N. 80° E.) made in the first months of a year's programme. The apparatus used is based on that of Appleton, Watson Watt and Herd, and their eye-and-hand method [now superseded by photography] is used. We are unable to find space to print the report in full, but the following account brings out the principal points.

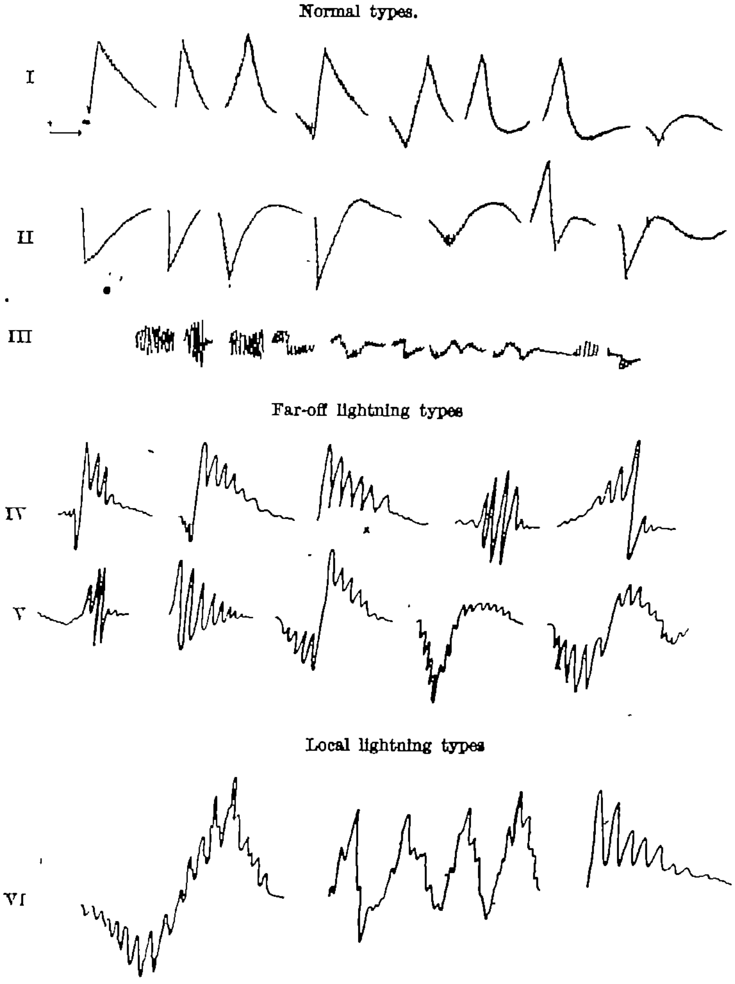

FIG. 1.

Mr. Rajam divides the observed types into three, the normal, the far-off lightning and the local lightning types. These are illustrated in the accompanying figure (Fig. 1). The types shown in rows I and II produce clicks; low-intensity atmospherics of the complicated forms shown in row III produce sustained "frying" sounds. Aperiodic clicks are predominantly negative on 60 per cent of normal days; durations lie between 1,000 and 4,000 μsec. and intensities between 0·1 and 0·3 volts/metre. Short aperiodics of similar intensity have a decay time of 100–700 μsecs. Next in prominence are negative quasi-periodics with a short negative peak of about 0·15 v./m. followed by a rounded positive portion of about 0·05 v./m. peak value; the total duration is 800–1,500 μsec. The most prominent positive type is quasi-periodic, with a brief positive peak followed by a longer rounded negative half-cycle. Here the total duration is 2,000–5,000 μsec., intensity 0·1–0·28 v./m., peak ratio about 6. A small percentage with three half cycles have total durations 4,000–8,000 μsec., intensities 0·2–0·35 v./m.

On 90 per cent of observed forms are found high-frequency ripples of 10–40 per cent relative amplitude; ripple periods range from 25 to 120 μsec., corresponding to frequencies of 8,000–40,000 cycles per sec. A rippled atmospheric produces a jarring click while a ripple-free atmospheric of the same gross form produces a mild click tolerable to the ear.

The "frying" types occur generally in the evening hours, persisting to about 10 p.m., and again before sunrise. They occur in quickly succeeding groups; the group duration is 100–700 μsec., intensity 0·03–0·75 v./m.

With distant visible lightning come the far-off lightning types, rows IV and V. These consist of a close succession of 3–10 impulses of normal type. The most prominent and frequent type (*x* in row IV) has a steep negative rise followed by further impulses on the negative side of the base line. Total durations are 1,500–8,000 μsec., intensities 0·2–0·5 v./m.; 10 per cent show ripple structure of 30–100 per cent relative amplitude and ripple-frequency 8,000–15,000 cycles per sec.

Local lightning types, associated with audible thunder, are shown in row VI. These have durations of 1/25–1/10 sec., intensities 0·7–2 v./m.

The diurnal variation in atmospheric activity on a normal day runs as under. From 1 a.m. to 5 a.m. activity is low, with occasional negative aperiodics. Just before sunrise there is a slight rise, and "frying" type atmospherics appear; just after sunrise there is a marked fall and "frying" ceases. From 8 a.m. to 12 noon activity is very low; until 2 p.m. this state is modified only by the intrusion of low-intensity negative aperiodics and quasi-periodics. From 3 p.m. there is a slow rise to a maximum about 5.30 p.m., with frequent atmospherics. This maximum persists through 6 p.m., with slight decrease to 9 p.m., and an accelerated decrease from 10 p.m. to a midnight minimum.

The work is continuing, and apparatus for automatic recording of wave-forms is under construction.

The Agent of Virus Disease in Plants*

By Dr. John Caldwell

MOST of the detailed work on the nature of the virus agent has been carried out on the virus of the mosaic disease of tobacco. This virus is very easily obtainable in a fairly pure condition, is easily inoculable by rubbing virus preparations into healthy tissues and is resistant to storage and to chemical treatment. This resistance to ageing makes it possible to store the virus *in vitro* in powder form or in liquids over periods of years, and its presence as an active pathogen is easily demonstrable quantitatively as well as qualitatively by the use of the host-plant *Nicotiana glutinosa*, the leaves of which develop local lesions after being rubbed with virus material. It has long been known that there is a definite relationship between the number of lesions and the amount of virus present in the inoculum.

The most outstanding recent development in the study of the virus is the preparation by Stanley of a crystalline protein from the juice of plants infected with mosaic disease. The agent is separable from the crude, expressed plant juice by treatment with protein precipitants, and the virus has an intimate connexion, at the least, with the proteins of the tissues, as evidenced by the effect of pepsin in destroying the activity of the virus and by its antigenic reaction. While it has not yet been clearly demonstrated that the crystalline protein is, in fact, the virus agent in a pure state, Stanley's demonstration of the existence of the virus in the crystallizable protein fraction constitutes a step forward in the isolation of virus [see also p. 1051].

The study of the virus from the point of view of its possible protein nature is complicated by two main factors. It is apparently easily absorbed and inactivated by native proteins and, further, tests for virus activity must be carried out on host plants, since it is the pathogenic effect of the virus which ultimately demonstrates its presence in a given juice.

This biological test requires that, to demonstrate the activity of the virus, there be present no substance which prevents the entry into or subsequent increase of the virus in the host tissues. It has been shown that dead cells do not permit the entry into, or the movement of the virus in, the tissues, and absence of infection in the leaves of the test plant *Nicotiana glutinosa*, in some instances, may be due to the death of cells in the regions of inoculation and not to the absence of active virus. A test has recently been devised which makes it possible to distinguish between an inhibitory effect on the virus itself and a toxic effect on the tissues of the treated leaves. If the inhibitory substance be added in the same concentration to different concentrations of the virus material, that concentration not being too great to prevent lesion formation on the leaves of the host plant at some concentration of the virus, then the effect of the inhibitor will be different if it is acting on the virus, from its effect if the action be on the host tissues. If the action of the inhibitor be on the virus, then its effect will be most marked at the lower concentrations of virus and will be less obvious as the concentration increases until at high concentrations of virus it may not be demonstrable at all. If, on the other hand, the effect of the inhibitor is on the host tissues, the effect will be most marked at high concentrations of virus, when far fewer than the expected number of lesions will be formed, while at low concentrations of virus the effect of the inhibitor may not be demonstrable, since there are comparatively large numbers of possible points of entry of the virus.

The question of the entry of the virus into the tissues has received some attention recently. I demonstrated some time ago that it is possible to inject into the intercellular spaces of leaves large quantities of virus, to spray the leaves of a tomato or tobacco plant with virus material or to immerse the roots in virus juice without subsequent infection of the plant provided the tissues remain undamaged. It was concluded that virus is unable to enter an unbroken protoplast. This conclusion was challenged by Duggar, who reported that if tobacco virus No. 1 material was sprayed with an atomizer on to the leaves of tobacco plants, infection followed, in the course of a few days, entry of the virus being affected apparently through the stomata of the treated plants. In the light of these results, the work on the spraying of tobacco plants with virus material in an atomizer has been carefully repeated and it has been found that no infection was obtained under our conditions even after repeated spraying at three- or four-day intervals, when rigorous precautions were taken to prevent the rubbing of the leaves of the plants and special care was taken in watering them. All plants so sprayed and with one leaf lightly rubbed developed symptoms after only one spraying. This conclusion has been confirmed in a paper published last month by Dr. F. M. L. Sheffield at Rothamsted, whose experiments are reported to show "quite conclusively that the virus is unable to enter uninjured cells".

I have shown that the virus of tobacco mosaic does not travel across areas of dead cells but is confined to the living tissues, and that the weight of evidence suggests a fairly rapid passage along the protoplasmic strands between the cells. I have also shown that there is little evidence that the virus moves mechanically with the main food-streams. This conclusion has been questioned by various workers and further experiments have been carried out to examine this point. Experiments carried out in Exeter have shown that virus activity seems to be associated more with the activity of growing cells than with the movement of materials from the inoculated leaves. Three groups of tobacco plants were used in the experiments. One group was inoculated on the youngest available leaf, the second on a half-grown leaf and the third on the oldest leaf, all the plants being in the 4th–5th leaf stage. All the inoculated leaves were covered with tinfoil or black paper immediately on inoculation. Symptoms appeared first on the plants of the first group, then on most of the plants of the second group and rarely on the plants of the third group. The treated leaves of the first two groups of plants grew rapidly under the covers; while the adult leaves of the third group withered and died in the course of a week. It was evident that the virus could and did move rapidly out of the younger leaves, and that the movement of food materials into them had little effect on the movement of virus out of them.

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* Based on a paper read on September 11 before Section K (Botany) of the British Association meeting at Blackpool.

The conclusion that the movement of the virus takes place along the protoplasmic strands was confirmed by the observation that the embryo of the seeds of infected tobacco and tomato plants has been shown by the work of myself and others to be healthy and to contain no virus. This may be due to the irregular distribution of virus in the plant tissues and to the absence of direct protoplasmic connexion between the embryo and the parent plant.

The conclusion that the protoplasmic strands are not the paths of movement has also been supported just recently by another paper of Dr. Sheffield, in which she shows that the guard cells of the stomata of *Solanum nodiflorum* do not contain inclusion bodies, while the epidermal cells of this plant on infection with tobacco mosaic virus develop very characteristic inclusion bodies. It has been possible to demonstrate the existence of protoplasmic strands between the epidermal cells of this plant and their complete absence between the guard cells and the neighbouring epidermal cells.

The work on the nature of the virus has opened up some interesting fields for further study. Evidence is being accumulated which indicates that the virus is protein in nature and that it can develop only in living tissues, with which it is intimately connected. This conclusion is of special interest when it is remembered that tobacco virus No. 1 has been shown to exist in some sixty strains, most of which are known to be mutually antagonistic in the plant.

The Electrical Machinery Laboratory, Polytechnic, Regent Street, London

THE newly-equipped Electrical Machinery Laboratory at the Polytechnic, Regent Street, was formally opened on December 10, by Sir E. Henry Pelham, permanent secretary to the Board of Education. The occasion was the jubilee commemoration of the School of Engineering, which first provided an organized engineering training in 1886.

A feature of interest at the meeting was the presence of all three heads of the School, Mr. H. J. Spooner, the first head, who retired in 1922, Prof. A. R. Horne, professor of mechanical engineering at the Heriot-Watt College, Edinburgh, who retired in 1929, and Mr. Philip Kemp, the present head.

The Electrical Machinery Laboratory was first equipped in 1911 when the Polytechnic was re-built, and the machines and apparatus then installed did good service both before and after the Great War. It was realized, however, that if instruction had to be given on up-to-date lines, a thorough re-organization was necessary, and accordingly, plans were prepared for a complete new equipment. The London County Council was approached for financial assistance and a very generous grant was made, enabling the work to be begun in 1933.

The main supply to the Laboratory, which has an area of 4,800 sq. ft., is obtained from the Borough of St. Marylebone three-phase mains at a pressure of 416 volts and a frequency of 50 cycles per second. This is fed to three 20 kva. three-phase transformers in order to step the voltage down to 100 volts, which is the value chosen for the operation of the experimental plant. These three transformers can be operated singly or in parallel, and are each provided with an auxiliary boosting transformer for the purpose of maintaining a constant voltage on the experimental circuits. This voltage is ultimately maintained at a constant value by means of an automatic voltage regulator.

Direct current supplies are obtained from two 15 kw. rotary converters, each with its own transformer. A 540 ampere-hour secondary battery is also available for D.C. work demanding a steady voltage. This battery is connected to the main D.C. bus bars, but has its own separate charging plant. The experimental D.C. supply is taken to a special distribution board, before going away to the various experimental circuits.

The whole of the A.C. experimental supply is brought to a large plug board enabling single-phase or three-phase supply to be delivered to any of the experimental machines at will. If necessary, a particular circuit can be fed from one particular transformer, which can be isolated for the purpose. Signal lights are provided at various points to indicate live circuits.

Instead of using the transformers directly, alternative 100 volt A.C. supplies can be obtained from four 3 kva. three-phase alternators, these also being connected to the main plug board. Two of these alternators are separately driven by two three-phase synchronous motors, a third by a three-phase commutator motor of the Schrage type, whilst the remaining alternator is driven by a D.C. motor.

A feature of the laboratory is the large-scale diagram printed on the wall, showing the whole of the experimental supply circuits.

The four motor-alternator sets mentioned above can be used for experimental purposes as well as for supplying other machines. The synchronous motors of the first two have their stators mounted on a rack and pinion, for the study of load conditions, and they are also each provided with a Joubert contact equipment for wave form investigations.

The D.C. testing plant consists of two 3-h.p. shunt motors, two 3-h.p. series motors and two 3 kw. motor-generator sets, the motors of which can be uncoupled at will.

Converting plant is represented by a 3 kw. three-phase rotary converter and a 3 kw. six-phase rotary converter direct coupled to a 3-h.p. three-phase induction motor, so that the combination can be run as a motor-converter if required. Both these sets are provided with Joubert contacts for wave form work.

Two mercury arc rectifiers are also installed, one being a 3 kw. single phase unit, whilst the other is a 3 kw. six-phase rectifier with grid control.

Alternating current motors are represented by two three-phase induction motors of 2 h.p. and 3 h.p.

respectively, a 3-h.p. synchronous-induction motor, a 3-h.p. three-phase Schrage type commutator motor, and a 5-h.p. commutator motor which can be operated in a number of ways both single and three-phase.

A number of transformers are also available for experimental work of various types, including an equipment which can be used for three- to two-phase transformation.

Oscillatory Discharges in a Magnetic Field

HIGH-FREQUENCY oscillations produced in electrical discharges under the influence of a magnetic field have attracted considerable attention in recent years. In addition to their purely physical interest, they have proved of value to the engineer in the magnetron oscillator, a device which is quite closely related to the cyclotron, or proton accelerator, of Lawrence and Livingston. The secondary emission electron-multiplier of P. T. Farnsworth provides another example of a device in which oscillations can be produced by means of the co-operation of electric and magnetic fields; it differs from the magnetron in that the two fields are aligned instead of being approximately perpendicular.

Prof. T. V. Ionescu has recently described (*C.R.*, 202, 1160 and 1842; 203, 57; 1936) some interesting results relating to a somewhat similar type of discharge tube having a thermionic cathode, two ring-shaped electron-accelerating electrodes and a circular plate which could be given a positive or negative potential with respect to the cathode. A magnetic field was directed along the common axis of these electrodes. (Some results obtained with a similar kind of discharge tube were reported by Prof. K. Okabe recently in NATURE, 138, 685; 1936). Measurement of the voltage-current characteristics of the plate at a gas pressure of the order of 10^{-7} mm. (reported by Prof. Ionescu and Mr. C. Mihul) showed that an electron current could reach that electrode when its potential was below cathode potential (presumably indicating the presence of electronic oscillations) without any magnetic field. The effect of the magnetic field was to increase this current and apparently to split it up into components having different velocities.

In further experiments at a pressure rather less than 10^{-4} mm., a luminous column appeared along the axis of the tube, between the second accelerating electrode and the plate, at a definite value of magnetic field strength. The form of this column varied with the electrode potentials, the cathode emission, and the magnetic field strength, but it apparently did not show the nodes and loops characteristic of ordinary magnetic focusing. The luminous column was found to persist for an appreciable time after the cathode emission was stopped. Electron currents up to several times the cathode emission were observed to flow away from the plate (secondary emission) and regions of negative resistance were obtained.

The tube appeared to be generating powerful high-frequency oscillations, but the available power does not seem to have been determined; the frequencies were of the order of 100–1,000 mc./s. In the last paper, a theory of the oscillations is given which treats them as plasma electron oscillations modified by the magnetic field; two oscillation frequencies then arise in a way reminiscent of the Zeeman effect.

Educational Topics and Events

CAMBRIDGE.—The General Board has recommended that Dr. U. R. Evans continues as assistant director of research in metallurgy for five years from January 1, 1937, or for so long as the Iron and Steel Industrial Research Council continues its grant to the University for scientific research on corrosion, whichever period be the shorter.

It is recommended by the General Board that a readership in plant physiology be established as from October 1, 1936, and that G. E. Briggs (St. John's College) be appointed to that post.

LEEDS.—Mr. Frank Parkinson, head of the firm of Crompton Parkinson, Ltd., and an old student of the University, has given £200,000 for the proposed main frontage to the University in connexion with the reconstruction scheme now proceeding. Earlier this year, Mr. Parkinson gave £50,000 for the establishment of a scholarship fund.

SHEFFIELD.—The following appointments have recently been made: J. L. A. Grout, to be honorary lecturer in radiological anatomy: G. Clark, to be junior assistant bacteriologist; W. A. Timperley, to be research fellow in the Department of Physiology.

DR. H. S. RUSE, lecturer in mathematics in the University of Edinburgh, has been appointed professor of mathematics at University College, Southampton, in succession to Prof. R. C. J. Howland, who died in August last.

THE British Film Institute's third annual report tells of much useful work done and in progress: of answering inquiries from all parts of the Empire; supervising production of thirteen films illustrative of physical training; helping to produce thirteen films for use in the teaching of physics, ecology, and history; publishing a catalogue of British medical films; preparing for the Child Welfare Committee of the League of Nations a report on entertainment films for children, and organizing a conference for discussing the same subject; publishing a new leaflet on non-theatrical apparatus and films for schools; and maintaining the publication of the quarterly *Sight and Sound* and monthly film bulletins. Nine local branches were in operation in England and Ireland, and a Scottish Film Council represents the Institute in Scotland. All this is good so far as it goes, but it must be admitted that the growth in membership has been disappointing. On June 30 there were 597 full and 1,700 associate (branch) members. If any substantial progress is to be made towards realizing the Institute's object "to influence public opinion to appreciate the value of films as entertainment and instruction", its efforts will need to have much more vigorous and widespread backing than they have hitherto received. No local education authority in Great Britain could deny the enormous importance of the objects for which the Institute was formed, and every one of them might well be a full member and help towards the formation of a local branch; but in fact the total number of education committees in Great Britain which have joined is 36.

Science News a Century Ago

Rev. J. B. Reade on Solar Rays

AT a meeting of the Royal Society on December 22, 1836, the secretary, J. G. Children, communicated a paper by the Rev. J. B. Reade entitled "Observations and Experiments on the Solar Rays that occasion Heat; with the application of a remarkable property of these rays in the construction of the Solar and Oxy-Hydrogen Microscope". The method employed by the author for obtaining, by a combination of lenses, the convergence to foci of the 'colorific' solar rays, together with the dispersal of the 'calorific' rays, consisted in making a beam of solar light, after it had been converged to a focus, pass through a second convex lens placed at a certain distance beyond that focus; that distance being so adjusted that the calorific rays were collected into a focus more remote from the first lens than the colorific rays, and consequently nearer to the second lens. By this means, the calorific rays emerged either parallel or divergent while the colorific rays could be brought to a focus which would exhibit a brilliant light without manifesting any sensible degree of heat. The light so obtained could be advantageously applied to the solar, and to the oxy-hydrogen microscope, producing no injurious effects on objects enclosed in Canada balsam or even on living animalcules.

The Rev. Joseph Bancroft Reade (1801–70) was known for his work as a chemist, microscopist and photographer. Educated at Trinity and Caius Colleges, Cambridge, he was successively rector of Stone, Ellesborough and Bishopsbourne. In 1861 he invented "Reade's kettledrum", a hemispherical condenser for the microscope.

Specific Inductive Capacity Apparatus

TOWARDS the end of 1836, Faraday's mind was much occupied with the problem of electrostatic induction. He had been led, by the experiments in electrostatics which he had begun in November of the previous year, to speculate on the mechanism of induction, in particular, as to what was happening in the intervening air or other substance between two opposed conductors. In December he made some experiments with metal plates, charged inductively, to see if the induction measured by an electrometer varied on the introduction of plates of shellac in the space between the conductors.

Although these experiments were inconclusive, he suspected that the induction was affected by the nature of the interposed material, and hit upon a new device to test this, an arrangement of two concentric metal spheres, one within the other, with the non-conducting material or "dielectric" introduced between. The first use of this method is recorded in the "Diary" on December 23, 1836. He says: "Have had two apparatus made for Induction through air and liquids, in which an inner and an outer ball are kept at fixed distances and serve as coatings of Leyden Phials, air being between. They are numbered i and ii and are in all general respects alike. The insulation of the inner ball is by a metallic wire enclosed in a glass tube, the latter being covered well over with lacquer."

This was the famous specific inductive capacity apparatus, still preserved at the Royal Institution. With it, during 1837, he made an exhaustive series of experiments, comparing the induction through gases, liquids and solids such as glass and shellac, which he cast in hemispherical form to fit between the conductors; until he came finally to the conclusion that each of the interposed materials had its own characteristic and measurable capacity for induction, or as we should say, its specific inductive capacity or dielectric constant.

Dr. James Johnson on Health

IN the *Athenæum* of December 24, 1836, is a review of "The Economy of Health; or the Stream of Human Life, from the Cradle to the Grave: with Reflexions Moral, Physical and Physiological on the Septennial Phases of Human Existence, by James Johnson, M.D., Physician Extraordinary to the King". Dividing the life of a man into periods of seven years each, Dr. Johnson said: "the first seven years embrace the *hygiene* of the nursery; the second that of education; the third of the sexual crisis; the fourth of station in life and matrimony; the fifth and sixth of ambition; the seventh may be termed the pathological septennary, or that in which the accumulated venom of numerous petty chronic abuses of health, incidental to a civilized life, break out in positive diseases; and the eighth, ninth and tenth contain the melancholy history of the progressive decline of life, and the gradual breaking up of the effete machinery." In speaking of the seventh septennial, he said, "the immense increase not only of the pleasures, but the pains of existence resulting from a high state of civilization make calls upon the nervous system for a corresponding increase in activity. The result is a morbid increase of sensibility in the nervous system, which operating by sympathy on the nerves of the stomach, liver and other organs, changes their action and deranges their function." The subject, said the *Athenæum*, was investigated by Dr. Johnson "with much acumen and exposed with a vigour of style that is entitled to rank as eloquence".

Melloni's Investigations on Light

"THE Italian natural philosopher Melloni," said the *Athenæum* of December 24, 1836, "has recently invented a mode of depriving the rays of light of caloric, which seems to open the way to great discoveries, respecting the nature of light, thus insulated. His method is very simple: he passes the sun's rays through a combination of transparent bodies (water, and a particular sort of glass coloured green with oxide of copper), which bodies absorb all the caloric, and but little of the light. The light thus separated from its caloric is very yellow with a green tinge; and when so concentrated by lenses, as to be as bright as the direct ray, the most delicate thermometer does not show the smallest degree of warmth. It has long been known that the prism, besides dividing the ray into its several pencils of colours, separated at one end of the spectrum a pencil of heat-making rays, and at the other a pencil of chemically-acting rays, both perceptible only by their effect; but this mode of separating. the heat from the light offered little means of experimenting upon the unadulterated light, of which Melloni's discovery seems to give the philosopher as complete command as he has of the gases, etc."

Societies and Academies

London

Royal Society, December 10.

A. G. MacGregor: Preliminary report on the geology of Montserrat. Montserrat, in the Leeward Islands, is a small member of the series of islands that form the volcanic arc of the Lesser Antilles or Caribbees. The island consists of six mountain masses and hills, each of which represents an old volcano modified by erosion. Active soufrières, emitting hydrogen sulphide gas and steam, have, however, persisted on the flanks of the Soufrière Hills, the youngest volcano, until the present day. Temperatures at the soufrières have remained low from a volcanological point of view during the abnormal gas-emission that accompanied the recent earthquakes. The eruptions of the Soufrière Hills volcano were of the Peléan explosive type, characterized by incandescent avalanches of gases, rock fragments and dust. Part of a large crater with a central "dome" and andesite can still be recognized. True lava flows are found only in the south of the island, where they were emitted from a volcano somewhat older than that of the Soufrière Hills.

C. F. Powell: Preliminary report on seismic observations in Montserrat. An account is given of the results obtained with the Wiechert seismograph and Jagger shock recorders installed in Montserrat in April 1936 by the Royal Society Expedition. The general seismic intensity during this year has been appreciably less than in 1934 and 1935. The monthly number of observed tremors shows a succession of pronounced maxima at roughly six-monthly intervals, the times of greatest activity being May and November–December. The shocks were highly local in origin, most of the foci lying under the island. By comparing the amplitudes of the shocks recorded on the Jaggar shock recorders maintained at different points in the island, the epicentres were found to lie in a broad belt running across the middle of the island. This belt also embraces the active soufrières, but the epicentres are not confined exclusively to the immediate neighbourhood of the active soufrières. A considerable number of shocks originated at a comparatively few "active" foci. Many twin earthquakes, originating at the same focus, were observed. A number of temperature measurements were made, together with observations on the concentration of the hydrogen sulphide and sulphur dioxide.

Paris

Academy of Sciences, November 23 (*C.R.*, 203, 1037–1104).

Louis Blaringhem: A new case of mosaic in a hybrid of wallflower, *Cheiranthus Cheiri* × *Erysimum cheirantoides*.

Marcel Godchot and Mlle. Germaine Cauquil: The action of hydrocyanic acid upon active 3-methylcyclohexanone.

George Albert Boulenger: The genus *Herperhodos* (Rosaceæ).

J. Neyman: Verification of the hypothesis concerning the law of probability of contingent variable.

Georges Kurepa: Souslin's problem and abstract spaces.

Georges Bouligand: Partial differential equations of the first order.

Victor Valcovici: The relative movement of a solid in a viscous fluid.

Jean Mariani: The universe interval in relativist wave mechanics.

Arcadius Piekara and Bruno Piekara: Electrical saturation and the critical point of solution.

Mlle. Suzanne Veil: The systematic construction of batteries with two liquids on gelatine.

Raymond Hocart and Maurice Fallot: The structure and magnetic properties of manganese boride, MnB. Results of X-ray studies on the crystals and behaviour in the magnetic field.

Jean J. Trillat and Shiguéo Oketani: Studies on the transformations produced in certain metals by heating in a vacuum or in air. The changes in structure produced in thin films of gold and silver by heating to 500° C. have been studied by electron diffraction.

Louis Guitton: Application of potentiometric methods to the prediction of corrosion in ferrous alloys.

Pierre Donzelot: Structure of methyl and ethyl selenides. Deductions made from Raman and infrared spectra.

Guy Emschwiller: An optimum of chemical reactivity of gases adsorbed at their critical temperature.

Mlle. Yvonne Garreau: Oxidation of hydroquinone by air in the presence of monomethylammonium sulphite. Oxidation of hydroquinone monosulphonic acid in the presence of methylamine.

Maxence Meyer: Some ethylenic α-ethoxyacids.

Jean Décombe: Condensation of ketones with formaldehyde in alkaline medium.

Jean Goguel: The Cevennes border.

Pierre Auger, Paul Ehrenfest, jun., and André Fréon: Studies on the cosmic 'showers' at high altitudes.

Jean Piveteau: The origin and morphological evolution of tailless amphibians.

Frédéric Marie Bergounioux: Origin of the group of the Trionychoides.

Mme. Panca Eftimiu Heim: Presence and evolution of the micro-nucleolus in the Cucurbitaceæ.

Mlle. Marie Thérèse Gertrude: Action of the aquatic medium on the nitrogen nutrition and phosphorus nutrition of a herbaceous plant.

Robert Lami: Value and variations of the salinity and alkalinity of the water contained in the cavity of *Codium Bursa*.

Henri Geslin: The evaporating power of the air and the humidity of the soil.

Jean Servy: A new index characterizing the dryness factor in agronomy.

Pierre Menard: Suppression of the causes of errors in measurements of arterial pressures.

Maurice Doladilhe and Charles Morel: Contribution to the study of the influence exercised by alexin on the dispersion of a colloidal complex by a blood serum.

Moscow

Academy of Sciences (*C.R.*, 3, No. 6, 1936).

L. B. Robinson: A functional equation satisfied by a lacunary function.

M. Kravčuk and C. Latyševa: Application of the method of moments to the approximate solution of linear differential equations with unitary coefficients.

S. JANČEVSKIJ: Complex equation of Fredholm.

B. V. NUMEROV: Compiling a fundamental catalogue of faint stars.

B. V. NUMEROV and D. CHRAMOV: Determination of the shape of the geoid by gravity measurements.

B. V. NUMEROV: Principles of the method for the determination of the geoid on the basis of gravimetric and astronomical-geodetical observations.

S. I. VAVILOV: Productivity and duration of fluorescence.

S. I. VAVILOV and A. N. SEVČENKO: Extinction of fluorescence by the solvent.

P. BAŽULIN: Absorption of ultra-sonic waves by acetic acid.

N. DOBROTIN: Absorption of neutrons in silver, cadmium and boron (2).

L. A. DREMLJUG: Morphology and cytology of the hybrid of *Nicotiana paniculata* × *N. langsdorfii*.

K. V. KOSSIKOV: A new duplication in the *X*-chromosome of *Drosophila melanogaster* and its evolutionary significance.

V. M. KATUNSKIJ: Short periodical illumination as a method of controlling the development of plant organisms.

P. J. SCHMIDT, G. P. PLATONOV and S. A. PERSON: Anabiosis of fish in super-cooled water (see NATURE, Dec. 5, p. 977).

Washington, D.C.

National Academy of Sciences (*Proc.*, 22, 567–619, Oct. 15).

CLAUDE E. ZOBELL and HELEN M. MATHEWS: A qualitative study of the bacterial flora of sea and land breezes. Wind is an important factor in the exchange of land and sea bacteria. Although many marine forms may survive in the soil, and few terrestrial bacteria survive in the sea, yet exposure of culture plates showed the presence of marine bacteria 30 miles inland, and terrestrial forms 130 miles at sea during relatively calm weather. Bacterial content may aid in indicating the origin and course of large air masses.

L. J. STADLER and G. F. SPRAGUE: Genetic effects of ultra-violet radiation in maize. (1) Unfiltered radiation. Irradiation of pollen greatly increased the frequency of both entire and fractional endosperm deficiencies, and point mutations affecting seed and seedling characters were induced; but no increase in frequency of translocation was observed. (2) Filtered radiation. Radiation of wave-length λ 3130 and longer is relatively ineffective, while λ 3022 and shorter wave-lengths are effective in inducing deficiencies. (3) Effects of nearly monochromatic λ 2537, and comparison of effects of X-ray and ultra-violet treatment. With radiation from a quartz mercury discharge tube, the relative frequency of induced deficiency is about the same as that for longer wave-lengths, but the maximum dose tolerated is much lower. X-rays (1333 r.) produced deficiencies most of which affected the whole endosperm, while a large proportion of deficiencies produced by filtered ultra-violet light affect approximately half the endosperm. The frequency of germless seeds produced by pollen irradiated with X-rays was very much higher than for pollen treated with filtered ultra-violet light.

B. P. KAUFMANN: A terminal inversion in *Drosophila ananassæ*.

TZE-TUAN CHEN: Observations on mitosis in Opalinids (Protozoa, Ciliata). (1) The behaviour and individuality of chromosomes and their significance. In *Zellerella intermedia*, from the rectum of a toad, there are two identical nuclei, each with 24 chromosomes arranged in twelve pairs; the chromosomes are recognizable by constant differences of size, structural peculiarities and position of point of fibre attachment. The behaviour of the chromosomes in cell division is fundamentally the same as that of chromosomes of higher animals and plants. (2) The association of chromosomes and nucleoli. Nucleoli, four, six or more number according to the race of *Z. intermedia* under investigation, are found, each pair occupying a definite non-terminal position on a specific pair of chromosomes. Unlike the nucleoli of higher organisms, they maintain their relation with the chromosomes during cell-division, dividing with the chromosomes. The nucleolar material is considered not to be identifiable with the macrochromatin of the macronuclei of other ciliates.

H. BATEMAN: Progressive waves of finite amplitude and some steady motions of an elastic fluid. A theoretical discussion.

Official Publications Received

Great Britain and Ireland

Croydon Natural History and Scientific Society. Regional Survey Atlas of Croydon and District. Pp 19+12 plates+Locator template. (Croydon: Roffey and Clark, Ltd.; London: Thomas Murby and Co) 12*s*. 6*d*. [212

P E P (Political and Economic Planning). Report on the Supply of Electricity in Great Britain: a Survey of Present-day Problems of the Industry with Proposals for Reorganisation of Electricity Distribution. Pp. vi+171. (London: P E P.) 6*s* net. [412

Twenty-seventh Report of the Commissioners of His Majesty's Customs and Excise for the Year ended 31st March 1936. Being the 80th Report relating to the Customs and the 79th Report relating to the Excise (Cmd. 5296.) Pp. 219. (London: H.M. Stationery Office.) 3*s*. 6*d*. net. [412

The Teaching of General Science: Science Masters' Association Interim Report of the Sub-Committee appointed in 1935, adopted by the General Committee in 1936. Pp. v+49. (London: John Murray.) 2*s*. 6*d*. net. [712

Electricity (Supply) Acts, 1882 to 1936 Sixteenth Annual Report of the Electricity Commissioners, 1st April 1935 to 31st March 1936. Pp. 195. (London: H.M. Stationery Office.) 3*s* net. [812

Technical Publications of the International Tin Research and Development Council. Series A, No. 47: The Preparation of Tin and Tin Alloys for Microscopic Examination By H J. Taffs Pp. 9+5 plates. (London: International Tin Research and Development Council.) Free. [912

Rubber Growers' Association. Rubber and Agriculture Series, Bulletin No 5: The Uses of Rubber in Stable Management. By Alexander Hay. Pp. ii+16. (London: Rubber Growers' Association.) Free. [912

Other Countries

Les bases de l'influence des phénomenes solaires en météorologie Par Henri Mémery. Pp. 32. (Talence: Observatoire de Physique solaire et Météorologie.) [112

Astrophysica Norvegica Vol. 2, No. 1: On the Trajectories of Electric Particles in the Field of a Magnetic Dipole with Applications to the Theory of Cosmic Radiation. By Carl Størmer. Pp. 124+20 plates. (Oslo: Jacob Dybwad.) [112

A Compendium of Minerals and Stones used in Chinese Medicine from the Pen Ts'ao Kang Mu, Li Shih Chen, 1597 A D Compiled by B E. Read and C Pak. (Published by the Peking Natural History Bulletin) Second edition. Pp. viii+98. (Peiping: The French Bookstore.) 1.50 Chinese dollars. [412

II Internationalen Kongress fur Krebsforschung und Krebsbekämpfung (IInd International Congress of Scientific and Social Campaign against Cancer) Vol. 1. Referate (Reports). Pp. xvi+503 (Bruxelles: Comite National d'Organisation.) [412

U.S. Department of Agriculture. Circular No. 401: Control of the Japanese Beetle and its Grub in Home Yards. By W. E. Fleming and F. W. Metzger. Pp. 15. 5 cents. Circular No. 410: Results from Breeding Rabbits that are Suckling Young. By Chas. E. Kellogg Pp. 8 5 cents. (Washington, D C: Government Printing Office.) [712

Report on the Administration of the Meteorological Department of the Government of India in 1935–36. Pp. ii+37+2 plates. (Delhi: Manager of Publications) 14 annas; 1*s*. 6*d*. [712

Catalogues, etc.

Second-hand Books in many Departments of Literature, together with a Selection of Remainders. (Catalogue 400.) Pp. 74. (Oxford: B. H. Blackwell, Ltd)

Calendar for 1937. (Newcastle-on-Tyne: C. A. Parsons and Co., Ltd.)

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Rearmament and the League of Nations

ALTHOUGH general, but by no means unqualified, support has been given to the Government's programme of rearmament, the impossibility of attaining security in this way alone is fully appreciated by all thoughtful opinion; and much of the support of the Government is conditional upon its efforts to promote collective security and the methods of peaceful change which will diminish the causes of international friction and misunderstanding. Misgivings about the extent of the Government's constructive effort in this field are, however, still apparent.

Unless men are sane enough to recognize that under modern conditions the changed nature of modern warfare makes its renunciation as an instrument of national policy not merely an ideal but also an essential, catastrophe cannot be averted. The most untoward consequence of the present concentration of effort on national rearmament is that it distracts attention from the underlying issues and constructive efforts to find a real basis for peace. Rearmament is at best a counsel of desperation, and no Government to-day has discharged its obligations in the matter of national defence if it has not at the same time explored to the utmost the possibilities not merely of collective defence and security but also of the removal of causes of international friction and of the organization of peace.

The limitations of rearmament, however, are none the less made manifest from time to time, as in the recently published report of the sub-committee of the Committee of Imperial Defence on the vulnerability of capital ships to air attack. While no ship is less likely to be destroyed by air attack than the heavy battleship, the report is on the whole inconclusive. On the high seas, in the main, an air force is still unable to perform the functions of a navy, but the vital question of vulnerability in the narrow seas around the coasts of Great Britain remains undetermined. The sub-committee considers that the day of the capital ship is not over, now or in the near future, but it is clear that while impressed with the vulnerability of the battleship to concentrated air attack under favourable conditions, the Committee merely shrinks from making a decision where the consequences of a mistake might be so serious.

The very inconclusiveness of the report indicates, however, the changed position of Great Britain in regard to defence. Its insularity has gone for ever, and now the ability of the Navy to perform its time-honoured functions can be called in question without instant refutation. Moreover, evidence provided by such a report is very welcome as coming from those the sincerity of whose efforts to secure effective defence cannot be questioned.

This is, in fact, one of the most untoward consequences of the political discussion of rearmament. There is a disposition to assume that those who doubt or deny the possibility of effective aerial or naval defence under modern conditions are anxious to commit the country to the opposite policy of pacificism, and to overlook the extreme dangers which Fascism and militarism offer to the best in man's heritage to-day. Accordingly, Mr. Jonathan Griffin's "Alternative to Rearmament"* is to be welcomed as a vigorous demonstration of a constructive alternative policy which should commend itself to a great body of moderate opinion in Great Britain which, while convinced of the necessity of improving defence, is indisposed to afford the militarists *carte blanche* and realizes that rearmament alone can offer no solution.

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* Alternative to Rearmament. By Jonathan Griffin. Pp. xii+215. (London: Macmillan and Co., Ltd., 1936.) 6s. net.

Mr. Griffin is under no illusions as to the consequences of rearmament, and quotes comprehensively from authorities to demonstrate the extreme vulnerability of Great Britain to air attack, and the impossibility of any really effective defence. He does not, however, urge that the only policy is one of developing our air forces so as to be capable of rendering instant and equally heavy reprisals. On the contrary, he argues convincingly that to rearm with bombers in this fashion would almost certainly precipitate conflict, and he urges accordingly that our policy should be to concentrate on the measures which would make this country less vulnerable but which would not be construed as a threat to other countries.

On the question of defence without menace, Mr. Griffin makes numerous constructive proposals. He questions the utility of those air-raid precautions which undermine liberty, such as masks and drills, which he stigmatizes as deception, not defence. He urges instead the duplication, dispersal and protection of essential public services and buildings; development of fire-fighting services; exploration of the possibilities of searchlights; the rebuilding or evacuation of great towns; the development of anti-aircraft guns; provision of fighting planes instead of bombers, and above all the adequate organization of the storage of food. If we could store a year's food supply, we should be freed from dependence on the doubtful ability of the Navy to fill its old functions, and in this we should be offering no menace to other countries.

The defence policy advocated thus aims at saving life, not at maintaining morale, and it is insisted that we should avoid measures involving education of the public in passive defence as much as that the policy outlined should be used as an alternative to rearmament. Rearmament should only be permitted on the condition that menacing armaments are definitely limited and co-ordinated for collective security; that there should be no provocation except sanctions against an aggressor; no commitments except the Covenant of the League and a Europe-wide system of collective security against aggression from the air.

On many of these points it is clear that Mr. Griffin is already assured of the support of scientific workers who have devoted attention to this question, and his statement is to be commended to the growing number of scientific workers who are concerned about the prostitution of scientific effort for war purposes and look for some solution which offers a chance of constructive effort for peace and security, and who are prepared to take trouble to sift out the facts from the prejudices in which they are so often embedded.

Many of Mr. Griffin's arguments are underlined in the restatement by Lord Davies of views on the relations of force and law in the light of the unhappy experience of the Italo-Abyssinian conflict*. While he contributes little that is new, Lord Davies, without dwelling unduly on the mistakes of the past, emphasizes the steps which can and must be taken to prevent a like outrage again endangering the foundations of our common security and order. No reader of this book can be blind to the mistakes which Great Britain, though not this country alone, has made, and its failure to render wholehearted and unambiguous support of the collective principle at decisive moments.

Here again is the constructive and practical outlook which scientific workers should welcome. The case for federation and an international police force is set forth with an urgency and relevance which are fresh and effective, even to those familiar with Lord Davies's earlier books. Notably is this true of his discussion of the reform of the League, the present ineffectiveness of which he attributes, after the reluctance of certain powerful members to use the machinery already existing, to the absence of federation in Europe. A new and reformed League must be based on an impartial exploration of the possibilities of the federal system in Europe. Much indeed could be done within the framework of the present Government, and the book contains trenchant criticism of the premature judgment passed on the sanctions system from an experience of its very limited and partial application.

Like Mr. Griffin's book, "Nearing the Abyss" is a challenge to further thought and investigation on vital matters while yet there is time, and both books will indicate fields in which the help of scientific workers is welcome if not essential. Equally impressive is the plea which Mr. C. R. Buxton has recently entered† for an exploration of the possibilities and mechanism of peaceful change in such fields as access to raw materials, population, mandates and the like.

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* Nearing the Abyss: the Lesson of Ethiopia. By Lord Davies. Pp. xiii+182. (London: Constable and Co., Ltd., 1936.) 3*s*. 6*d*. net.

† The Alternative to War: a Programme for Statesmen. By C. R. Buxton. Pp. 176. (London: George Allen and Unwin, Ltd., 1936) 4*s*. 6*d*. net.

Scientific workers who will take the trouble to examine the material now available, in these three books and elsewhere, cannot fail to realize how wide is the field awaiting the application of the scientific spirit and the scientific method, or to find some section of the field in which their own contribution might be made to national defence and security, and the development of that educated opinion upon which alone all constructive effort must rest.

Ancient Buildings in Scotland and England

THE discussion which took place in the House of Lords on December 2, when the question was raised as to the preservation of ancient structures in Scotland and England, while achieving little in the way of immediate action, the motions upon which debate arose being by leave withdrawn, was far from abortive. It served emphatically to direct public attention to an irretrievable loss of material of historic or æsthetic value, especially in Scotland, and in the replies elicited from the representatives of the Government, afforded hope of official support and co-operation in the efforts which are being made to avert further destruction, even though the prospects of financial assistance from the Treasury are not encouraging.

The debate was, perhaps, most useful in clearing the way for further action and in suggesting lines along which further effort might be directed. The problems in the two countries, though very similar, are not identical. Whereas in England the question before the House was concerned only with structures of the eighteenth century, in Scotland material surviving from the whole historic period is affected. In both instances, however, the structures are not 'historic' in the technical sense, or 'country houses', but examples of humbler domestic architecture—a class of building which in both rural and urban areas is of special importance for the cultural history of Scotland, where the strongly marked individuality of the people clearly has been affected distinctively by environmental influences. It was pointed out by Lord Hamilton of Dalzell and other members of their Lordships' House, who supported him, that during the last few years destruction has been taking place in Scotland wholesale and at an extremely rapid rate. "Old Scotland," said Lord Crawford, "is vanishing before our eyes."

The tragedy of this destruction lies in the fact that so often it is avoidable, but is justified as a public improvement, or amelioration of social conditions—road-making or widening and the improvement or extension of housing accommodation for the poorer classes. In Scotland, more especially, Government financial assistance has been made available in a form which has acted as a spur to the destructive activities of local authorities, while the private owner, suffering under a public burden in the form of rates—payable in Scotland on empty property—has sought relief from an expense without return.

In his sympathetic reply on behalf of the Government, Lord Strathcona pointed out methods by which complete destruction of buildings worth preservation might be avoided without forfeiting assistance from the Treasury in certain classes of property, and indicated the extent of departmental supervision already exercised in endeavouring to secure that no historically interesting building should be demolished. The financial obligation, however, involved in any promise of financial assistance from the Government towards the cost of preservation is an uncertain factor, and the delay for which Lord Strathcona asked until the information now being collected by the National Trust is available, though unfortunate, is not unreasonable.

The First Commissioner of Works (Lord Stanhope), in dealing with the position of the eighteenth-century house in England, was less sympathetic, and in suggesting that effort should be directed to persuasion of the local authority, upon whom he sought to throw responsibility, he ignored past experience. For their notorious shortcomings in such matters, local authorities are not entirely to blame; and the time has surely come when the public may be regarded as sufficiently instructed in the value of its ancient treasures to accept the overriding verdict of a Department which speaks with full scientific and technical knowledge. The powers of the Office of Works as a protector of ancient structures should be enlarged to cover in some measure inhabited or habitable structures not contemplated in existing provision.

The Impact of Civilization in Australia

(1) North Australia
By C. Price Conigrave. Pp. 319 + 12 plates. (London: Jonathan Cape, Ltd., 1936.) 10*s.* 6*d.* net.

(2) The Red Centre:
Man and Beast in the Heart of Australia. By H. H. Finlayson. Pp. 146 + 52 plates. (Sydney: Angus and Robertson, Ltd.; London: Australian Book Co., 1935.) 7*s.* 6*d.*

(3) All-About:
the Story of a Black Community on Argyle Station, Kimberley. By Mary and Elizabeth Durack. Pp. 105. (Sydney: The *Bulletin*, 1935.) 3*s.* 6*d.* net.

IN these three books Australia is presented from very different points of view; but the three have this in common—their authors are enthusiastic about their subject, and they succeed in conveying no little of their enthusiasm to their readers.

(1) Mr. Conigrave's book, though by no means heavy in treatment, aims at a more or less comprehensive survey of the history, character and resources of the Northern Territory. The story of its discovery, settlement and exploration, and of its fortunes under the administration of South Australia, are told in some detail, but without tedium. North Australia, as the author points out, is not well known, even to Australians, and lack of understanding has been a handicap throughout its history, which has not been removed entirely in the improved conditions under Federal Government. One great obstacle to development, especially of Port Darwin, is the failure to complete the trans-continental railway. There is still a gap of seven hundred miles between the ends of the northern and southern lines. Nevertheless, it will come as something of a surprise to most readers to find that in 1933 there were still only 3,306 inhabitants, apart from the aborigines. Notwithstanding the development of air traffic, Port Darwin, as the first great port of entry to the continent, has not yet come into its own.

Of the many problems for which the Federal Government made itself responsible when it took over the Northern Territory, that of the aborigines was not the least difficult. There are still some twenty thousand aborigines in the Territory. Mr. Conigrave, while admitting the cruelties and injustice meted out to the aboriginal in the early days of settlement, retorts to the criticisms of the South with the *tu quoque* of the complete extinction of tribes in southern lands. Under the Federal Government and with a changing public opinion, he thinks, the aboriginal has a better chance of a fair deal. While the author allows certain good qualities and abilities to the blackfellow, he is, he maintains, an inferior type, which will answer the irresistible call of the white man's civilization, and then inevitably suffer degradation and ultimate extinction.

Is it true, however, that this fate is inevitable? Anthropological science maintains that study of aboriginal character, abilities and institutions, under sympathetic and understanding administration, will go as far as is humanly possible to ensure that changes are along lines which will develop rather than destroy, and, it may be, provide what will prove ultimately an asset in the economy of the State. It is, therefore, gratifying to note that one recommendation made by the author, the reform of judicial procedure in aboriginal criminal cases, has been carried out since he wrote, on lines which would commend themselves to him, by the appointment of an anthropologist to be responsible for investigation and disciplinary measures in all but the most serious cases of aboriginal crime. Further, the administrative changes now being made by the Federal Government should mitigate the destructive impact of white civilization.

(2) Mr. Finlayson has a story to tell which differs essentially from that of Mr. Conigrave; and the difference is not merely that of environment, although his scene is set in the central desert—the 'Red Centre'. If Mr. Conigrave aims at showing what has been gained for Australia through civilization in the development of a once isolated tropical land, Mr. Finlayson, in his turn, shows how some of the most characteristic features of wild life in Australia are being lost rapidly through civilization, even though in the attenuated form of such settlement as is possible in an arid or semi-arid land. The mammalian fauna is in danger of complete extinction, even before it has been adequately surveyed.

In the hope of arousing a public sense of responsibility in Australia, Mr. Finlayson has written a description of the topographical features and the most distinctive forms of the Mammalia to be found in these desert lands. In order that these mammals may be preserved, he suggests that that part of the central area which is now an aboriginal reserve should be declared a national park. As honorary curator of mammals of the South Australian Museum and a close student of the fauna of the central area—he rediscovered *Caloprymnus*, the Plain kangaroo rat, known previously from three specimens only, which were collected in 1843, and lost to sight since that date—Mr. Finlayson speaks with authority.

Nor are the claims to attention of that most important mammal, man, overlooked. Three chapters are devoted to the people known by the Arunta name of 'Loritja'. The author not only takes a sympathetic view of this people, but also gives them an excellent testimonial for intelligence, good temper and generosity, when in their native surroundings and conditions. This estimate of their character is based upon exceptional opportunities for impartial judgment, when the aborigines thought themselves free from observation and were engaged in their ordinary vocations. His view that the settlers' opinion of the aboriginal is not so entirely adverse as its public expression would convey is probably correct. It is clear at any rate that public opinion is growing slowly in the direction indicated by Mr. Finlayson, who holds that a debt is due to the aboriginal, which must be discharged.

(3) The Misses Durack, members of a family which in 1881 first introduced cattle ranching in the Kimberley district of Western Australia, have jointly produced a book, the one providing the letterpress, the other the illustrations, which describes the aborigines, male and female, who work on the ranch and about the house at Argyle Station. It is an entertaining and valuable psychological study, which at the same time affords an instructive picture of the somewhat remarkable relations between employers and employed. The authors have succeeded in conveying vividly to the reader the aloofness of the blackfellow from the white, even after a long and intimate association, and the completeness of the reversion of the aborigines to the wild state, when they take their 'holiday'.

In these three books, it will be seen, three different views of the aboriginal are presented, which concur, notwithstanding differences of conditions, in ascribing to him some excellences, while taking a lenient view of characteristics and qualities for which he has been condemned. All alike will help to fuller understanding.

Foundations of the New Geography

(1) Elements of Geography
By Prof. Vernor C. Finch and Prof. Glenn T. Trewartha. (McGraw-Hill Series in Geography.) Pp. x+782. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 24*s*.

(2) Geography:
an Introduction to Human Ecology. By Prof. C. Langdon White and Dr. George T. Renner. (Century Earth Science Series.) Pp. x+790. (New York and London: D. Appleton-Century Co., Inc., 1936.) 16*s*. net.

THERE is a certain ruthless analysis, a pitiless perfection of detail as it were, about American scientific writings which leaves the reviewer a little breathless. This is well illustrated in the two works now before us They are almost too thorough. Every *i* is dotted, every *t* crossed; it is the *dernier cri* in university geography. This complete presentation of the subject, so typically American, is nevertheless invaluable to the student. If not exactly inspiring, it is at any rate challenging, which is better. "That," say the authors in effect, "is everything known on the subject. Can you get beyond it?" If the student is content to play for safety, he can come to no harm; but equipped so thoroughly for the fray, the pioneer mind will presently find the weakest link in the iron chain of fact, and push outwards into new fields of learning.

These two books aim successfully at a compact presentation of the groundwork of geography, and supplement one another. The new geography recognizes that the study of land forms has no meaning except in relation to the earth's inhabitants, the ultimate stuff of geography. But the science of land forms, and of the elements which shape them, is essential to an understanding of human environment, which is an aspect of geography too often stressed by people who have no very clear understanding of what human environment is.

(1) Profs. Finch and Trewartha describe in detail the natural elements which affect or produce land forms, the climates and their distribution, and the land forms themselves. In Part 2 of their work the cultural elements of the landscape are described in 30 pages, as against more than 500 pages for the natural elements. Part 3 is devoted to a short description of the geographical *realms*, combining the features already described into a geographical unit.

This method of analysis followed by synthesis is useful, although the correlation between the elements and the finished product might have been carried further. Thus nothing is said of mountain regions in the humid tropical realm, and of the conserving role of the forest covering. In fact, the synthetic portion suffers from over-compression. However, the student should be able to apply what he has learnt in the earlier chapters to any natural region in the world. The book can be recommended to university students.

(2) Prof. Langdon White and Dr. Renner begin where Profs. Finch and Trewartha leave off. The latter incline to the traditional view that geography is the science of land forms, and rather evade the question of what use land forms are—even as an intellectual exercise—apart from the human relationship. The former start with geography as a study of environment, and boldly assert the belief of the neo-geographers, that the human relationship concept is the only justification for geography's existence. They assume a knowledge of the elements which make up the landscape, and plunge at once *in medias res* by describing the climatic realms. These are analysed on the basis of the geographical elements, and are followed by a description of the four principal habitats, similarly treated.

Only at the very end of the book, however, do we find a brief account of man as a serious factor in geography. Considering that the whole book aims at describing man's adjustment to, and activities in, his environment, the last chapter might well have been amplified and put at the beginning. The book is both readable and informative, and lavishly illustrated. It should stimulate students to ponder on the great geographical problems of the near future.

Quantum Theory and Physical Problems

Anschauliche Quantentheorie:
eine Einführung in die moderne Auffassung der Quantenerscheinungen. Von Prof. Dr. Pascual Jordan. Pp. xii+320. (Berlin: Julius Springer, 1936.) 13.80 gold marks.

POSSIBLY the description *anschaulich* in the title of Dr. Jordan's book may tend to deter some enthusiasts for quantum theoretical matters from reading it; since it may be claimed that only macroscopic conceptions can make physical theories *anschaulich* and it is just these which the quantum theory throws overboard. On the other hand, such a description is likely to attract those who, while having no great interest in the quantum theory itself, find themselves forced to know something about its pronouncements on various physical problems.

Of course the attribute of *Anschaulichkeit* belongs rather to the description of the empirical material out of which the theory has emerged and especially to Bohr's correspondence principle which, if a paradox may be permitted, is the most important contribution to the quantum theory and yet no part of it at all. It is the one great and indispensable guide in its development. Though perhaps Dr. Jordan (and even Bohr himself) would insist that the correspondence principle is not merely a heuristic device but an organic part of the quantum theory. Indeed such a claim may possibly be consistent with the 'positivistic' outlook of the author and of many other theoretical physicists, especially in Germany.

The book contains a quite admirable presentation of the main features of the quantum theory written by one of the great contributors to it. The importance of a thorough grasp of classical physical theory for a proper appreciation of quantum dynamics is very rightly emphasized in the very beginning of the book. The former indeed emerges from the latter in the limit $h \to 0$. The early chapters deal with the fundamental experimental deliverances which have given birth to the quantum theory, and with their theoretical analysis. Then follows an account of quantum and wave mechanics with a simple proof of the equivalence of the two chief methods of the quantum theory, namely, that of Heisenberg with its matrix schemes and that of Schrödinger with its proper functions and associated proper values.

The part of the book which follows this deals with 'many-body' problems, with Fermi and Bose statistics, relativistic wave equations, nuclear structure and associated things. Here the author has been forced to squeeze a vast amount of material into too small a space with a consequent lack of clarity. Indeed the whole work is rather condensed and therefore more difficult to read than it might otherwise have been. In particular, the description of Dirac's electron theory is obscure. The author might have given a much better justification for equation (15) on p. 208 than the rather feeble statement that the generalization of the non-relativistic Schrödinger equation can only have the form (15). One wants to know the origin of the $h\,\delta/2\pi i\,\delta x - e\,\varphi/c$ which is so prominent in the equation. And why are there only four of the matrices α ? Why not another matrix α in front of μc instead of $\sqrt{-1}$ in (23) on p. 210 ?

The latter part of the book has a distinctly philosophical character. It deals with the positivistic method, causality statistics and finality and the structure of the real world. No doubt the name positivism is applied to the philosophy of Mach and his disciples because of its resemblance to the philosophy of Comte ; but its most distinctive features are *negative*. It is nearly always *rejecting*, and in the microphysical world it rejects the causality which has dominated science until the present day.

The main epistemological principle of positivism seems to be that which permits only those statements to have a meaning which can be confirmed or denied by the outcome of some actual or conceivable experiment. It has at least one success to its credit. It rejected the ether and thus facilitated the development of the theory of relativity. Many of us, however, will doubt whether this principle is a safe guide, and will prefer the philosophical outlook of Planck, to whose genius and intuition the quantum theory is due. W. W.

Structure and Activities of Protoplasm

Protoplasm

By Prof. William Seifriz. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. x+584. (New York and London : McGraw-Hill Book Co., Inc., 1936.) 36*s*.

BROADLY speaking, there are in the field to-day three views of the constitution of protoplasm. While all are agreed that protoplasm is essentially a colloidal system, these views differ as to the kind of colloidal system which constitutes the living substance. According to one opinion, protoplasm is a liquid with a low viscosity and the general properties of a suspensoid or lyphobe system ; according to another view, protoplasm is much more viscous and possesses rather the properties of a multiphase emulsoid or lyophile colloidal system ; while the third view lays emphasis on its elastic properties which bring it rather into the category of gels. The chief exponents of the first two views, Profs. Heilbrunn and Lepeschkin, have already published books dealing with protoplasm and expounding their particular points of view. With the publication of a work on protoplasm by Prof. Seifriz, we have now a reasoned account of the subject by the chief exponent of the third view, which may be summed up in the words of the author : "Though often fluid, and though superficially an emulsion, protoplasm is primarily and fundamentally a lyophilic colloidal system, that is to say, a jelly".

The writer of a book with the simple title "Protoplasm", unlimited by any particular aspect of the subject, has to decide two main points with regard to the scope of the book. One of these is how much knowledge of physics and chemistry his readers may be assumed to possess, the other is how much of what are called cytology and general physiology of the cell should be included. Actually quite a large proportion of Prof. Seifriz's book is devoted to a discussion of certain aspects of physics and chemistry, no less than 17 of the 27 chapters having physical or chemical titles such as "The Colloidal State", "Adsorption", "Viscosity", and it is a question whether most readers of a book of this kind would not already be acquainted with much of the physical and chemical information provided. Certainly most students in England who would want to read this book would have a general knowledge of the properties of colloidal systems, carbohydrates, fats and proteins, and know the meaning of the terms normal solution, electrolytic dissociation, hydrogen ion concentration and *p*H. It seems to the reviewer that all these matters are now so adequately dealt with and accessible in text-books of various branches of chemistry that a book with the title of "Protoplasm" is unnecessarily overloaded with such material when it reaches the proportions it does in the volume under review.

To a less extent the same criticism can be levelled against the book with regard to the quantity of material contained in it which deals with the physiological properties and behaviour of the cell. Thus there are chapters entitled "Permeability", "Electrophysiology" and "Regulatory Substances" (that is, hormones and vitamins), matters which are regarded as part of the province of physiology. Of course, it is quite logical to take the view that the study of protoplasm includes that of its activities, and that on these depend almost the whole of the physiological behaviour of the organism. Indeed, on p. 42, the author writes, at the end of a chapter on cytology : "Such are cells ; with these and the matter that fills them does this book deal". All the same, the subject of cell structure is generally called 'cytology' and that of cell behaviour 'cell physiology'. Moreover, it is not clear why, if a treatise on protoplasm is to have such a wide scope, some aspects of cell physiology, such as those mentioned above, are included, while others, such as respiration, a universal property of living matter, are excluded.

What, then, of protoplasm itself ? The chapters dealing definitely with the subject of the book are the first ("The Living Substance"), the fourth and fifth on "Micrurgy" and "Tissue Culture" respectively, and the fifteenth ("The Structure of Protoplasm and Organic Colloidal Matter"). There are also throughout the book, even in chapters purporting to deal with chemical and physical subjects, constant references to the bearing on protoplasm of the subjects discussed. To the reviewer, the chapter on the structure of protoplasm is the most interesting in the book, for in this the author presents his reasons for regarding protoplasm as possessing a fibrillar structure ; reasons, the forcefulness of which readers must judge for themselves, but which the reviewer must confess he does not find particularly convincing.

The reviewer is mystified by the arrangement of the material in the book ; why, for example, the chapters on carbohydrates, fats and proteins follow, instead of precede, the chapter dealing with the structure of protoplasm.

All the same, if the contents of the book do not fit the title, and if they are strangely arranged, they do comprise much valuable and interesting material. The author states in his preface that the book is written for students of biology and medicine and the related fields of biophysics and biochemistry. Actually, as already indicated, it contains among other material, accounts of physical and chemical principles with which students of physiology should be acquainted, and as such can be recommended to those who require a text-book bringing together necessary information on these matters. The reviewer, however, cannot help feeling that Prof. Seifriz would have rendered much greater assistance to students of biology if, instead of bringing together the materials he has into one book, he had divided it and written two books, one comprising an exposition of the fundamental physical and chemical principles necessary for an understanding of physiological processes, the other a work more strictly confined to an account of protoplasm. The latter might well have included not only a detailed statement of his own views of the structure of the living substance, but also a reasoned criticism of other views of the constitution of protoplasm with which he may not be in agreement.

Bird Migration

Bird Migration:
a Short Account. By Dr. A. Landsborough Thomson. (Birdlovers' Manuals.) Pp. 224+6 plates. (London: H. F. and G. Witherby, 1936.) 5*s*. net.

AN account of a subject with as many ramifications as bird migration can be handled in different ways. Dr. Landsborough Thomson has chosen to present the subject from the impartial point of view of a well-informed spectator. He has neither pet theories to develop nor a personal axe to grind. His treatment is comprehensive in spite of rather severe space limitations, and the vast array of facts is systematically marshalled and logically presented.

The book is quite general and deals with migration in the widest sense. Specific examples of migratory behaviour are not too freely used and are drawn in the main from British sources. Authors are sparingly cited and there is no bibliography. Readers interested in more particular knowledge are referred to a short list of suitably selected works.

The make-up of the book is attractive and its few illustrations are unusually well reproduced. Occasional inaccuracies occur, as in the description of the migrations of the American golden plover. The statement that the spring passage is through the interior of the continent and the autumn passage over the Atlantic from Newfoundland to the Lesser Antilles is only partly correct. Actually it is only the adults that use the latter route in the autumn, while the immature birds proceed south separately through the interior, generally at a later date. It would be nice to see this classical but incorrect account dropped permanently from migration literature, particularly in a book with the merits of this one. The author appears to be over-cautious in his treatment of modern investigations. Even if their final implications are as yet open to doubt, they should at least be mentioned if there is no space to accord them a brief description.

It seems regrettable that interest in bird migration should be largely confined to ornithologists. The present volume, short but dependable and eminently readable, contains much food for thought for the general biologist.

WM. ROWAN.

Handbuch der Astrophysik

Herausgegeben von G. Eberhard, A. Kohlschütter, H. Ludendorff. Band 7: Ergänzungsband, Berücksichtigend die Literatur bis Ende 1934, nebst einem Generalregister des Gesamtwerkes. Pp. ix+756. (Berlin: Julius Springer, 1936.) 129 gold marks.

THE previous volumes of this "Handbook" came out during the course of the years 1928–33. As the articles were mostly undated, the general effect was ragged. This supplementary volume serves three purposes. It gives a common date, the end of 1934, up to which the literature of the separate branches has been considered by the writers of the articles, it covers the recent developments of the subject-matter and it fills gaps in the earlier discussions.

The same subdivisions of each chapter are followed as in the earlier volumes, new items being indicated by placing letters *a,b,c,* after the number of a paragraph. The practice of different contributors in distinguishing new topics from additional or supplementary material has varied; still, the affixed letters do direct attention to the most recent developments in the subject. It is significant that in the section on photometry there are 48 new paragraphs and only 18 supplementary ones. In this section there is no reference to recent work on the profiles and central intensities of spectral lines; these are only referred to in the appropriate sections dealing with the sun and the stars, but in view of the amount of work done since 1929, one would have expected some notes in the section on spectral photometry.

It is impossible to mention all the thirty articles in a short notice, but we can note in that by Dr. Wurm on band spectra an interesting new section on astrophysical applications. In two articles, on the "Thermodynamics of the Stars and Pulsation Theory" and on "The Ionization in the Atmospheres of Celestial Bodies", Dr. Bengt Stromgren has given a full account of recent work on stellar interiors and radiation, having to blend in his treatment references to the articles of Prof. Milne and Prof. Pannekoek in the earlier volumes.

In rounding off various topics and in giving a combined subject-index, this supplementary volume adds appreciably to the value of the earlier parts of the "Handbook", and the editors are to be congratulated on bringing a long and arduous task to a worthy conclusion.

The Earth's Magnetism

By Prof. S. Chapman. (Methuen's Monographs on Physical Subjects.) Pp. xi+116. (London: Methuen and Co., Ltd., 1936.) 3*s*. 6*d*. net.

THE phenomena comprised under the general head "Terrestrial Magnetism" are important, and their explanation is still far from complete. A concise account of present knowledge of the subject was needed. From the hand of one who himself has contributed largely to recent advances such an account is doubly welcome.

In his small monograph, "The Earth's Magnetism", Prof. Chapman has attempted at least to touch upon all material points, leaving amplification of details and theory to a more extended treatise which is already planned. A relatively large amount of information is given, however, about effects of solar and even of lunar origin, the existence of which has been demonstrated by laborious statistical treatment of observatory records and could not otherwise be revealed. The inclusion of a number of illustrative diagrams is helpful in this section. The author's terse and graphic style matches the compact form in which the subject is presented. Readers will find themselves carried on from page to page with absorbing interest.

A few typographical errors in formulæ await correction in subsequent editions; while the method of measuring horizontal force by the Schuster-Smith coil-magnetometer, described on page 7, should be restated, as it differs in a fundamental particular from the method actually proposed by Schuster and employed in the instrument. W. M. W.

Annual Survey of American Chemistry

Vol. 10, 1935. Edited by Clarence J. West. (Published for the National Research Council.) Pp. 487. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1936.) 25*s*. net.

THIS volume presents an interesting view of the progress made in certain branches of pure and applied chemistry in the United States during 1935. The fact, however, that it deals only with the work of one nation, limits its usefulness as a guide to the advancement made in any particular subject, and leads perhaps to a somewhat distorted view. Nevertheless, it provides an excellent résumé of the activities of American chemists, and moreover supplies a comprehensive bibliography of their work.

The subject matter is divided into twenty-five chapters, each compiled by an expert in the topic under review. For the most part, these are well written, interesting and readable, even although the space available necessitates considerable compression and permits of only a brief summary of the many contributions made in each section. Thirteen of the chapters deal with pure chemistry while the remainder are devoted to industrial chemistry. Included in the latter is a chapter on chemical economics which, like one or two other sections, covers a longer period than one year. G. R. D.

The Little Wolf:

a Story of the Coyote of the Rocky Mountains. By Wendell and Lucie Chapman. Pp. xii+140+31 plates. (London: Charles Scribner's Sons, Ltd., 1936.) 6*s*. net.

No one can have travelled in the western States of America without having become more or less acquainted with the coyote. But whether one has done so or not makes little difference to the enjoyment of this book, which is a true piece of nature study at its best. The authors have spent years in the uninhabited sections of the western part of the United States and Canada, and have been able to make friends with the shyest of wild creatures, observing them at work and play, and finally enlisting the help of the camera. Both the story and the illustrations are excellent.

Theory of Complex Atoms[*]

INTRODUCTION

THE structure of complex atoms forms one of the main fields of application of quantum mechanics to many-body problems. The subject has two main aspects: the outer electronic structure, taking the nucleus as a point charge; and the structure of the nucleus.

In considering the outer electronic structure in non-relativistic approximation, which is sufficient for evaluating the main features of the structure of all but the heavy atoms, the forces involved are known, so that an exact wave equation can be written down, and the only difficulty, though a formidable one, is to obtain a solution of it. In the relativistic treatment of the electronic structure, there is the additional difficulty that the exact interaction between two electrons is as yet unknown, so that no exact wave equation can be written down; whereas in the nucleus the quantitative behaviour of the forces concerned are almost entirely unknown, and even their nature is still uncertain.

QUANTITATIVE EVALUATION OF ATOMIC STRUCTURES IN NON-RELATIVISTIC APPROXIMATION

The calculation of atomic properties usually involves a knowledge of the atomic wave functions, and the first step is therefore the evaluation of such wave functions; no exact solution of the wave equation of a many-electron atom is known, and one has to be content with an approximation. The 'solar system' type of approximation, in which the mutual interactions of the electrons are first neglected, and later introduced as a perturbation, is too crude to give significant quantitative results.

A simple type of approximation is to reduce the many-body problem to a set of one-body problems by regarding each electron as being in the field of the nucleus and some average of the field of the other electrons. This type of approximation had already been found to be qualitatively, and roughly quantitatively, successful in the days of the old quantum theory; wave mechanics made it possible to apply it much more precisely, and led Hartree[1] to the idea of the 'self-consistent field', in which each electron is considered to occupy a definite wave function in the field of the nucleus and of the average distribution of charge of the other electrons. In so far as the description of the structure of an atom in terms of occupied one-electron wave functions is significant at all, the electrons cannot really be ascribed each to a specific one of the wave functions, but account should be taken of the possible exchange of electrons between them in obtaining the average field of each electron; this improvement was carried out by Fock[2].

The solutions of the differential equations of the self-consistent field, either with or without exchange, have to be evaluated by numerical integration. Solutions of the equations without exchange have been carried out for a number of representative atoms up to mercury; the solution of the equations with exchange presents a much more formidable problem of numerical technique, but has been carried out for several atoms up to copper.

Another, more analytical, approach to the determination of approximate wave functions is provided by the variation principle, which also provides a criterion for comparing two approximations, without knowing the exact wave function. This principle states that the value of a certain integral expression, involving an arbitrary function, is an absolute minimum when evaluated for the wave function of the normal state, and has certain minimal properties for that of any excited state. It can be applied to the determination of the best approximation of any particular form to the wave function of an atom in two ways.

One way is to take for the whole atom a wave function constructed in a definite way out of adjustable *functions* of the variables of the system; the variation principle then leads to differential equations for the unknown functions. This method was used by Fock[2] to derive the equations of the self-consistent field with exchange, and shows that the solutions of these equations provide the best possible wave functions for the whole atom that can be obtained, so long as the structure is regarded as consisting of a number of one-electron wave functions each occupied by an electron.

The other way is to limit the functions to specified analytical forms (usually sums of products of exponentials and polynomials), with adjustable *parameters* whose best values are determined by the appeal to the variation principle. This method has been used by Zener[3] and others[4] to obtain

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[*] A review of a group of papers by Prof D. R. Hartree, F.R.S., Dr. B. Swirles and Dr. H. S. W. Massey, read to Section A (Department of Mathematics) of the British Association at Blackpool on September 14.

The general impression created by the fauna is that it represents the Upper Pleistocene period (Gamblian Pluvial period). In Kenya the fauna of the Gamblian Pluvial is known to consist mainly of living species with a few extinct ones, among which is *Bos bubalus*, and an extinct antelope. The presence of rolled teeth and bones of the older fauna cannot be used for dating this deposit because they are obviously derived fossils. Prof. Detreich has examined the fauna since I left Berlin, and has confirmed the views expressed above.

CULTURE OF THE REMAINS

Associated with the fauna described above was a large series of stone artefacts, the majority of which are unrolled and of apparently the same date as the unrolled fauna. Careful examination of every specimen showed that the culture was essentially of Levalloisian type. There are many 'tortoise cores', some of them having had Levallois-type flakes struck from them and some of them having been prepared but unstruck. With these cores are large numbers of absolutely characteristic Levallois flakes with faceted striking platforms. Only two or three pieces, however, show any signs of secondary retouch.

Compared with Levallois material from elsewhere in East Africa, my own impression is that the assemblage represents a stage of development similar to that which occurs in deposits which can be dated to the early and middle part of the Gamblian Pluvial period. The evidence of the culture thus corroborates the Gamblian age suggested by the fauna.

Associated with the Levallois assemblage were a very few broken Acheulean hand-axes, as well as many lumps of lava. Personally, I am inclined to regard these few broken hand-axes as having been picked up and brought to the site with the rough blocks of lava as raw material for making the artefacts of Levalloisian type.

THE SKULL

The skull, which is unrolled, and in exactly the same state of fossilization as the unrolled faunal remains described above, was represented by numerous fragments, and before it was possible to examine it, Prof. Reck had to fit the pieces together so far as possible. It was my good fortune to assist in this task; many of the fragments fitted perfectly, and when fitted together they were found to represent:

(*a*) the greater part of the left parietal;
(*b*) the greater part of the occipital;
(*c*) the greater part of the left temporal including the mastoid and petrous portions.

In addition, several further fragments fitted together to form a part of the frontal bone, with which were associated two fragments from the supraorbital region; these, however, *did not have any direct points of contact* with the rest of the broken frontal. On the other hand, the occipital, left parietal and left temporal bones fortunately articulated perfectly along the sutures, so that their relation to each other was clear. All the bones are very thick compared with the comparable parts of a modern skull. Figs. 1 and 2 show the result of the preliminary reconstruction, which may be regarded as reasonably accurate so far as these three portions of the skull are concerned, owing to the fact of articulation along the suture lines.

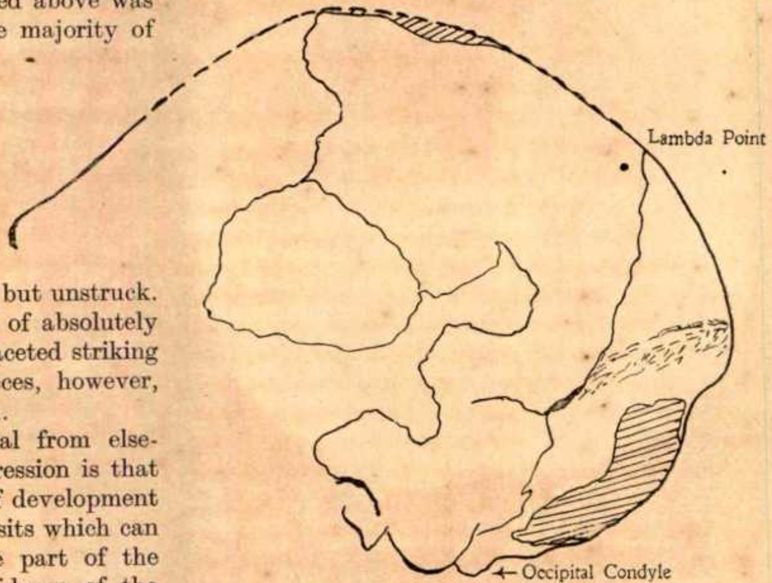

FIG. 1. Profile drawing of the Eyassi skull, based upon photographs. × ½.

The skull presents certain remarkable features. First, the *foramen magnum*, part of which is fortunately preserved, is inclined backwards at an angle comparable to that found in the great apes and quite unlike any *Homo*. Secondly, when viewed from the back, the greatest width of the skull is seen to be in the region of the mastoids, and the form is thus one which approaches that found in *Sinanthropus Pekinensis* rather than any other known human skull. Thirdly, the external occipital crest is very strongly marked, but is smooth and rounded in form. Unfortunately, the fragments of frontal bone which fit together do not have any point of contact with the parietal, so that their exact relationship to the rest of the skull can only be guessed. What is, however, important is that the fragments of supra-orbital show clearly that the skull had a torus (Fig. 3) not unlike that in *Sinanthropus*. One of the fragments is from the region of the glabella and the other from the right external orbital angle.

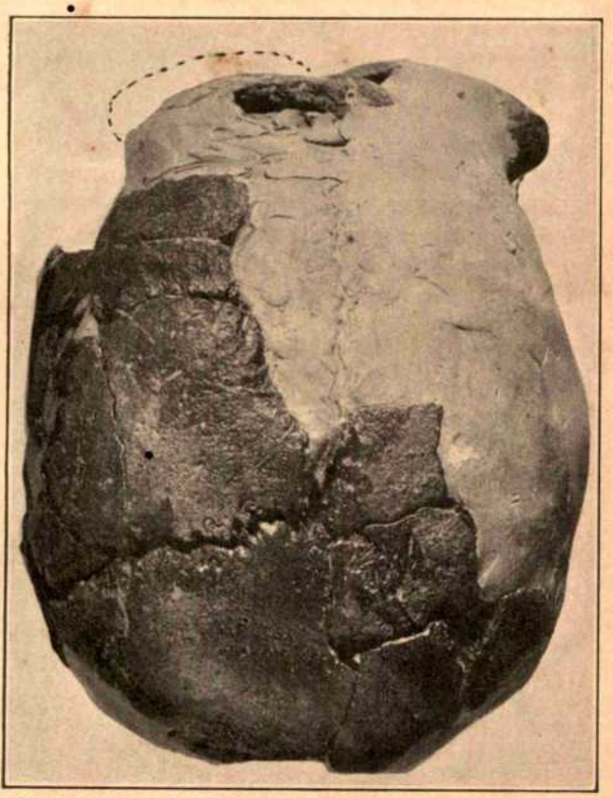

FIG. 2. The Eyassi skull fragments set on a rough block of plasticene. (Owing to tilting, the front is foreshortened.) × ½.

In addition to the parts already mentioned, there is a fragment of the left maxilla which contains the broken sockets of the two incisors, the left canine and first premolar teeth, and the broken socket of the second premolar. There is also a loose upper (first ?) molar of which the roots are somewhat damaged. (It should be pointed out here that in the illustrations published in *Forschungen und Fortschritte* of September 1, this molar tooth is shown in the position of the second premolar, having been mistakenly fitted into the broken socket of that tooth.)

The teeth are well worn and have several remarkable characters, but all that need be said at present is that the canine is of human rather than anthropoid proportions and form, and that there seems to have been no diastema between it and the incisors.

One other small fragment, which does not, unfortunately, fit on to the major portions of the skull, deserves special mention. This is a part of the tympanic plate from the right side (that on the left side is broken away although the rest of the left temporal bone is more or less complete) which is remarkably like that of a chimpanzee, and quite unlike the form found in *Sinanthropus* or, so far as I know, in any *Homo*.

SUMMARY OF PRELIMINARY CONCLUSIONS

Dr. Kohl-Larsen has undoubtedly discovered an exceedingly interesting and very important new document relating to early man. The skull represents a low type of human with some markedly anthropoid characters (the angle at which the *foramen magnum* is set, and the nature of the tympanic plate, for example) while in other ways it approximates more to the type represented by *Sinanthropus* than to any other known human fossil. In a preliminary report by Prof. Reck and Dr. Kohl-Larsen, it is attributed to the genus *Palæoanthropus*, but my own view is that it will have to be accorded new generic rank, although it doubtless belongs to the palæoanthropid branch of the human stem.

This new East African skull is associated with a stage of the Levalloisian culture and with a fossil fauna which both strongly suggest an Upper Pleistocene (early or middle Gamblian) date.

Quite apart from the fact that the skull represents a new genus of man, it is of the greatest importance because it once again demonstrates the association of the great Levalloisian-Mousterian culture complex with that branch of the human stem which is characterized by a massive torus and other specialized features which are never found in any *Homo sapiens*, but are typical of the palæoanthropid branch of man. It is also of particular importance because it demonstrates still further the already established fact that during the Pleistocene period (and even the Upper Pleistocene), the human family was represented in the world by a number of distinct genera and species, of which only one, *Homo sapiens*, has survived.

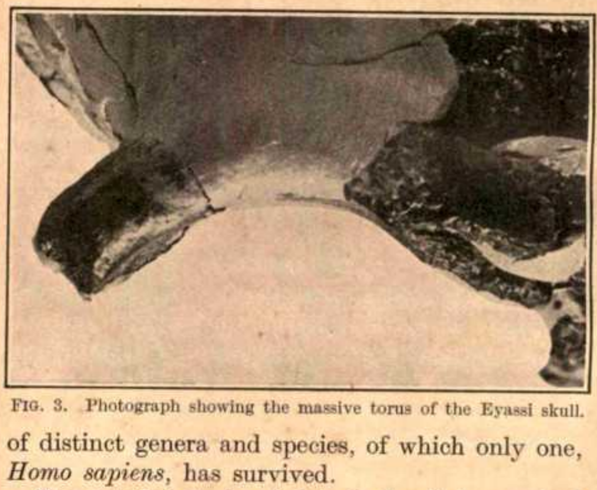

FIG. 3. Photograph showing the massive torus of the Eyassi skull.

The detailed study of this skull will be awaited with the greatest interest.

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[1] "Erster Ueberblick uber die Jungdiluvialen Tier-und Menschenfunde Dr. Kohl-Larsen im Nordöstlichen teil des Njarasa-Grabens (Ost-Afrika) und die Geologischen Verhaltnisse des Fungebietes," *Geologische Rundschau*, Nov. 1936.

The Imperial Cancer Research Fund

THE thirteenth report of the British Empire Cancer Campaign was dealt with in NATURE of December 12. We have now received the thirty-fourth annual report of the Imperial Cancer Research Fund*. The Fund began in 1902, and its activities have been in the main devoted to the experimental study of cancer in its own laboratories; besides being one of the first, it has earned its position as one of the leading organizations for the study of malignant disease, and the high quality of the work done under its first two directors, Dr. E. F. Bashford and Dr. J. A. Murray, has been generally recognized. The Fund is under the direction of the Royal Colleges of Physicians and Surgeons, and it has until now been housed in their Examination Halls on the Embankment and in Queen Square, London; more room is now needed, and a new building is to be put up at Mill Hill with plenty of spare land leased from the Medical Research Council. When the cause and cure of cancer have been ascertained, the Royal Colleges will have the duty of diverting the endowment to some other line of medical research; meanwhile, there is no reason for supposing that the new director, Dr. W. E. Gye, and his assistants will not have their hands full with the multiplicity of work in various directions into which modern cancer research has developed.

The present report details sound progress, though Dr. Gye has nothing sensational to announce. He stresses the necessity of distinguishing between two categories of 'causes' of cancer which are sometimes confused. There is first the nature of the intrinsic cellular change which confers upon a cell the property of malignancy, that is, its dissociation from functional relationships with the rest of the body and its capacity for continuous and autonomous growth. The factor which produces this change resides in the cell, and cannot be attributed to external agents; it is the proximate cause of cancer and we know little about it, but seeing that in essential characters all malignant cells are alike, we may surmise that the nature of the change is always the same. It may, however, be preceded by a number of remote causes of diverse nature which bring about the fundamental intracellular change—radium, X-rays, many chemical substances, etc.—and of these we now have fairly extensive knowledge which, if it tells us little about the nature of malignancy, enables us on one hand to prevent some cancers in man, and on the other to produce fresh tumours in animals for experimental study. Another general point brought out in several places in the report is the importance of constitution or diathesis, which comes out clearly now that more precise methods of starting tumours are available, and it seems that this concerns particular organs rather than the animal as a whole.

Much attention has naturally been paid to the virus tumours which can be transferred from one animal to another by cell-free extracts. Attempts to repeat McIntosh's observation that fowl tumours produced by chemicals could be transmitted by filtrates all failed, but it was found that such cell-free extracts injected into rabbits would, equally with tumour tissue, excite the appearance in the blood of a capacity to neutralize the virus of the Rous sarcoma. Since the same chemical (tar, dibenzanthracene, etc.) will induce tumours in mammals as well as birds, it seems likely that something like a virus can be evoked from all cancers. The whole question is at the moment extremely complicated. The effect of radium has also been further investigated, especially by the study of its action on various enzyme systems: it appears that radiation inhibits the utilization of carbohydrates by the cells, which are driven to get their energy from proteins.

The report also announces that the Duke of Bedford has felt compelled to resign from the office of president after more than thirty years service, and that he will be succeeded by Viscount Halifax.

SIR BASIL MAYHEW, vice-president, presiding at the general meeting of the Imperial Cancer Research Fund held on December 15, stated that the new building at Mill Hill will cost £20,000 and a further £10,000 will be required for equipment. The Fund has £11,000 in hand; it requires £19,000. Referring to the relationship of the British Empire Cancer Campaign to the Imperial Cancer Research Fund, he said that the latter has raised large sums, and its policy is to use them in endowing and supporting institutions and individuals engaged in research work. Many of those to whom such grants have been made by the British Empire Cancer Campaign have been supplied with scientific material by the Imperial Cancer Research Fund. By this means, investigators have been enabled to start on their researches at a stage far in advance of that otherwise possible. Advice and suggestions are given whenever asked, facilities are given for research workers to use the Fund's laboratories, and tests are undertaken of cancer 'cures'.

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* Thirty-fourth Annual Report 1935–1936 of the Imperial Cancer Research Fund. Pp. 44. (London: Imperial Cancer Research Fund, 1936.)

Obituary

Dr. W. Schmidt

THE news of the death on November 27 of Dr. Wilhelm Schmidt, the director of the Central Institute of Meteorology at Vienna, comes as a great blow to his friends and colleagues in meteorology and geophysics. Many of us had seen him recently at Edinburgh at the meeting of the International Union of Geodesy and Geophysics, quite recovered from his illness, keen and interested as always, full of energy and to all appearances with a long period of active scientific work still before him.

Wilhelm Schmidt was born on January 21, 1883. His forbears, as his name indicates, were smiths, in a village some 12 km. from Innsbruck. His grandfather, a man of great courage and determination, decided to go to the University at Innsbruck to study, and began to walk there and back every day, working in the smithy before he started and after he got back. Schmidt may be said to have inherited from him his determination and his capacity for work.

After an education at the University of Vienna, Schmidt entered the Central Institute for Meteorology and Magnetism and was appointed assistant in 1909. I first met him there at the beginning of 1909 when Trabert was director and Julius Hann, former director and editor of the *Meteorologisches Zeitschrift*, had his room at the Institute. Among Schmidt's colleagues in the Institute were Exner, Defant, Wagner, R. Schneider, Hanzlik and von Ficker—a notable company.

Schmidt's main interest at that time, as indeed in later years, lay in the study of the structure of the atmosphere. It was a time when the first fruits of the international investigation of the upper air were being gathered. He was anxious to test their basis and invited me to collaborate with him in finding the lag of the instruments which were being used. The result proved to our satisfaction that the stratosphere could not be explained away as due to lag in the instruments.

Shortly afterwards, Schmidt turned his attention to an examination of barometric waves of relatively short period, particularly in the neighbourhood of Innsbruck. He found that the waves agreed with the waves which would be expected at the boundary between two currents of different density and that observations of cloud confirmed his deductions. He gave an account of his experiments at the Sheffield meeting of the British Association in 1910.

During and after the Great War, Schmidt became specially interested in the phenomena of turbulence and worked on this subject at about the same time as G. I. Taylor was working on it in Great Britain. The results of his work he embodied later in a book entitled: "Der Massenaustausch in freier Luft und verwandte Erscheinungen". Schmidt attacked the problem of turbulence in a slightly different way from that adopted by Taylor. His development of the theory was based on the assumption that an eddy carried with it (at least throughout the period of life in which it is of interest) the momentum with which it enters the field of observation. The quantity which he defined as *Austausch* is equal to the eddy viscosity multiplied by the density. The lead which Schmidt gave has been followed by other writers such as Prandtl and von Kármán.

In this as in other branches of meteorology, Schmidt always wanted to get behind the formulæ and the mathematics to the underlying physical principles. This is illustrated by a remark of L. F. Richardson's about the independence of the coefficient of eddy diffusion of the quantity diffused: "This was explained by G. I. Taylor and later W. Schmidt gave the general notion behind any mathematical argument in the form that an exchange of mass goes on, and that the measure c will be the same for any properties which this mass simply carries with it."

In 1930 Schmidt was appointed editor of the *Meteorologische Zeitschrift* in collaboration with Süring, and under his editorship the *Zeitschrift* maintained its high position as the leading monthly meteorological journal of the world.

In 1924 Schmidt was appointed professor of meteorology at the Agricultural College at Vienna, and he became particularly interested in problems of local climatology. During this period and the period while he was director of the Institute after the death of Exner in 1930, he gave himself wholeheartedly to investigations in this subject. It was at a time when funds for scientific research were very difficult to secure in Vienna, but he managed to get some help from the Deutsche Notgemeinschaft and he fitted out a travelling observatory for investigating the practically simultaneous variations in conditions in different parts of Vienna and the neighbourhood. Later on, he extended these investigations of local climate and micro-climatology to some parts of the Austrian Alps, and he gave a lecture before the Royal Meteorological Society in March 1934 briefly describing this work. In the following year he described the results of his investigations of turbulence and of the flow of air in the neighbourhood of the ground in a paper read before the Royal Aeronautical Society.

Early in 1935, after the death of Prof. Wallen, Schmidt took charge of the International Commission for Agricultural Meteorology, of which he had been secretary, and he was elected president at the meeting of the Commission in Danzig in 1935. At the end of 1935 he was awarded the Symons Gold Medal of the Royal Meteorological Society, perhaps the highest meteorological award of any in the world. His most recent work was a book written in collaboration with Dr. Brezina on "Kunstliche Klima in der Umgebung des Menschen", a copy of which he sent to me with a friendly note on November 25, only two days before he died.

Schmidt loved the country and the mountains as he loved his work and intercourse with his colleagues. He was a great meteorologist and a lovable man. His loss will be keenly felt by all who knew him personally and by many who knew him only through his published work. It is a blow which falls particularly severely on Vienna, the more so coming as it does after the sudden and unexpected death of Exner six years ago. E. GOLD.

Prof. J. T. Cash, F.R.S.

JOHN THEODORE CASH, emeritus professor of materia medica and therapeutics in the University of Aberdeen, who died on November 30, was a man of wide sympathies and, to those fortunate to know him intimately, a delightful companion. Born in Manchester in 1854, he studied arts and medicine at Edinburgh, qualified as M.B., C.M. in 1876, and proceeded to M.D., his thesis for which earned a gold medal, in 1879. After qualification he worked and studied at Paris, Vienna, Berlin and Leipzig.

Cash's early interests were in physiology and hygiene, but later they became almost purely pharmacological. The post-Continental period he spent in London, and investigated the pharmacological action of organic lead compounds, the action of chemical disinfectants (which he reported to the Local Government Board), and contributed, with Lauder Brunton, an important paper on the connexion between chemical constitution and physiological action to the Royal Society. He was elected a fellow of the Royal Society in 1887.

The appointment of Cash to the chair of materia medica and therapeutics at Aberdeen in 1886 was a surprise, for the chair had previously been held by medical practitioners, and Theodore Cash was a pure researcher. The appointment was, however, fully justified. Although only a part-time job, he devoted himself wholly to university work. A student of his first class was Arthur Cushny, who became successively professor of pharmacology in the University of Michigan, in University College, London, and lastly professor of materia medica and therapeutics in the University of Edinburgh.

At Aberdeen, Cash continued his investigations on chemical constitution and physiological action, then on the action of the pure organic nitrites prepared by Dunstan, and later on the action of the aconitines, which also had been prepared by Dunstan. The results were incorporated in papers to the Royal Society. They show that thoroughness and attention to detail which is characteristic of all Cash's work. He also investigated and wrote, among other matters, on tobacco smoking and skin irritants. His administrative work was equally thorough. For a time he was dean of the Faculty of Medicine and the University's representative on the General Medical Council. His work was acknowledged by the LL.D. of Edinburgh and, after retirement, of Aberdeen.

Cash was renowned as a fisherman as well as a pharmacologist. Once, the present writer when at a fisherman's inn in Scotland inquired from a visitor what fly he used and he replied "Cash's". On relating the incident to Prof. Cash, he confessed to having prepared and tried his own flies. This incident illustrates the man; he was as modest of his prowess with the rod as of his abilities in other spheres. He fished nearly all the streams of the British Isles, and up to a few years ago could still be found occasionally on the banks of his beloved Don.

Prof. Cash married the youngest daughter of the Right Hon. John Bright. Her death, soon after their removal to Hereford, was a great blow to him. There are four children of the marriage, two sons and two daughters, to whom we extend our sympathy.
C. R. M.

Dr. G. Schack-Sommer

DR. GUSTAF SCHACK-SOMMER died in London on October 16, aged eighty-two years. The sugar industry, home-grown sugar in particular, and his many friends will regret the passing of one who was blessed with a charming personality and presence, and whose interest in sugar was maintained to the last. He was unmarried. It was his intention to be present at the International Conference of Sugar Analysts in London in September, but unfortunately he was prevented by ill-health at the last moment. His family home was at Marienlyst, Elsinore, in Denmark, but at the time of his birth in 1854 his father was Danish Consul in Hamburg, and it was there that he spent his school life, although the summer vacation was always spent at Elsinore. In 1872 he was attracted to Heidelberg by the work of Bunsen, Kirchhoff and Kopp, and in 1875 he graduated and obtained his Ph.D. degree. His first professional post was in a German chemical works.

In 1877 Dr. Schack-Sommer decided to live in England and took the opportunity offered him to assist at one of the first alkali works in this country, the Newcastle Chemical Works. In 1878 he left Newcastle for Liverpool, where he joined the sugar-refining firm of Crosfield, Barrow and Co., of which he became a partner in 1884. In the same year he renounced his Danish nationality in favour of English. In 1881 he assisted in the foundation of the Society of Chemical Industry; he became a fellow of the Institute of Chemistry a few years later.

Dr. Schack-Sommer's early years in Germany had impressed upon him the benefits resulting from the growing of sugar beets, and from 1889 until 1895 he was instrumental in the growing of sugar beet in Lancashire and Ireland. Each year the results were carefully tabulated, supporting his contention that the crop was as suitable for England as for the Continent. With other pioneers, of whom Lord Denbigh and Sir George Courthorpe were the chief, he never missed an opportunity either at lectures or meetings of impressing all concerned with the merits of beet growing in this country. In 1890 he delivered a lecture which was attended by many members of Parliament interested in agriculture, and he was one of the earliest members of the British Sugar Beet Council, becoming chairman of the Liverpool section in 1895. He frequently recalled the pleasure it had given him to be present at the invitation of Sir George Courthorpe when the first batch of white sugar ever produced from English grown beets was completed at Cantley in 1912. Earlier attempts in 1868 at Lavenham had only produced syrups.

In 1894 the refinery of David Martineau and Sons, one of the oldest established in the sugar industry, was burnt to the ground, and in the following year Dr. Schack-Sommer assisted members of the old company to carry on its tradition by the formation of a new company. Of this company, now known as Martineaus, Ltd., he became the first chairman, a position which he held for thirty years, until advancing years prompted him to retire at the age of seventy-two. His tact and ability during these years are gratefully remembered, and even in his retirement he was a frequent visitor to the place of his former labours up to within a fortnight of his death.

Mr. Hugh Richardson

We regret to learn that Mr. Hugh Richardson, who for many years had a stimulating influence upon school science teaching, died on November 24 at seventy-two years of age. Mr. Richardson was educated at Bootham School, York, and King's College, Cambridge, where he graduated in 1887. In the following year he became a master on the modern side of Sedbergh School, Yorks, where he remained until 1897, when he became science master at Bootham School, remaining in that position until he retired in 1914. He was an enthusiastic teacher with unusually wide interests and fertility of ideas; and his work at Bootham School represented science teaching at its best, being both practical and comprehensive. The school possesses an astronomical observatory, and Mr. Richardson used this to teach astronomy by similar practical methods to those adopted by him for instruction in physics and chemistry, botany and geography. He was an examiner in botany for matriculation at the University of London in 1904–7, and was secretary of the Educational Science Section of the British Association during the years 1906–15.

When attention was being given to the application of scientific methods in the teaching of geography, Mr. Richardson, with the late Mr. A. T. Simmons, produced in 1905 the first helpful guide for use in schools, in their "Introduction to Practical Geography". He was also the editor from 1911 until 1919 of a Nature Study Series published by the Cambridge University Press.

During the last twenty years Mr. Richardson has led the life of an enlightened country landlord in Northumberland, planting trees, studying butterflies and their natural history relationships and raising varieties of primulas and gentians. He maintained to the last a keen interest in all developments of science and their relation to human life and will be remembered with affection and esteem by all who came in contact with him in educational and scientific circles.

We regret to announce the following deaths:

Sir John Bland-Sutton, Bt., president of the Royal College of Surgeons in 1923–26, on December 20, aged eighty-one years.

Prof. F. A. Laws, emeritus professor of electrical measurements in the Massachusetts Institute of Technology, on November 12, aged sixty-nine years.

Prof. R. F. C. Leith, emeritus professor of pathology and bacteriology in the University of Birmingham, on December 14, aged eighty-two years.

Sir John Robertson, C.M.G., O.B.E., professor of hygiene and public health in the University of Birmingham, on December 16, aged seventy-four years.

Prof. H. Westergaard, formerly professor of statistics in the University of Copenhagen, known for his statistical work in connexion with population and other social problems, on December 13, aged eighty-four years.

News and Views

Twelve Notable American Inventions

The granting of patents in the United States was provided for in the Constitution, and on April 10, 1790, Congress specified how patents were to be issued. It was, however, not until an act of July 4, 1836, that the Patent Office was established under a Commissioner. In that year, too, the Patent Office started numbering serially the patents issued. In connexion with the centenary of these events, a list of twelve of the inventions that have done most to change life in America, together with the inventors' names, has been drawn up. The list is as follows: The telephone, Alexander Graham Bell (1847–1922); the electric telegraph, Samuel Finley Breese Morse (1791–1872); the electric light, the cinema and the gramophone, Thomas Alva Edison (1847–1931); the commercial steamboat, Robert Fulton (1765–1815); the aeroplane, Wilbur Wright (1867–1912); the air-brake for trains, George Westinghouse (1846–1916); the linotype machine, Ottomar Merganthaler (1854–99); the sewing machine, Elias Howe (1819–67); the cotton gin, Eli Whitney (1765–1825); the vulcanization of rubber, Charles Goodyear (1800–60); a practical reaping machine, Cyrus McCormick (1809–84); and aluminium manufacture, Charles Martin Hall (1863–1914). The compilation of any such list is always a matter of great difficulty, but there can be no question that the inventors and inventions here recalled are truly representative of the great contributions to mechanical progress by men of American nationality.

Coulomb and Structural Engineering

To mark the bicentenary of the birth of Charles Augustin Coulomb (1736–1806), to which reference was made in NATURE of June 13, p. 976, Mr. S. B. Hamilton read to the Newcomen Society on December 16 a paper dealing with his work as a "Pioneer in the Science of Construction". After briefly sketching Coulomb's career, Mr. Hamilton dealt first with Coulomb's paper written in 1773 entitled "Essay on the Application of the Rules of Maxima and Minima to Statical Problems Relating to Architecture". This paper, which has never been published in English, was concerned with beams, piers and arches. Mr. Hamilton then turned to the researches of Coulomb on torsion, and after reviewing the work of Galileo, Mariotte, Hooke, La Hire and many others, he said that Coulomb, in considering the strength of materials, realized that brittle materials subject to crushing failed by shear; that he recognized the truth of Hooke's law and gave it its true place in elastic theory; that his theories of bending and twisting, although incomplete, were a sound contribution to knowledge, and still provide the basis of everyday calculations; that by a stroke of genius he anticipated the modern view that elastic strains are due to distortion of the space lattice within a crystal, while plastic deformation and fracture are due to the development of slip planes; and he also derived a satisfactory *simple* method of calculating the thrust of earth against retaining walls, and made a sound contribution to the study of masonry arches.

Air Raid Precautions

THE sixth of the handbooks issued by the Air Raid Precautions Department of the Home Office is entitled "Air Raid Precautions in Factories and Business Premises" (London : H.M. Stationery Office, 1936. 6*d*. net), and is intended primarily for factory occupiers, for occupiers of large commercial premises and other employers of labour, on whom would rest in time of emergency a responsibility for the protection of their employees while at work and the safeguarding of their property. The handbook explains that the air raid precautionary services which are being organized by local authorities all over the country should be supplemented by the individual efforts of householders and of employers of labour. It is suggested that in undertakings employing considerable numbers of workers, a scheme of air raid precautions embracing as many as possible of the services required should be worked out. The importance of close co-operation with the local authority of the area is stressed. Since in the event of air attack it would be impossible to improvise the necessary precautionary measures at short notice, the measures to be adopted should be surveyed at the present time and the necessary plans and preliminary arrangements made for putting them into force without delay. The handbook contains detailed guidance on means of protecting employees against gas, and blast and splinters from high-explosive bombs; the safeguarding of property and material from damage, and arrangements for emergency repair work; first-aid facilities; the organization of adequate fire-fighting appliances, including special measures to deal with incendiary bombs; decontamination of material affected by persistent gas; provision of emergency communications and steps to ensure the effectiveness of lighting restrictions. Employers of labour are recommended to prepare schemes covering these aspects of air raid precautions and to arrange for their employees to receive training in the duties involved.

Celtic Studies

MR. J. M. DE NAVARRO, in his John Rhŷs Memorial Lecture for 1936, delivered before the British Academy on December 17, surveyed the history of research in an early phase of Celtic culture, dealing with the La Tène period of the European Iron Age, in which the Celtic peoples emerged from the half light preceding the dawn of written history. He pointed out that the geographical extension of the La Tène civilization and its association with Celtic peoples was first determined by Sir Augustus Franks. Subsequent research has tended to confirm his views. No serious contribution to the study of this civilization was made before the fifties and sixties of the last century, when Thurnham, Franks and the German archæologist Lindenschmidt made research possible by assembling various La Tène types into a definite group. The problem was at first approached in the light of literary evidence. Therefore, Mr. de Navarro went on to show, special importance is attached to the typological work in 1885 of Tischler, which resulted in his division of the La Tène period into three phases, and the work five years later of Sir Arthur Evans on the Aylesford urnfield, a contribution of which the significance is felt more to-day than it was then. After reference to Reinecke, Déchelette and others, special mention was made in dealing with post-War activities in this field to the work of Jacobsthal, who like Reinecke was a trained classical archæologist. He viewed the La Tène style on its own merits, and not as a mere barbaric reflection of classical art. Finally, in discussing the locality in which the La Tène civilization originated, M. de Navarro expressed himself as in agreement with Déchelette and Dr. R. M. Wheeler in placing it in the region of the rich Early La Tène chieftains' graves of the middle Rhenish area.

Central American Studies: The Copan Project

DR. A. V. KIDDER, reporting on the work of the Division of Historical Research of the Carnegie Institution, Washington, D.C. (Year Book, Carnegie Institution of Washington, 1935), in Central America during the year 1935, records two additions to the already wide range of subjects embraced in the Institution's scheme of correlated research in the archæology, ethnography, physical anthropology and human ecology of Yucatan and Honduras. The new activities are the Copan Project and the Maize Survey. The Copan Project is a joint undertaking with the Government of Honduras to conserve and make available for scientific study and lay observation outstanding examples of the architectural and sculptural art of the ancient Maya. Similar work has already been carried out by the Institution on the temples of Chichen Itza and the stelæ of Quirigua. Copan is a centre in which are the finest products of the art of the Old Empire of the ancient Maya. It has the added interest that not only was it one of the first sites investigated by those pioneers of Central American archæology, Stevens and Catherwood, in the earlier half of the nineteenth century, but it was also the site from which A. P. Maudslay obtained, at his own expense and with immense difficulty and labour, his famous collection of plaster casts of architectural and artistic detail, of which examples are now displayed in the British Museum, after many years of neglect. The operations of the Institution at Copan began in 1935 under Mr. Gustav Stromwik, and have already produced important chronological data relating to pottery found at the base of reconditioned stelae.

The Maize Survey

THE Maize Survey has been established by the Institution in co-operation with the United States Department of Agriculture, officers from the Department being seconded for the purpose. The object of the survey is to investigate the origin of maize and to make a study of the maize agronomy of the Maya area. Although maize is the cereal which made possible the rise of pre-Columbian American civilization, its ancestry is problematical and it is not known certainly where and when it was brought under cultivation—a question having an intimate bearing on the beginnings of higher New World culture, including that of the Maya. In reporting on the results of a preliminary survey, which lasted for about a month in the field, Messrs. R. A. Emerson and J. K. Kempton offer certain tentative conclusions, which will serve to throw some light on the density of the ancient population and the relative proportions of the urban and agricultural population. The cultivation of maize, as at present practised, is on the milpa system; that is, a plot, after being burned off, is cultivated for two years, when it is allowed to revert to forest conditions, taking about eight to ten years to become completely re-established and ready for burning off again. Consumption is at an average rate of 1·6 lb. per head per day, which gives an annual consumption by a family of two adults and three children requiring from three to four acres under cultivation. This is about the amount which the Indians now claim to cultivate. The milpa system is the only system possible in Yucatan, even with modern tools and transport, and may, therefore, be presumed to be that followed by the ancient Maya. There is no evidence that it might not be followed indefinitely. The region, as thus cultivated, is capable of supporting a population of fifty persons per square mile, with ten persons as non-agricultural urban inhabitants. Maize cultivation has now completely supplanted the cotton grown by the ancient Maya, and only a small quantity of tobacco is grown.

New Exhibits in the Museums at Kew

THROUGH the generosity of various firms, the Royal Botanic Gardens, Kew, have recently acquired some additional specimens of general interest to the public. A new set of examples in Museum IV showing the various processes in the manufacture of a modern tennis racket has been presented by Messrs. F. H. Ayres, Ltd. The old method of making a tennis racket was to bend a single strip of ash into the required shape, but now a better process has been developed by the use of laminated wood of various kinds. In the modern examples on exhibit, the outer layer is of English oak, the innermost is of ash, and the several ply between are of Canadian birch and English beech with an insertion of walnut. The wedge at the top of the handle is of English sycamore, the top and side clasps are of Malayan lauan, whilst the wedge bend is of Canadian rock elm. A very carefully prepared series of veneers is shown in Museum No. III. The samples shown have been presented by Messrs. John Wright and Sons (Veneers), Ltd., Avon Wharf, Mile End Road, E.3, many of them having been supplied by the firm for the interior decoration of the *Queen Mary*. The veneers are cut from logs obtained from many parts of the world, some of the species being rare and not even yet known botanically. By very thin cutting in various directions a single tree supplies a great quantity and range of veneers, and very large sheets are obtained by cutting around the tree with a rotary machine. In the same Museum (No. III) new exhibits include a fine series of photographs by Dr. I. B. Pole-Evans, which give a good idea of the floral regions of South Africa, and alongside are bouquets of some of the beautiful everlasting flowers (mostly Composites) from the same region. These have been sent by Dr. Fourcade, Humansdorp, and Dr. Muir, Riversdale. In the large Indian case at the west end of the building are displayed a series of botanical paintings of Swiss alpine plants by the late Miss Sidney E. Forster and presented by Miss A. E. Pepys in 1934, together with a fine set of coloured postcards of similar subjects from the private collection of the Director.

'Degassing' by Electricity

IN *World Power* of October an interesting device is described for 'degassing' underground channels, such as sewers, drains and conduits, which has been used successfully abroad. Many large towns have records of street explosions proving the dangers arising from fortuitous concentration of gases such as methane, ether and benzene arising from the greater use of petrols in vehicles and the increasing variety of industrial chemical processes. As a rule, these gases are heavier than air, and become highly explosive when mixed with it. The apparatus consists of a motor-driven centrifugal suction fan. This is connected by suitable tubing to a floating suction head. The heavy gases are collected as nearly as possible at the level of the water at the suction head and pass through the tube with considerable velocity to the fan in the container. The power taken to drive the fan is only nine hundredths of a horsepower, and its capacity is a third of a cubic metre per second. The electrical vehicle used for transporting the degasser is operated by an 80-volt battery. According to recent experiments, an area contained by a circumference of about 300 metres and covering sewers approximately 1,000 metres in total length can be degassed in 10–15 minutes. It was proved that the ordinary method of circulating fresh air in the system was useless and sometimes dangerous.

Effects produced by Ultra-Sonic Vibrations

AN abstract of a paper read by Dr. L. A. Chambers of the School of Medicine of the University of Pennsylvania to the Institute of Radio Engineers, on the effects produced by intense sounds on liquids, has been issued by Science Service, of Washington, D.C. The intense sounds produce impacts on the liquids comparable to mechanical blows and make changes in them which will sometimes be useful in science and industry and should prove most useful in the field of medicine. Dr. Chambers uses sound vibrations having a frequency of 1,200 cycles per second and an intensity which is at least equal to one hundred times that of a large orchestra when playing together. These vibrations are produced by electric oscillators and kindred devices. When milk has been subjected to these vibrations, it acts as if it were purely homogeneous. The cream cannot be made to separate from it, and it is stated that it is now more digestible. Rapid progress is being made in the field of medical research, and it has been shown that certain organisms are killed by the pressure pulses. Dr. Chambers' researches have shown that these intense mechanical vibrations will be most useful for the preparation of serums. Whisky subjected to this treatment aged very rapidly. Samples subjected to it for seven hours produced a whisky which experts stated to be equivalent to one which had been aged in the wood for four years in the usual way.

Forests in the Canadian Prairie Provinces

A FOREST SERVICE BULLETIN, No. 88, has been issued under the auspices of the Department of the Interior, Canada (Ottawa, Printer to H.M. the King, 1936) entitled "Forest and Forest Industries of the Prairie Provinces" by J. D. B. Harrison of the Division of Forest Economics. The Prairie Provinces occupy a part of the interior continental plain of North America and have thus many characteristics which differentiate them from other parts of the Dominion. A National Forest Inventory was commenced jointly in 1929 by the Dominion and provincial forest authorities but had to be retarded owing to the general economic situation; in spite of this it has proved possible to collect a large amount of information on the subject of these Prairie Provinces and this the author summarizes in the present bulletin. A brief but comprehensive review of the principal factors affecting the forests, together with a description of the forests themselves, is given. The dominance of agriculture as the principal industry of the region is emphasized, and questions of population and of communications dealt with, in order to place the forest resources in their proper economic perspective. Sufficient historical material is included, in the appropriate chapters, to explain the course of events leading up to the present situation. The bulletin is written by an economic research officer from the purely economic point of view. It is, however, none the less disquieting to observe that the forests of a country are still mainly regarded from the point of view of what they can be made to yield in produce to man, whilst the protection they offer to mankind as a whole, and to certain of the natural resources of the country, are so little appreciated until almost irretrievable damage by over-exploitation has been done.

Agricultural Statistics

THE International Institute of Agriculture, Rome, has now published the sixth of its economic commentaries, "The World Agricultural Situation in 1934–5" (price 25 lire). As in the preceding issue, the volume is divided into two parts, the first of which deals with world agriculture and the second with the individual policy and conditions in the different countries. Both sections contain a wealth of interesting material of which it is impossible to give more than the briefest outline. Under the first heading, an analysis is made of the more important changes and trends in world economy as influenced by national planning, together with a survey of the market conditions of the principal agricultural crops and livestock. The year under review was a period of adjustments and adaptations involved in the carrying out of schemes of planning and control rather than a period of new initiations in economic organization, the outstanding feature being the increasing development of economic autarchy, which in theory stands almost universally condemned. The effects of this tendency, economic, political and technical, are discussed at length, and it is shown that greater stability is now being sought by the formation of large economic combinations between countries usually with close political associations. Further, the various forms of industrialization that are taking place in the so-called agricultural countries are shown to be producing far-reaching repercussions upon international economic relations. The information in the second part is principally concerned with Government measures for farm relief and the economic conditions of agriculture prevailing in the various countries. More than thirty countries are considered, information with regard to Austria, Portugal and Portuguese Colonies being included in this issue for the first time. Data for Argentina and Poland which were omitted in the last issue of the commentary are again included.

Medical Centre for Moscow

A LARGE medical centre which will include the All-Union Institute of Experimental Medicine, the institutes of the State Health Department, the Second Moscow Medical University and a traumatological institute, will be built on the outskirts of Moscow between Pokrovskoye-Streshnievo and Khoroshevsky Serebrianny Bor in 1937. Among the buildings already under construction on the site are the Epidemiological and Microbiological Institutes of the State Health Inspection Department, veterinary stations for horses, laboratories where horse serums and vaccines will be prepared and a department to house small animals for experimental purposes. The Traumatological Institute will have a children's clinic for the study of common injuries, especially those sustained in street accidents. An Orthopædic Department, a special jaw clinic, and a large department for mechanical therapy are also included in the plans for this Institute. The buildings of the All-Union Institute of Experimental Medicine will be commenced next spring and will occupy a site of 1,000 acres. The Institute will also serve as a post-graduate medical school.

Gold Coast Surveys

THE report of the Gold Coast Survey for 1935–36 (Accra, 1936. 1*s.*), while recording a steady development of useful work, lays stress on the want of resources for the adequate survey of the Colony. It is the difficulty which most colonial surveys have to face and represents the results of a short-sighted policy. The greater part of the Northern Territories is completely unmapped. In the south and in Ashanti only part of the primary triangulation is completed. Development of prospective mining areas is liable to be checked by want of geological surveys, which cannot be carried out without a topographical map. Air surveys have been considered, but the two difficulties are much densely forested country and a lack of fixed points from which to work. Another urgent matter is the extension of geodetic levelling. An old network of levels exists, but requires checking with modern standards of accuracy.

Steam Locomotives and Small Craft

FROM the Association of Engineering and Shipbuilding Draughtsmen come two pamphlets—"Steam Locomotive Design" by D. Patrick (London: The Draughtsman Publishing Co., Ltd. 4*s.*) and "Small Craft Types" by John A. Mavor (*ibid.* 3*s.*). The former discusses the design of component parts and includes all the more important details, except the boiler and its attachments. An earlier publication dealt with preliminary design, and the present work carries it on from the point at which wheel arrangements, cylinder sizes, etc., have been determined, and, with the above exception, practically completes the subject in relation to engines of normal design. In his pamphlet, Mr. Mavor gives general descriptions and data of the humbler types of craft including trawlers, tugs, lightships, dredgers, etc., and explains the special features and working conditions peculiar to each. The main outlines of their design are presented, and the methods are indicated by which the forms of structure, machinery and fittings are adapted to meet the different conditions under which these ships are navigated and operated.

Catalogue of Fishes

GÜNTHER'S "Catalogue of Fishes in the British Museum" was issued in 1859–70, and has long been out of print. The great work of Cuvier and Valenciennes was never finished, and Günther's is the only complete systematic monograph of the group in existence, and is therefore indispensable to ichthyologists. The time that has elapsed since Günther prepared his catalogue has seen the collection on which it was based quadrupled, and the number of known species about doubled; these factors alone would make the preparation of a revised edition a heavy task, and if to them be added the necessary study of the numerous systematic monographs and faunistic memoirs that have appeared since the catalogue was published, it is clearly one that no man could hope to complete In these circumstances, to meet an evident demand, the Trustees of the British Museum have decided to reissue the "Catalogue of Fishes" in its original form, and at the original price of £3 9*s.* for the complete work in eight volumes. It will be available early in 1937.

Pathology and Bacteriology at Leeds

THE annual report of the Department of Pathology and Bacteriology of the University of Leeds, recently issued, by Profs. M. J. Stewart and J. W. McLeod, gives an account of the teaching and research work and routine examinations conducted in the Department during 1935. The research work includes the systematic investigation of industrial pulmonary affections, studies on new growths, and an investigation of types of the diphtheria bacillus present in six thousand cases of diphtheria occurring in England, Scotland, Ireland and Germany. Prof. R. D. Passey contributes a summary of researches carried out in the Department of Experimental Pathology and Cancer Research.

The Indian Earthworm

TEN years after its first appearance, Prof. K. N. Bahl's monograph on *Pheretima*, the Indian earthworm, has passed into a second edition (Lucknow: Lucknow Publishing House, 1936). That is sufficient to indicate that the work has found its place as a guide to teachers and students of Indian zoology, as one of the excellent series of Zoological Memoirs on Indian Animal Types, projected and edited by Prof. Bahl. The first edition was favourably reviewed in NATURE (119, 557; 1927), and the second is even better in that the author has revised the text and incorporated new information and illustrations.

Birds of Agricultural Importance

THE Ministry of Agriculture and Fisheries has issued, bound in an attractive folder, a group of twenty-three "Advisory Leaflets", dealing with the agricultural activities of common British birds. Several of these have already been referred to in NATURE. The price is 1*s.* 6*d.* net.

The Night Sky in January

IN the middle of the month at 22^h, the full pageantry of the winter constellations is on the meridian; the segment of bright stars is outlined by Capella (near the zenith), the Pleiades and Aldebaran, Rigel, Sirius, Procyon, Castor and Pollux, and so back to Capella. South of Orion's belt may be seen with the naked eye the hazy patch that marks the great gaseous nebula. The planet, Venus, is a brilliant object in the early evening sky; it will continue to increase in brightness until the middle of March. Venus is in conjunction with the moon on January 16^d 15^h and with Saturn on January 24^d 2^h after the two planets have set, their closest approach in the sky being 1·9°. Mars is a morning star as well as Jupiter, the latter rising only about one hour before the sun in mid-January. The phases of the Moon are: Last Quarter, January 4^d 14^h: New Moon, January 12^d 17^h: First Quarter, January 19^d 20^h: Full Moon, January 26^d 17^h. The only bright star to be seen occulted from Greenwich is τ Tauri (mag. 4·3) whose disappearance takes place on January 22^d at 18^h 0·6^m. Members of the Quadrantid meteor shower may be looked for about January 2–3, the radiant point being at R.A. 15^h 20^m and Dec. 53° N. The times of minima of Algol accessible to observation are: January 10^d 4^h, 13^d 1^h, 15^d 21^h, 18^d 18^h, 30^d 5^h.

Announcements

SIR ARTHUR HILL, Director of the Royal Botanic Gardens, Kew, has been awarded a Veitch Memorial Gold Medal of the Royal Horticultural Society for his services to horticulture.

THE American Association for the Advancement of Science will hold its ninety-ninth meeting in Atlantic City on December 28–January 2. The address of Dr. Karl T. Compton, the retiring president, will be entitled "The Electron: its Intellectual and Social Significance". The president-elect is Dr. Edwin G. Conklin. A new feature of this forthcoming meeting is an attempt to bring together for general programmes all those attending the meeting. January 1 has therefore been set aside as "Association Day". On this day, an Association luncheon will be held at which all members may participate; a general lecture on changes in the conception of cancer will be given by Dr. Walter Schiller of Vienna; and in the evening there will be an exhibition of scientific films. The Association will adjourn its sessions to Philadelphia on January 2.

THE well-known publishing firm of Ferdinand Enke in Stuttgart celebrates on January 1, 1937, the hundredth anniversary of its foundation. This firm specializes in works on medicine, natural science and law, and has published a number of important works and periodicals on these subjects.

DR. PAUL RAMDOHR, professor of mineralogy at Berlin, has been elected a member of the Geologiska Foreningen of Stockholm.

PROF. RICHARD KOLKWITZ, professor of botany in Berlin, has been elected an honorary member of the Botanical Society of Japan in Tokyo.

THE first award of two thousand dollars of the Squibb fellowship at Harvard University for research in organic chemistry by E. R. Squibb and Sons, New York, has been made to William P. Campbell of Hagerston, Md., for research in phenanthrene.

THE Institute of Malariology at Rome, directed by Prof. G. Bastianelli, has sent a mission to Abyssinia to study various aspects of malaria. The chief members of the mission are Prof. G. Lega (pathology and clinical medicine) and Prof. G. Raffaele (entomology, epidemiology and prophylaxis).

A STUDENTSHIP is offered to a young, recently qualified medical graduate who wishes to acquire experience in cancer research from the biological point of view and particularly from the virus aspect. The studentship is tenable at the Lister Institute for three years. Further information can be obtained from the secretary, British Empire Cancer Campaign, 12 Grosvenor Road, S.W.1.

H.M. STATIONERY OFFICE is now acting as an agent for the sale of publications of the British Museum. New publications of the Museum will, in future, be regularly listed in "Government Publications", the monthly catalogue of the Office.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

Evening lecturer in electrical machinery and design in the West Ham Municipal College—Romford Road, Stratford—The Principal (December 31).

Assistant curator in charge of the Decorative Department in the Royal Botanic Gardens, Kew—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (January 4).

Lecturer in heat engines in the Wimbledon Technical College, Gladstone Road, S.W.19—The Principal (January 5).

Assistant lecturer in dairying in University College of Wales, Aberystwyth—The Registrar (January 11).

Lecturer in education and psychology in Rhodes University College, Grahamstown—The Secretary, Office of the High Commissioner for South Africa, Trafalgar Square, London, W.C.2 (January 18).

Botanist, advisory officer (Botanical Division), advisory officer (Soils and Chemistry Divisions), and junior assistant (Experiment Station) in the Rubber Research Institute of Malaya—The Secretary, London Advisory Committee for Rubber Research (Ceylon and Malaya), Imperial Institute, London, S.W.7 (January 31).

University professor of pathology in the British Postgraduate Medical School—The Academic Registrar, University of London, W.C.1 (April 16).

Head of the Department of Dairy Chemistry in the National Institute for Research in Dairying, Shinfield, Nr. Reading—The Secretary.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1102.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Isotopic Weights by the Doublet Method

CONTINUING work with my second-order focusing mass-spectrograph, the doublet 31 formed by P and CF has been measured by the use of a mixture of phosphine, carbon tetrafluoride and helium in the discharge. On some of the plates obtained well-matched doublets appeared at 28 due to Si and CO derived from the walls of the tube. This was very fortunate, for the intensities of these lines are virtually beyond any ordinary control. The value of the packing fraction of ^{28}Si deduced is only slightly different from that already given.

The first determination of the packing fraction of an isotope of sulphur has been made by means of the doublet ^{32}S and O_2 obtained by means of a mixture of sulphur dioxide, oxygen and helium.

Measurement of the chlorine isotopes was first attempted with heavy phosphine PD_3 mixed with a little CCl_4. This behaved very badly in the discharge tube, and a much better result was later obtained by the use of propane and methyl chloride which, when suitably mixed, gave three doublets 36 due to H^{35}Cl and C_3, 37 due to ^{37}Cl and C_3H and 38 due to H^{37}Cl and C_3H_2. The masses of the chlorine isotopes were calculated from the first two and the result for ^{37}Cl confirmed by measurements of the third. The following are the results :

Doublet	Number of doublets measured	Difference in packing fraction	Difference of mass
^{28}Si, CO	11	6·15 ± 0·2	0 0172
^{31}P, CF	18	7 88 ± 0·15	0·0244
^{32}S. O_2	18	5·53 ± 0·1	0·0177
H^{35}Cl, C_3	8	6·25 ± 0·2	0·0225
^{37}Cl, C_3H	22	11·14 ± 0·2	0·0412

Symbol	Packing fraction	Isotopic weight
^{28}Si	−4·90	27·9863 ± 0·0007
^{31}P	−5·30	30·9836 ± 0·0006
^{32}S	−5·53	31·9823 ± 0·0003
^{35}Cl	−5·71	34·9800 ± 0·0008
^{37}Cl	−6·10	36 9775 ± 0·0008

In calculating these, I have used the values of the doublets appearing in my two previous letters[1]; however, since these appeared, other workers' values have been published. K. T. Bainbridge and E. B. Jordan[2], using a double focusing mass-spectrograph of about the same dispersion and even greater resolving power than mine, give for the fundamental doublet O,CH_4 a difference of mass of 0·0369 ± 0·0002, whereas I obtained 0·03601 ± 0·00024. The discrepancy only amounts to 5 parts in 10^6 in the absolute mass, but it is well outside the probable error.

I have therefore repeated my measurements with special precautions. The electric deflecting plates were resurfaced, a new front slit was fitted and a different form of discharge tube used, but the mean value given by thirteen doublets was virtually the same as mine given above. No individual doublet in this group even reached the higher figure.

As a final check and to eliminate any possible difference between atomic and molecular lines, I decided to measure the doublet CO, C_2H_4, which will obviously measure the same difference of mass, though less accurately. To get matched pairs in this case has proved extremely difficult, but after long running with pure ethane, this has been done and measurements of ten doublets definitely support my value.

Bainbridge and Jordan do not state with what unit their dispersion coefficients were calibrated. I used the bromine lines to calibrate the instrument originally, and for these two particular doublets was able to check the figures to within a fraction of 1 per cent by the positions of the neighbouring lines CH_3, OH in one case, and C_2H_3, C_2H_5 in the other. The discrepancy therefore remains quite unexplained.

F. W. ASTON.

Cavendish Laboratory,
Cambridge.
Dec. 8.

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[1] NATURE, 137, 357 (February 29, 1936); 137, 613 (April 11, 1936).
[2] *Phys. Rev.*, 49, 883 (1936).

Selective Absorption of Neutrons in Silver

WE have measured the absorption in boron of the neutrons which excite γ-rays in silver. The arrangement used is shown in Fig. 1. The silver in the form of a hollow cylinder 4 mm. thick surrounding the counter was shielded from the effects of stray neutrons by layers of B_4C about 5 mm. thick. After being slowed down by the paraffin block and the thermal neutrons filtered out by a cadmium sheet 0·5 mm. thick, the neutrons passed through the B_4C absorber placed directly beneath the silver.

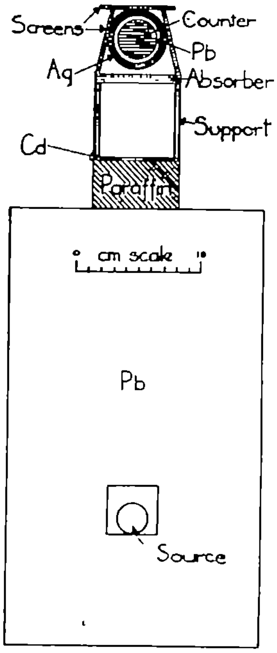

FIG. 1. Experimental arrangement.

Fig. 2 shows the curve obtained when the γ-ray activity induced in the silver is plotted against the amount of boron contained in the absorber. The figure shows also a second set of points obtained when the system consisting of the counter, silver, etc., was lowered 5 cm. The close similarity of the two curves shows that no appreciable correction for geometry is required.

The absorption curve of Fig. 2 may be analysed into two portions as is explained in the figure :

(i) An initial steep exponential decrease corresponding to an absorption coefficient of 8·1 gm.$^{-1}$ cm.^{2}.

(ii) A region of slow, almost linear decrease. Supposing this to be part of an exponential curve, the absorption coefficient is 0·24 gm.$^{-1}$ cm.^{2}. Most likely the curve is a combination of several exponentials. Extrapolating the second component to zero boron thickness, it is found that approximately one third of the total activity is due to component (i).

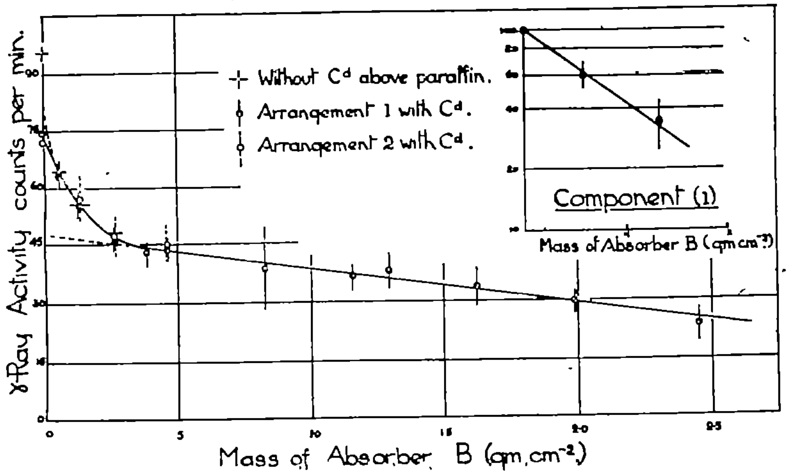

FIG. 2. γ-Ray activity for different boron thicknesses. Three sets of readings are plotted as explained in the text. Inset—Absorption curve for component (1) of the text.

The early part of the absorption curve was also determined without the cadmium filter. The points obtained are also shown in Fig. 2. It is seen to be almost identical with the previous curves except that the point for zero absorber lies about 25 per cent higher. This represents the amount of the γ-ray activity due to neutrons of thermal energy, and is of the same order of magnitude as the activity produced by that component having an absorption coefficient in boron of 8·1 gm.$^{-1}$ cm.^{2}.

On removal of the neutron source, the counter immediately registered its normal natural count, showing that the γ-rays do not arise from a decay process of appreciable period.

It is interesting to note the difference between the above curve and the curves obtained for the absorption of those neutrons which excite the 22 second and the 2·3 minute activities in silver. Both the latter curves can be analysed into an exponential part and an almost constant background representing about 15 per cent of the total activity (when samples of silver 0·5 mm. thick are used as detector). Measurements that have been made on the 22 second period indicate an absorption coefficient in boron (for the exponential portion) of 3·25 ± 0·15 gm.$^{-1}$ cm.^{2}. For the 2·3 minute period, much less accurate measurements indicate for the corresponding coefficient a value of about 1·5 gm.$^{-1}$ cm.^{2}.

Since there are only two known isotopes of silver, it is difficult to decide the origin of the two radioactivities and the γ-ray emission. A possible explanation of the above curves would be that a nucleus can possess two systems of energy levels, one corresponding to β-decay and the other to the emission of γ-radiation.

Assuming that:

(i) the $1/v$ law holds for boron absorption;

(ii) the thermal neutrons which are strongly absorbed in cadmium have energies of $\frac{3}{2}kT$ ($= 0·038$ volt if $T = 290°$ K.), and taking the value for the absorption coefficient in boron of thermal neutrons to be 28 gm.$^{-1}$ cm.^{2} as found by Goldsmith and Rasetti[1], the energy of the first resonance level for the neutrons which produce γ-rays in silver works out at 0·45 volt, whilst that corresponding to the harder component comes to about 500 volts. Since the second component probably consists, however, of the combination of a number of exponentials, the actual spacing of the first and second levels is probably a little smaller than this. Such a value is in good agreement with Bethe's[2] approximate calculations of the spacing of nuclear levels.

We are indebted to the Commonwealth Radium Laboratory for the supply of emanation with which this work was carried out, and particularly to Mr. W. N. Christiansen, who prepared the sources. We also wish to thank Prof. T. H. Laby for assistance in preparing this work for publication.

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R. D. HILL.
A. A. TOWNSEND.

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[1] Goldsmith and Rasetti, *Phys. Rev.*, **50**, 328 (1936).

[2] Bethe, *Phys. Rev.*, **50**, 332 (1936).

Activation of Silver by Neutrons

THE different authors who have dealt with the radioactivation of silver by neutrons agree in admitting the formation of two radio-elements such as would result from a process of neutron capture without emission of heavy particles. One would thus have in both cases

$$^{x}_{47}\mathrm{Ag} + ^{1}_{0}n = ^{x+1}_{47}\mathrm{Ag}.$$

The first radio-element would have a short period: 22 sec. (Amaldi and co-workers; Alichanow; Gaertner, *et al.*) or 26 sec. (Livingston, Henderson and Lawrence). The second one has a longer period 2·3 min. (Amaldi and others, Hevesy and Levi, *et al.*) or 154 sec. (Livingston and others). Bjerge and Westcott[1] alone have found a period of 40 sec., which is different from the generally admitted period.

Further, it seems surprising that the process of radioactivation mentioned above should be the only one observed with silver. Undoubtedly it is the most frequent for the elements beyond a certain atomic number. But would it not be possible to have

$$^{107}_{47}\mathrm{Ag} + ^{1}_{0}n = ^{104}_{45}\mathrm{Rh} + ^{4}_{2}\mathrm{He}\ ?$$

Now $^{104}_{45}$Rh radioactive with a period of 44 sec. is known and results from the irradiation of rhodium by neutrons. Is it not this radio-element that has been observed by Bjerge and Westcott?

In order to verify this conclusion, I have undertaken the following experiments:

(*a*) Irradiation of a silver sheet with the neutrons of a radium-beryllium source, the irradiation being continued for 0·5 min., 1 min., 2 min., followed by observation, with a Geiger-Muller counter, of the activity and of its variation with time; (b) irradiation of the same sheet for the same periods, but with 4 cm. paraffin interposed between the source and the silver.

For the interpretation of the results, we followed the method suggested by McLennan, Grimmet and Read[2]. Repeated experiments gave for the period in case (a) 47 ± 3 sec.; in case (b) 30 ± 4 sec. It seems thus that without paraffin, the swift neutrons form a radio-element different from those formed by slow neutrons. After irradiation for 15 min., one finds a curve which shows a period of 2·5 min. and another period which, in the case of interposition of paraffin, is about 30 sec. and reaches about 50 sec. when no paraffin is interposed.

It seems thus that the action of neutrons on silver determines the formation of three radio-elements: the first one is produced by the swift neutrons, period about 50 sec.; the second is produced only by the slow neutrons, period about 30 sec.; the third with a period of 2·5 min. is produced by the swift and by the slow neutrons, but with an intensity enhanced by interposing a hydrogenated substance between the source of neutrons and the silver.

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Nov. 23.

[1] Bjerge and Westcott, NATURE, **134**, 177 (1934).

[2] McLennan, Grimmet and Read, NATURE, **135**, 505 (1935).

A Simplified Procedure for Determining Normal Boiling Points by the Comparative Method*

ŚWIĘTOSŁAWSKI'S method[1] for determining the normal boiling point of a substance by comparing its boiling point with that of water at three or more pressures, and applying his equation involving the ratio of the *dt*/*dp* coefficients of the two liquids, can be simplified by working as nearly as possible at a pressure of one normal atmosphere. If the manostat, which equalizes the pressures in the two ebulliometers, can be adjusted previously to one normal atmosphere (as determined by the temperature of boiling of water in the barometric ebulliometer) the normal boiling point of the substance in the second ebulliometer can be measured directly.

If, as is likely to be the case, the pressure cannot be adjusted to one atmosphere within the required precision of ± 0·02 mm. of mercury, it is only necessary to make a second pair of observations at a pressure which differs so little from the first pressure that the variation of boiling point with respect to pressure can be assumed to be linear (over the small interval), both for water and for the substance under investigation. If the first pressure is below normal, the second preferably should be above normal, and vice versa. The normal boiling point can then be calculated from the observed boiling points by the use of simple proportion between the observed changes in boiling points and the correction to 760 mm. of mercury, corresponding to 100° as the defined normal boiling point of water. One form in which the equation may be written is

$$t_s = t_{s_1} + \frac{\Delta t_s}{\Delta t_w}(100 - t_{w_1}),$$

in which t_{s_1} and t_{w_1} represent either pair of observed boiling points of the substance and of water, respectively, and Δt_s, Δt_w are the changes in the boiling points occurring between the first and second pairs of observations.

Determination of the boiling point of carbon tetrachloride and of trimethylcarbinol.

Substance	Boiling point of water (°C.)	Boiling point of substance (°C.)	Normal boiling point of substance determined by Świętosławski's procedure (°C.)
Carbon tetrachloride	99 527	76·180	
	99·934	76·608	
	100 000	76·685 (calc.)	76 685
Trimethylcarbinol	99·885	82·240	
	99·980	82 327	
	100 000	82 345 (calc)	82·347

To illustrate the applicability of this simplified procedure, the normal boiling points of carbon tetrachloride and trimethylcarbinol were determined and compared with those obtained by Świętosławski's procedure, using the dt_s/dt_w ratio for reducing to normal pressure the boiling point actually measured. The carbon tetrachloride used for the measurements was of the fifth degree of purity on Świętosławski's scale[2], having a difference of 0·002° C. between the boiling point and temperature of condensation in a standard differential ebulliometer. The trimethylcarbinol was of the fourth degree of purity, having a corresponding difference of 0·007° C. The data are given in the accompanying table.

The agreement of the data obtained by the use of the two methods demonstrates the validity and high precision of the new method. Details will be published elsewhere.

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*Publication approved by the Director of the National Bureau of Standards of the U.S. Department of Commerce.

[1] W. Świętosławski, *J chim. phys* , 27, 496 (1930); *Roczniki Chem.*, 9, 266 (1930).

[2] W. Świętosławski, IX Cong. Intern. Quimica Pur a Aplicada, Madrid, 81 (1934); *Roczniki Chem.*, 13, 176, 227 (1933); *J. Phys. Chem.*, 38, 1169 (1934); *Z. phys. Chem.*, A, 160, 257 (1932).

Vibrations of the Ethylene Molecule

BONNER[1] has recently recorded seven frequencies (1619, 3009, 1341, 3069, 950, 2880 and 1654) in the Raman spectrum of liquid ethylene. In the earlier work of Dickinson, Dillon and Rassetti[2] on the Raman spectrum of ethylene gas, 1623·3, 3019·3, 1342·4, 3240, 3272 and 2880 were recorded. I have recently obtained an intense Raman spectrum of ethylene gas at a pressure of 40 atmospheres using λ4358 radiation, and have measured lines at 1626, 3020, 1343, 2880 and 1656. Thus, both Bonner and I have failed to record the lines at 3240 and 3272, and these are probably spurious.

Vibrations of the ethylene molecule and the deduction of the force constants therefrom have been the subject of recent investigations by several workers[1,3,4,5]. Six of the twelve fundamental frequencies of this molecule are active in the Raman effect, and these have been identified (see refs. 5

and 1) as 1621·3, 3019·0, 1343·9, 3069·0, 950·0 and 1100. Of these six, the last one has not yet been observed, but 3069·0 and 950·0 have been recorded by Bonner in the liquid. That they do not appear in the gas is presumably due to the very low intensity which may be expected of them. The first three, namely 1621·3, 3019·0 and 1343·9, need special mention, as they should be intense and exhibit a high degree of polarization in the Raman spectra.

I have made a careful study of the state of polarization of two of these three intense Raman lines. Details will be given elsewhere and only the results mentioned here. Depolarization factors of 0·10 and 0·17 respectively have been obtained for lines 3019·0 and 1343·9. The depolarization factor for 1621·3 could not be determined with as good an accuracy, but the results show it to be also of the same low order. Such low depolarization factors are in complete accord with the theory.

The fact that two weak lines at 2880 and 1656 which are not fundamentals have been recorded in the Raman spectrum both by Bonner and by me in the liquid and the gas respectively is interesting. As has been suggested by Bonner, 1656 may be regarded as the overtone of an inactive fundamental at 825, appearing as a result of its proximity to 1620 (similar instances occur in the Raman spectra of carbon dioxide, carbon disulphide, etc.), but the origin of 2880 is not at all clear.

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Oct. 24.

[1] Bonner, *J. Amer. Chem. Soc.*, **58**, 34 (1936).
[2] Dickinson, Dillon and Rassetti, *Phys. Rev.*, **34**, 582 (1929).
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Dissociation Energy of Carbon Monoxide and the Abundance of Elements in Stellar Atmospheres

A GREAT deal of work has been carried out by many investigators during the last two years in order to determine the heat of dissociation of carbon monoxide by means of spectroscopic methods. But as yet this very important figure is not known with any certainty, the values proposed by different authors varying between 11·06 and 6·9 e.v.; however, only the values 9·1 e.v. and less are not in contradiction with existing spectroscopic and thermochemical data.

The purpose of the present letter is to direct attention to the fact, that from all the proposed values for D(CO) equal or less than 9·1 e.v., only the value $D(\text{CO}) = 9{\cdot}1$ e.v. proposed by Goldfinger, Lasareff and Rosen[1] and by Herzberg[2] is in good agreement with our actual theoretical and observational knowledge of the composition of the atmospheres of late-type stars. A detailed investigation of this question has proved that: either the heat of dissociation of CO is really $D(\text{CO}) = 9{\cdot}1$ e.v., and the related value of the heat of dissociation of CN is $D(\text{CN}) = 5{\cdot}97$ e.v., or the abundances of light atoms in the main sequence as postulated by Cambresier and Rosenfeld[3] and by Russell[4] must be entirely revised.

Owing to the important role played by D(CO) in all the calculations of molecular abundances in the late-type stars, the astrophysical evidence for the proposed value of D(CO) seems worth mentioning. Details on the subject will be published elsewhere.

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[3] *Mon. Not. Roy. Ast. Soc.*, **93**, 711 (1933).
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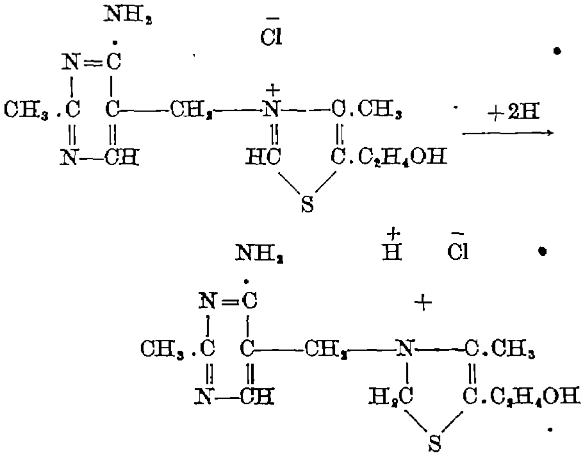
Hydrogenation of Vitamin B_1

WHEN treated with platinum-black or with hydrosulphite, vitamin B_1 is easily reduced. Crystalline preparations from Hoffmann–La Roche and from I. G. Farben were used. They gave identical results. Hydrogenation with platinum-black was measured in Warburg–Barcroft manometers. In phosphate solution at pH 7·5, 0·94 mol H_2 was absorbed per mol vitamin (average of three experiments).

To measure the reduction by hydrosulphite, the manometric method described by O. Warburg, Christian and Griese[1] has been used. With this method, in bicarbonate solution, the acid formation due to oxidation of hydrosulphite ($Na_2S_2O_4$) to acid sulphite is measured. One mol of acid is equivalent to one atom of hydrogen. But in many cases[2], in addition to that, acid is derived from the reduction process itself.

It has been found that 2·76 mols of acid are produced in the reaction between hydrosulphite and vitamin (average of four experiments). The reaction is finished after three hours at 25° C. No acid formation takes place when the vitamin is treated with sulphite at pH 7·8. This possibility had to be excluded on account of the reaction between $NaHSO_3$ and vitamin at pH5[3]. Then, of the 2·76 mols of acid, only two can be accounted for by oxidation of hydrosulphite, because only two atoms of hydrogen are added by platinum-black. The additional acid must be derived from the reduction process itself. Therefore it is assumed that the reduction takes place at the double bond closest to the quaternary nitrogen[3]. Then only one hydrogen is added; the other one is split into an electron and a hydrogen ion. The electron neutralizes the nitrogen and acid is formed. Tentatively the reduction of vitamin B_1 can be formulated as follows:



A very similar reaction takes place when the coferments of Warburg and of von Euler are reduced with hydrosulphite. According to Warburg and Christian[4] 2·8–2·9 mols of acid per mol coferment appear. Here, as Karrer and Warburg[5] have shown, two atoms of hydrogen reduce the double bond attached to a pyridylium nitrogen.

Reductions effected by hydrosulphate are similar to reductions effected by substrates in the cell[1]. The fact that vitamin B_1 is reduced by hydrosulphite makes it probable that in the cell[6,7] acting as a catalyst, the vitamin is reduced in the same way.

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[5] Karrer and Warburg, *Biochem. Z.*, **285**, 297 (1936).
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Reversible Oxidation and Reduction of Chlorophyll

IN experimenting with ethyl chlorophyllide, for specimens of which we wish to thank Prof. A. Stoll, of Basle, we observed the following reactions which illustrate a hitherto unknown property of chlorophyll.

(1) When, to a solution of ethyl chlorophyllide in methyl alcohol, a few drops of a solution of *ferric* chloride in the same solvent are added, the characteristic green colour instantaneously changes to a greenish yellow. An addition of a small quantity of *ferrous* chloride at once restores the original green colour. If ferrous chloride is added first, the subsequent addition of ferric chloride does not cause any change in colour at all.

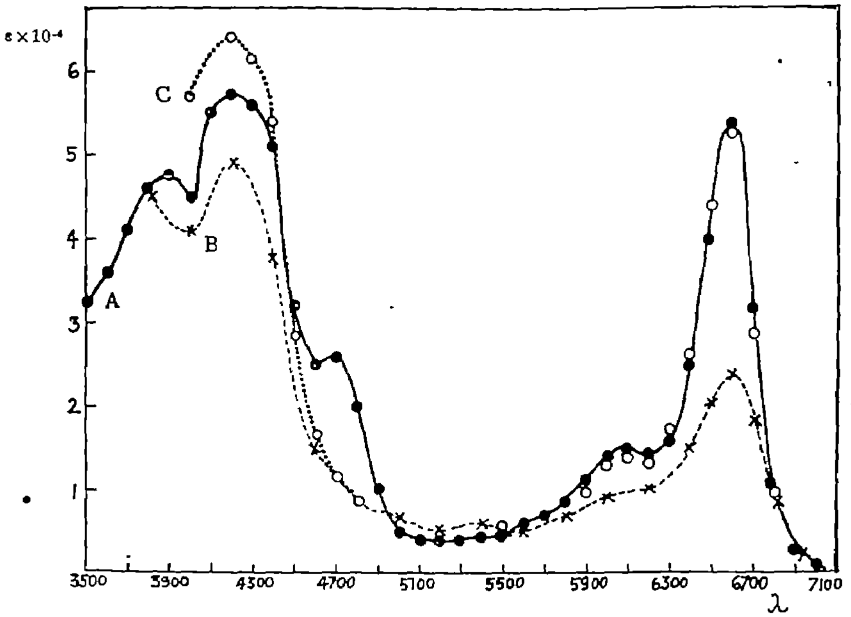

FIG. 1. Molecular extinction coefficient of ethyl chlorophyllide solutions · Curve *A*, original chlorophyllide; Curve *B*, oxidized chlorophyllide; Curve *C*, recovered chlorophyllide.

We measured, by means of a double monochromator and a photo-cell, the extinction curves of the original green solution, of the yellow (oxidized) solution, and of the recovered (reduced) green solution (Fig. 1). The oxidation causes a considerable weakening of the characteristic red band (5500–6900 A.), without affecting strongly the violet one. The extinction curve of the recovered green solution is practically identical with that of the original chlorophyllide, apart from a slight change in the violet consisting of the disappearance of the small hump at 4600 A., and a slight increase of absorption at shorter wavelengths, which we suspect to be due to a specific behaviour of the "C" component of chlorophyll.

It is thus highly probable that we have an equilibrium:

(I) Ethyl chlorophyllide + $Fe^{III} \rightleftarrows$ Oxidation product + Fe^{II}.

Another feature of the above reaction is the disappearance and reappearance of the fluorescence. The following figures show the intensity of the red fluorescence of the three solutions (excited by violet-blue light, which is absorbed by the yellow solution as well as by the green ones), measured by a photocell and galvanometer.

		Intensity of fluorescence (arbitrary units)
(*a*)	Original solution (ethyl chlorophyllide in methyl alcohol, 1 5 × 10⁻⁴ m /l.)	100
(*b*)	Oxidized solution (same with 0·4 mgm. ferric chloride in 50 c.c.)	33
(*c*)	Recovered solution (solution *b* to which 5 mgm ferrous chloride were added immediately after reaction with ferric chloride)	96

(2) The reduction has to be carried out almost immediately (that is, not later than a few minutes) after the oxidation in order to give a complete recovery. This shows that the first oxidation product is unstable, and slowly reacts further (with the ferric chloride or possibly with dissolved oxygen). If the reduction is carried out, for example, 30 minutes after the oxidation, the green colour reappears, but the extinction curve of the reduced solution is situated somewhere between the curves *A* and *B* in Fig. 1. The fluorescence is also only partially restored. The oxidation product is especially unstable to light: a few seconds of intense illumination (by violet or blue light, but *not* by red light) suffice to destroy it, and no trace of recovery can be observed by adding ferrous chloride to the yellow solution after such illumination.

(3) By illuminating a methyl alcoholic solution of ethyl chlorophyllide, containing ferric chloride alone or, better, ferric chloride together with some ferrous chloride, by *red* light, a bleaching of the solution occurs, which is reversed as soon as the illumination ceases. The amount of the bleaching observed (that is, the decrease in the extinction coefficient for red light) was of the order of 1 per cent. (Extinction changes of this order of magnitude can be measured exactly by an optical compensation

arrangement described previously[1].) The stationary decrease in the concentration of the absorbing chlorophyll molecules during the illumination is proportional to the light intensity, and (roughly) inversely proportional to the concentration of ferrous chloride. It increases at first with increasing concentration of ferric chloride and then becomes independent of it—showing that under these conditions each excited chlorophyll molecule reacts with Fe^{III}. All these results agree with the assumption that the influence of light consists in shifting the equilibrium (I) to the right, that is, in speeding up the oxidation.

(4) These experiments show that ethyl chlorophyllide is *reversibly* oxidized by ferric chloride (that is, probably by Fe^{3}+-ions) to some unstable intermediary product from which it can be recovered by reduction with ferrous chloride (that is, probably by Fe^{2}+-ions), and that the *oxidation is greatly favoured by illumination*. These facts are obviously not without interest in connexion with the assimilation process, in which chlorophyll has to act as a catalyst for the reduction of carbon dioxide by light.

We wish to express our sincere thanks to Prof. F. G. Donnan for his kind interest in this work.

Note added in proof.

The formation of ferrous ions in the reaction between ethyl chlorophyllide and FeCl$_3$ can be proved directly by means of a spot test reaction with αα′ dipyrridyl. It has further been observed that the yellow solution of chlorophyllide, oxidized by FeCl$_3$, changes to a green colour by addition of various electrolytes, for example, NaCl, CaCl$_2$.

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Nov. 18.

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[1] See, for example, *J. Chem. Phys.*, 4, 497 (1936).

Translocation of Solutes in Plants

In my experiments on the eradication of *Dichapetalum cymosum* (Hook) Engl., one of the most toxic plants of the Transvaal, I was led to the following technique for introducing copper into the stem of the plant. The stem and branches of the plant are entirely underground and only the leaves emerge above the soil. The stem may be up to 100 ft. long. For the purpose of eradication, the stem is freed from the surrounding soil to a depth of about 9 in. and then ringbarked on a length of 2 in. for a 1 in. stem. Around this ringbarked region a mixture of the following substances is packed: calcium chloride, copper sulphate and soil in the proportion 2 : 1 : 2. The hole is then filled up again with soil. The circulation of the copper is very rapid; within twenty-four hours, leaves 15 ft. distant from the main stem are practically dead or dying. The downward movement is much slower; it takes eighteen days to kill 104 inches of the stem. The movement of the copper was followed with the help of potassium ferrocyanide, and it was noticed that the translocation takes place essentially in the phloem, although in the ringbarked region it is first taken up by the xylem. Only after about eight days does the xylem show copper in the same degree as the phloem does after twenty-four hours.

In my laboratory experiments, I used the following method. A ringbarked young twig was pushed down the stem of a glass funnel so that it emerged about 1 cm. at the lower end. This part was dipped into water. The ringbarked region was so arranged that it was situated in the conical part of the funnel. This region was then covered with a mixture of calcium chloride, copper sulphate and soil all finely powdered and mixed. The soil is necessary to prevent the formation of a hard cake; it seems also to induce rapid absorption, for without it the transport of copper is much slower. Results are obtained after twenty-four hours. The translocation in cut twigs is, however, far slower than in branches attached to the main stem, where a transpiration stream passes through them.

I have also tested the method on two species of *Acacia*, on *Burkea Africana* and *Ochna pulchra* ringbarked near the crown; in all cases I obtained a rapid movement of copper into the leaves.

These experiments were carried out with the sole object of finding a suitable method for eradication. The method has given very satisfactory results with *Dichapetalum cymosum*. The technique could, however, also be used for the study of the translocation of solutes as such. Instead of a toxic substance, sugars, nitrogen compounds, phosphates, etc., could be added to the mixture of calcium chloride and soil, and the different regions of the branch then could be analysed to establish the main path of translocation. Even if the calcium chloride reacts with some of the substances to be used (as it does with copper sulphate) the experiment will not be disturbed.

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Differentiation of Varieties of Eucalypts by their Essential Oils

In continuation of our investigations into the occurrence of varieties of well-known species of eucalypts, *E. dives* and *E. radiata* (*E. numerosa*), *E. australiana*, etc., as determined by chemical analyses of the essential oils, we have made an interesting observation with *E. radiata* variety "A" which is considered worthy of early mention.

The occurrence of a number of varieties of *E. radiata* (*E. numerosa*) was investigated in 1930[1]. Young trees of the type and its varieties were raised from seed and the essential oils afterwards examined. These were found to be quite constant, with the exception of one tree of variety "A" which threw out two stems, each about 20 ft. in height, from the one root system. The leaves and terminal branchlets of each stem were examined separately and, to our surprise, they yielded different essential oils, one giving an oil indicative of variety "A" whilst the other was almost identical with what we prefer to regard as the type species. We are unacquainted with any record of a similar observation.

This observation provides additional evidence in support of our previous contention that the theory of the constancy of species, based upon the chemical composition of the essential oils, does not hold in every instance.

Full details of this investigation will be published in the *Journal and Proceedings of the Royal Society of New South Wales* for 1936.

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F. Morrison.

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Oct. 14.

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Colour in the Dogfish, *Scyllium canicula*

SINCE the completion of a paper on colour change in the dogfish[1], two points of interest have arisen. The first concerns the colour cells and their natural responses in the young fish, and the second one concerns melanophore control in the various members of the group Elasmobranchii.

The colour cells of a young dogfish (*S. canicula*) hatched in the Zoology Department at Liverpool were investigated, and observations made on the natural responses of the melanophores. There proved to be four types of colour cells, only three of which have been described from the adult[1]. The natural melanophore responses to illuminated dark and light backgrounds were the same as in the adult fish[1].

In the newly hatched fish, focusing from the lower skin levels to the surface on the pectoral fin, there appear in order very conspicuous deep yellow cells capable of completely rounding off and of expansion to a stellate condition, greyish brown cells never seen in the contracted state but always with blunt irregular branches, light brown melanophores and finally, dark superficial melanophores. The yellow cells are numerous and very conspicuous, whereas in the adult they are very few and frequently cannot be found at all. The greyish brown type of cell has not previously been described from either the young[2] or adult[1] fish. The pigment from both these latter cells was dissolved out in alcohol. The two types of melanophore are exactly similar to those described from the adult fish[1].

Although on some occasions no melanophore response could be obtained, as a rule on an illuminated white background and in complete darkness the melanophores contracted, while on an illuminated black background they expanded. The melanophore response to illuminated dark and light backgrounds is, therefore, the same as in the adult[1], and the same as in the young[3] and adult[4] of *Mustelus*. The response to complete darkness is not known for the adult *Scyllium* or for the young or adult of *Mustelus*. The changes of the yellow cells and of the greyish brown cells have not been studied and the ultimate fate of the latter is not known. Unfortunately, the fish died.

The observations recently made by Parker on the colour change mechanism of *Raja erinacea*[5] and *Squalus acanthias*[6] direct attention afresh to the possibility of a lack of uniformity in the mechanism of colour control among the Elasmobranchii.

In *all* Elasmobranchs so far investigated[1,7,8] it is established that the normal dark background reaction (dark skin, expanded melanophores) is due to the activity of neuro-intermediate lobe of the pituitary. Where more detailed information is available, it is clear that the neuro-intermediate lobe exerts its influence by means of a blood-circulated hormone[1,9].

Regarding the mechanism of the natural light background reaction (contracted melanophores), however, there is no uniformity of opinion. In *Mustelus canis*, Parker and Porter[10] and Parker[11] have described and figured paling effects in dark fins as a result of faradic stimulus and of cuts made transverse to the fin rays. These effects have been interpreted by them as showing that the natural paling response in this fish is due to direct nervous action on the melanophores. On the other hand, cuts made by me[12] in the fin of a dark *Scyllium canicula* failed to give any paling effects, and severance of selected nerves by Young[13] in *Scyllium* sp. and by Wykes[14] in *Scyllium canicula*, *Raia brachyura* and *Raia maculata* did not influence the melanophore condition or, in the latter cases[14], the melanophore response in the area supplied by these nerves. Further, electrical stimulation of nerves[14] in *Raia brachyura*, *Rhina squatina* and *Scyllium catulus* did not result in any melanophore changes. From these negative results it has been concluded that there is no direct nervous control of melanophores in these fish.

In *Scyllium canicula*[1], *Raia maculata* and *Raia brachyura*[7] removal of the anterior lobe of the pituitary alone destroys the natural light background reaction, and from this it has been concluded that the natural paling response of these fish is in some way connected with the activity of the anterior lobe. The effect of removal of the anterior lobe alone on the light background response of *Mustelus canis* unfortunately has not been described.

The above facts have led me to suggest[15] that in the various members of Elasmobranchii there may be found different methods of melanophore control. This suggestion has now received considerable support from the observations of Parker himself that cuts made in the fins elicit no paling response whatsoever in *Raja erinacea*[5] and only a very uncertain response in *Squalus acanthias*[6].

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Dec. 4.

H. WARING.

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The 'Specific Action' of Ultra-Short Wireless Waves

WE have received a letter from Prof. W. Szymanowski, of the Institute for Physiological Research at Moscow, in which he makes certain comments on our article on the above subject which recently appeared in NATURE[1]. We should like to be allowed to summarize these and to reply to them as briefly as possible.

(1) Prof. Szymanowski points out that his work with Dr. Hicks on the action of short waves on toxins and bacteria was begun, and a first note published[2] in 1930, before the corresponding work by Haase and Schliephake[3] (published 1931), so that our reference to the former work as confirmatory of the latter was likely to create a false impression in regard to priority. We admit the justice of this criticism, and tender our apologies to Prof. Szymanowski.

(2) In referring to two papers by Szymanowski and Hicks[4,5], dealing with the action of ultra-short waves on various bacteria, toxins, etc., we stated that in the second paper they withdrew their earlier results on toxin. Prof. Szymanowski takes exception to this statement, and makes it clear that no such withdrawal was intended. We accept his correction, and would merely remark that our impression was perhaps excusable in view of the general tone of the second paper, which, in contrast to the first, was mainly devoted to the presentation of negative evidence relating to the "specific effect", and included the sentence (p. 471): "The meagre character, however, of the action on diphtheria toxin and the delicacy of the conditions under which it may be

detected in any degree make it a phenomenon of relative insignificance in the interpretation of clinical or other studies of H.F. currents". Further, the authors state in conclusion (p. 472): "It is possible, however, to say from the work now reported, that at least there is no biologic action on the substances mentioned under the described conditions of exposure to ultra-high frequency field". We understand that Prof. Szymanowski did not mean to cast doubt on the reliability of the results in question, and are in full agreement with him that further investigation of these interesting effects is very desirable.

(3) Prof. Szymanowski further directs our attention to an interesting fact which had escaped our notice, namely, that in 1896 D'Arsonval and Charrin reported attenuation of diphtheria toxin by radiation of frequency 2×10^5 cycles per second, also without any dangerous temperature elevation. It is thus possible that such effects may be associated with high-frequency currents in general, rather than with ultra-short waves only.

(4) Prof. Szymanowski agrees with us that the overwhelming majority of the facts are consistent with a purely thermal explanation of the effects, and adduces some further evidence. For example, he has found[6], in a study of the lethal time of mice, an almost exact parallelism with the law of heating of electrolytes at these frequencies, and similar results, on *Drosophila*, were afterwards obtained by Malov[7]. Further, in work not yet published, he has shown that Pflomm and Liebesney's effect on the heartbeat of the frog, previously claimed as a clear case of a 'specific' effect, can be almost exactly reproduced by a very slow temperature elevation. We may mention that Hill and Taylor[8] have also shown that this effect is thermal in origin.

Prof. Szymanowski concludes by remarking that in spite of the meagreness of the positive evidence at the present time, it seems worth while to continue to look for it "by impartial and well controlled investigations". With this we entirely concur. The primary purpose of our article was to direct attention to the fact that scarcely any of the experimental work on which belief in specific effects has been based has satisfied both these conditions.

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[8] Sir Leonard Hill and Taylor, *Lancet*, 311 (Feb 8, 1936).

The Half-Drill Strip System Agricultural Experiments

"STUDENT'S" letter in NATURE of December 5 shows that he has overlooked the purpose of the paper he criticizes, although it was set out in the first sentence of the summary as follows:

"This enquiry was carried out to test the truth of the opinion expressed by 'Student' that randomization achieves its object 'usually at the expense of increasing the variability when compared with balanced arrangements', and that one of the means available to experimenters of reducing the error is by adopting 'a regular balanced arrangement'."

The quotations in this sentence are from "Student's" paper "Co-operation in Large-Scale Experiments", read before the Royal Statistical Society.

"Student" does not deny that the arrangement examined, and found to be extremely misleading, is, in fact, "a regular balanced arrangement". He even tells us that the method of calculating the error was that formerly used for half-drill strip experiments; though following his, "Student's", criticisms in 1923, "it has been customary" to use other methods of calculation for estimating the error.

It is not noticed, apparently, by "Student" that Dr. Barbacki and I criticize systematic arrangements in general on the ground that "the experimenter has an arbitrary choice between several widely different estimates". The two we show to be misleading correspond with the two random arrangements which we also test.

"Student" writes: "Had Prof. Fisher and Dr. Barbacki calculated the error on that basis" [as now advocated by "Student"] "they would have found a standard error of 2·37 per cent". This, then, it appears, is the standard error which "Student" thinks is appropriate for the systematic design discussed; yet we find that, on the same land, a random arrangement gives a standard error of less than 0·7 per cent. If "Student's" estimate is right, the randomized experiment is worth as much as the average of eleven such systematic experiments. This is, of course, a different ground of criticism from that on which I have habitually advocated randomization, for I cannot think that "Student's" new estimate is less arbitrary than the others. However, on his own result, what becomes of the claim that randomization tends to *increase* the error, or that experimenters can usefully try to diminish it by adopting regular balanced arrangements?

R. A. FISHER.

University College,
London, W.C.1.
Dec. 4.

Hypoglycæmic Action of Histone Insulinate

BY mixing a solution of thymus histone with another of crystalline insulin, at pH 7–7·2, a precipitate is produced containing most of the insulin previously present in solution.

When administered to normal or pancreatectomized dogs, the histone insulinate gives a more prolonged hypoglycæmia than the pure crystalline insulin. The level and duration of this hypoglycæmia are practically identical with that obtained by injection of the same amount of protamine (clupein) insulinate, prepared also from crystalline insulin[1].

As this crystalline insulin contains zinc, it is not improbable that this metal has a favourable influence in the prolongation of the hypoglycæmia, specially in view of the experiments of Fisher and Scott[2].

The detailed account of this work will be published in full shortly.

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VENANCIO DEULOFEU.
JORGE R. MENDIVE.

Instituto Bacteriologico D.N.H.,
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Dec. 2.

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[1] Jensen Hagedorn *et al.*, *J. Amer Med Assoc.*, 106, 177 (1936).
[2] *J. Pharm. Exp. Therap.*, 58, 78 and 93 (1936).

Latent Heat of Evaporation of Liquid Helium

EARLY last year[1], Prof. E. F. Burton gave the results obtained by Messrs. Wilhelm and co-workers for the viscosity of liquid helium at three temperatures, attention being directed to the marked change as HeI is transformed into HeII.

The data, however, possess a further interest. In 1934, I showed that the molar latent heat of evaporation, L, can be calculated, with the aid of an equation similar to the Clausius-Clapeyron equation, from viscosity data at temperatures near the boiling point[2]. The equation is:

$$L = 9{\cdot}2\,R\,\frac{T_1T_2}{T_2 - T_1}\log_{10}\eta_1/\eta_2,$$

where R is the gas constant (1·985) and η_1, η_2 are the viscosities at the absolute temperatures T_1 and T_2.

Taking Burton's values, namely, $\eta_1 = 27 \times 10^{-6}$ at 2·3° K. and $\eta_2 = 11 \times 10^{-5}$ at 4·2° K., we find:

$$L = 36{\cdot}2.$$

If now we calculate L with the aid of the Clausius-Clapeyron equation using the data of Onnes, as given by Mellor in his "Comprehensive Treatise, etc.", namely, $p_1 = 760$ mm. at $-268{\cdot}71°$ C. and $p_2 = 565$ mm. at $-269{\cdot}03°$ C., we find,

$$L = 31{\cdot}3.$$

As this latter temperature range is slightly higher than the former, a somewhat smaller value for L is to be expected than in the first calculation. Bearing this in mind, and remembering also the extreme experimental difficulty in carrying out measurements with liquid helium, the close agreement between the two values of L is remarkable.

J. NEWTON FRIEND.

Technical College,
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Nov. 20.

[1] NATURE, 135, 265 (1935).
[2] *Trans. Far. Soc.*, 31, 542 (1935).

Points from Foregoing Letters

THE isotopic weights and 'packing fractions' for atoms of silicon (mass 28), phosphorus (31), sulphur (32) and chlorine (35 and 37) have been obtained by Dr. F. W. Aston with his 'second-order focusing' mass-spectrograph, by comparing doublets (atoms and groups of atoms having the same mass/charge ratio). Dr. Aston directs attention to an unexplained discrepancy between his results in the case of the O,CH_4 doublet and those of Bainbridge and Jordan.

A curve showing the absorption, in different thicknesses of boron, of the neutrons which produce gamma-ray activity in silver, is submitted by E. H. S. Burhop, R. D. Hill and A. A. Townsend. This curve indicates the presence of two components (with absorption coefficients of 8·1 and 0·24 gm.$^{-1}$ cm.^{2} respectively) and differs from the curves obtained from the absorption of neutrons which excite the 22- and 138-second activities in silver. The authors suggest that the nucleus may possess two systems of energy levels, corresponding to the emission of electrons and of gamma radiation respectively.

By irradiating silver with neutrons, first directly and then through a paraffin screen, Prof. G. Guében finds that three radioactive substances of half-life 50, 30 and 150 seconds, approximately, are produced. Apparently the first, which may be rhodium of mass 104, is produced by fast neutrons, the second by slow neutrons and the third by both fast and slow neutrons. Previous investigators have reported activities of 22, 26, 40, 138 and 154 seconds.

A simplified procedure for determining accurately the boiling point of a liquid (by the comparative method of Świętosławski) is described by Dr. M. Wojciechowski. If the pressure cannot be adjusted exactly to one atmosphere, a second pair of observations is made at a pressure only slightly different, so that the variation of the boiling point with respect to pressure can be assumed to be linear, and the necessary correction can then be made.

Depolarization factors of 0·10 and 0·17 have been obtained for the 3019·0 and 1343·9 Raman lines respectively in ethylene gas by S. Bhagavantam. This high degree of polarization is in accord with the origin of these lines. In the Raman spectrum of this gas, besides the intense lines, two weak lines which do not correspond to fundamentals but which were obtained by Bonner in the liquid have also been recorded.

M. Nicolet directs attention to the fact that from the numerous values recently proposed for the heat of dissociation of carbon monoxide, only the value $D(CO) = 9{\cdot}1$ e.v. is in good agreement with theoretical and observational knowledge of the composition of the atmospheres of late-type stars.

The hydrogenation-reduction of vitamin B_1 by platinum-black and by hydrosulphite is described by F. Lipmann. The author formulates the reaction on the assumption that the reduction takes place at the double bond closest to the nitrogen atom with four valency bonds.

That chlorophyll (ethyl chlorophyllide) is reversibly oxidized by ferric chloride with change in colour to greenish-yellow and quenching of fluorescence is shown by experiments carried out by Drs. E. Rabinowitch and J. Weiss. They find that the oxidation is greatly favoured by illumination, which is important in view of the part played by chlorophyll in photosynthesis.

The behaviour of the coloured cells in a young dog-fish, under illumination, is described by H. Waring, who finds four types of cells as against three types described in the adult fish. The author considers that in some fishes (sharks, rays, etc.) there is no direct control of the colour cells but that the 'paling' effect is in some way connected with the activity of the anterior lobe of the pituitary gland.

ERRATUM. In the second paragraph under this heading in NATURE of December 5, p. 976, for "From the interchangeability of lactic dehydrogenase from heart muscle with alcohol dehydrogenase . . ." read "From the interchangeability of lactic co-dehydrogenase from heart muscle with alcohol co-dehydrogenase from yeast . . ."

Research Items

Maternal Mortality and Malnutrition

THE causes of maternal mortality are many. Sepsis still occurs, though it is subdued, and is now low compared with "other causes", among which malnutrition appears to be important. This is the conclusion that emerges from recent investigations which are described in an article by Lady (Rhys) Williams in the October number of *Public Health*. The practical work described was begun in the Rhondda Valley, a distressed area, on January 1, 1934. In spite of increased ante-natal care and medical supervision, the puerperal death-rate there rose to 11·29 per 1,000 total births. In 1935, expectant and nursing mothers were provided with extra foodstuffs, tinned and bottled but protective, and one pint of milk a day, with the result that not a single mother, who had received the extra food, died. The feeding scheme was extended to include five adjoining towns of a similar type. Up to June 30, 1936, the puerperal rate had fallen to 5·46 in the Rhondda, and 3·75 in the new areas, as compared with the previous eight-year averages of 7·72 and 6·65, respectively; and the puerperal rate fell much more than the sepsis rate. Numerous graphs are reproduced which show a striking correspondence between the puerperal and the infantile death-rates when the latter relate to the preceding year. The divergence of the rates for the same year and their correspondence for successive years is explicable in terms of nutrition, and it is pointed out that these rates would have been affected simultaneously had climate or epidemics been the cause. Stronger evidence that malnutrition is an important cause of maternal and neo-natal mortality is afforded by the much higher average levels of the death-rate in distressed, as compared with prosperous, areas; and it is shown that the differences cannot be ascribed to climate or, to any extent, to bad housing (see also NATURE, 137, 529; 1936).

Tripolje Settlement in Kiev Province

SOVIET archæologists of the Marr Academy of Material Culture, excavating near the village of Khalepye in the province of Kiev, it is reported by the Soviet Union Year Book Press Service, have brought to light a settlement belonging to the Tripolje culture. The settlement was circular in plan, enclosed by a single row of houses, with doors opening on the enclosed space, the whole resembling a fort, into which the domestic animals were driven at night for protection. The houses were built of clay, and were about twenty metres long. The baked clay of the floors, and remains of stoves, walls and fences were found in an excellent state of preservation. The stoves and walls in some of the houses had been coloured with red ochre. The chief occupations of the inhabitants of the settlement were agriculture and cattle-breeding; but there is evidence that hunting had been an auxiliary means of livelihood. Many stone grinders and agricultural implements made of horn were found inside the houses. One hundred earthenware utensils ranged in size from very small receptacles of not more than two centimetres high to vessels seventy centimetres high. Thirty statuettes were found, some of which are unique. They give an idea of the dress of both men and women of the settlement. The women wore their hair loose, but tied in a knot at the ends, while an indispensable article of their attire was a girdle, the ends of which hung down at the side. The men are shown as wearing a garment draped across the shoulder. The excavations are to be continued next season.

Visual Acuity and Speed of Vision in Road Lighting

IN observing objects on artificially illuminated highways the first requirement is to perceive the presence of the object. This is rendered possible by the contrast between the object and the road surface. The nature of the contrast and the sensibility of the eye are the determining factors. When the object has been perceived, it is necessary to see its exact form and estimate its distance. This is governed by the visual acuity of the eye. It is customary to take the angle of vision at which two parallel lines are still just perceptible as separate entities. It is better to take the reciprocal of this angle (expressed in minutes), so that the larger number gives the greater visual acuity. Another method is to give the distance at which a circle with a diameter of 1 cm. and a square with a diagonal of 1 cm. can still just be differentiated. In addition to visual acuity, the speed of vision is also an important factor. In the *Philips Technical Review* (Eindhoven) of July, the relationship is investigated, by P. J. Bouma, between the visual acuity and the brightness levels of the object and the background. The difference also between the type of illumination and distance of observer from object is examined. Close investigation shows that all monochromatic colours, with the exception of blue and violet, give a greater visual acuity than white light. The low visual acuity for blue light is partly due to the fact that the eye is myopic for this short wave-length. With technical sources of light, the visual acuity is considerably greater with sodium and mercury light than with ordinary glow lamp and neon light. The author investigates the speed of vision for various types of light. For stationary objects, mercury and sodium lamps are better than glow lamps and neon light; but for moving objects sodium light is the best, then glow lamps and finally mercury light.

Sheep and Wool Production in North-Eastern Asia

THE total sheep population of China, Inner Mongolia and Manchukuo is round about 30,000,000, mostly run under nomadic conditions and carrying a low wool crop averaging only about 2·6 lb. a head. I. Clunies Ross points out (Pamphlet No. 65, Council for Sci. Ind. Research, Australia: Melbourne, 1936) that improved wool production by crossing between native and merino sheep is difficult because of climatic conditions and the effect particularly of the severe winter upon pastures, and would entail housing and hand-feeding during six months of the year. In Japan, sheep-rearing is not likely to become a major industry, but the movement of the Japanese and Chinese markets from cotton and silk to woollen materials indicates a prospect of further demand for wool, and since both nations are developing their own woollen factories, the demand will be of direct benefit to the export from Australia of raw wool, from which the imported tops are manufactured.

Prosobranchs of the North Sea and Baltic

DR. W. E. ANKEL has contributed an excellent monograph on the gastropods ("Die Tierwelt der Nord- und Ostsee" (Lief. 29, Teil 9,b, "Prosobranchia", von W. E. Ankel. Pp. 240. Leipzig: Akademische Verlagsgesellschaft m.b.H., 1936). Although it deals only (except in a few cases) with the species occurring in the North Sea and Baltic, there are so many of these which are common on all the coasts of Britain that it is practically a text-book of the prosobranchs of our seas, and the general matter applies to all. The author has himself worked specially on the reproduction and reproductive organs of these molluscs, but the clear original drawings scattered about the work show that he is a true naturalist in every sense of the word. Many of these figures are of the live animals, showing them crawling, burrowing, feeding, and are of distinction and quality. Besides bringing together a large amount of work by other authors showing a thoroughly up-to-date knowledge of the subject, this monograph contains much original matter. It is refreshing to find here so much that is really new. The life histories of most of our common prosobranchs are now known, and we have a fair idea of their egg-laying habits and development, but these descriptions are scattered far and wide. This is the first time that an attempt has been made to bring them together, and we gradually come nearer to the ideal work in which the description of every species shall be accompanied by notes on its life-history, and not only adult characters shall be used in classification, but also those of the embryonic and larval forms.

Japanese Diatoms

DR. H. AIKAWA has contributed an extensive paper "On the Diatom Communities in the Waters Surrounding Japan" in vol. 8, No. 1 of the Records of Oceanographical Works in Japan compiled by the Committee of Pacific Oceanography of the National Research Council of Japan. All plankton samples collected by the research ships of the prefectural fisheries experimental stations along the coast of Japan are submitted to the Imperial Fisheries Experimental Station, Tokyo, and the author has studied these in detail both quantitatively and qualitatively. The number of individuals of different species is counted in a sample by Hensen's method, and the respective percentages of animal and plant plankton worked out. The work is mainly concerned, however, with diatoms, and diatom communities are described from the waters around the West Aleutian Islands, Okhotsk Sea, the Tôhoku region, Tokyo Bay, Sagami Bay, Suruga Bay, the southern Pacific coast, the tropical regions and in the Japan Sea with Wakasa Bay and Tyôsen Strait. Both cold and warm currents flow around Japan. Enormous mass-production is found in cold waters, the warm water regions being richer in species. Seasonal succession is very noticeable in the neritic regions whilst the oceanic plankton is remarkably uniform. A list of forty of the principal diatom species shows many that are common in British waters.

Spiders of Lahore

A COMPREHENSIVE paper on the spiders of Lahore, by Mr. Sukh Dyal, has been issued (*Bull. Dept. Zoo.*, Punjab University, 1, 119–252). This work forms the fourth of a series entitled "Fauna of Lahore", published by the Punjab University. Altogether, 121 species are enumerated and are comprised in 60 genera and 20 families: of these, 46 species were previously undescribed. The majority of the spiders of the district appear to be web-spinners of arboreal habits, and among them are instanced several remarkable examples of protective coloration. The paper is provided with keys to the families, genera and species dealt with, and the text is illustrated with a number of well-executed plates showing diagnostic structural characters. At the end of the text, a rather extensive glossary of the terms employed is given, together with a list of relevant papers and memoirs.

Origin of Rice

MUCH progress is now being made in connexion with the cytology and genetics of rice. The chromosome number is $2n = 24$ in all varieties of *Oryza sativa* examined, although haploids with 12 chromosomes frequently occur. Dr. H. K. Nandi has brought forward (*J. Genetics*, 33, No. 2) results of much interest to show that the genus *Oryza* is a secondary polyploid derived from a previous basic number of 5, and Mr. S. Ramanujam has found that the related *Zizania aquatica* has $2n = 30$ and is therefore probably a hexaploid based on 5. In the pollen mother cells of rice varieties Dr. Nandi finds two pairs of satellited chromosomes of unequal length attached to the nucleolus, and very clear secondary pairing of the chromosomes in the metaphase of both meiotic divisions. The maximum pairing gives three groups of two and two groups of three bivalents, thus indicating that 5 was the primary chromosome number in *Oryza*. Haploids also occasionally show two bivalents. It thus appears that the genus *Oryza* originated as an allotetraploid through hybridization between two different ancestral species having $2n = 10$ chromosomes. Due to meiotic irregularities in the hybrid, two chromosomes were probably duplicated, and subsequent chromosome doubling produced a stable type with $2n = 24$. The conclusion is reached that on the basis of present evidence it cannot be determined whether the cultivation of rice began in China, India or Africa.

Heat-Treatment for Wood-Decaying Fungi

A SHORT paper by Mr. H. B. S. Montgomery (*Trans. Brit. Mycol. Soc.*, 20, pts. 3 and 4, Nov. 1936) gives the results of some experiments upon the lethal temperatures for a number of common wood-decaying fungi. Four species of the genus *Lenzites*, *Merulius lacrymans* (dry-rot fungus), *Poria vaporaria*, *Pholiota adiposa*, *Polyporus hispidus*, *Schizophyllum commune*, *Fomes fraxineus* and *Lentinus lepideus* have been studied. Temperatures which destroy each species are set forth in tabular form, and *Lenzites lepideus*, the most resistant of the fungi tested, was killed by electric motors. In this way it is possible to direct the beam of X-rays at will, either through the applicator towards the patient, or into an absorbing lead saddle, six inches thick, suspended immediately above the tube. Thus, the portion of the X-ray tube within the treatment room is both shock-proof and ray-proof.

As the X-ray tube is fixed, the floor of the treatment room has been made movable, so that the position of the patient relative to the tube may be adjusted as desired.

THE GENERATORS

The generating equipment comprises two generators, one designed to give a positive potential of 600,000 volts, and the other a negative potential of the same value (Fig. 2). The current for each generator is fed from the 400 volt A.C. mains into a transformer from which a current at 150,000 volts can be drawn. By means of a modified Greinacher circuit, embodying columns of continuously-evacuated thermionic valves and oil-immersed condensers, a rectified current at a constant potential of 600,000 volts may be obtained from each generator. Thus by using both generators, a constant potential of more than one million volts may be applied to the X-ray tube. At this voltage, the tube is designed to carry a current of five milliamperes.

The X-ray tube and its generating equipment is the culmination of the remarkable series of X-ray installations designed and manufactured during the past few years by the Metropolitan Vickers Electrical Co., Ltd., of Trafford Park, Manchester. The company is to be congratulated on its fine achievement.

The Treasurer and Governors of St. Bartholomew's Hospital, also, should be congratulated on the vision and energy they have displayed in their endeavour to further the conquest of a dread disease. We wish the new department all success in its work.

Illumination Research at the Science Museum

THE special Exhibition on Electric Illumination being held at the Science Museum (see NATURE of December 19, p. 1046) contains a number of research exhibits of considerable interest.

One item from which valuable results may be obtained has been contributed by the National Physical Laboratory and has been designed under the supervision of Dr. J. W. T. Walsh. Two light sources, one a tungsten filament lamp and the other equivalent to the mercury discharge lamp, may be adjusted by the observer until equal brightness appears to be obtained by means of a photometer head. When this has been done, the observer records his observation automatically on a roll of paper, thereby contributing towards the accumulation of mass statistics on popular conceptions of heterochromatic photometry. Practically all observations on this subject have been done hitherto by trained observers. It will be interesting to check whether the untrained observer, some 250,000 of whom will probably visit the exhibition, has substantially the same outlook on the question of equal brightness of differently coloured light sources. A rough check with a small number of completely untrained observers at the National Physical Laboratory revealed considerable disparities compared even with the observations of the less-experienced trained observers. The value of a check test to reveal the disparity range in the visual experiences of the general public may be considerable.

Another experimental device with the object of obtaining mass statistics has been installed by the E.L.M.A. Lighting Service Bureau. Variations in the foot-candle intensity chosen by members of the public for comfort in reading are recorded by a ticket issuing machine which, in addition to delivering a ticket showing the value chosen by the operator, records statistically the sum of its operations. Although 5 foot-candles is an average value of illumination experienced in living rooms, it has been found as a result of 20,000 observations that 70 foot-candles is much nearer the desired value for comfort. Further statistics will be obtained at the Exhibition.

A number of other items in the Exhibition illustrate contemporary research without contributing towards it. One most interesting exhibit projects the arc from a mercury discharge lamp on to a translucent screen, and by means of a stroboscopic disk shows that while the cathode discharge emanates from a hot spot on the cathode, the anode discharge takes place from the surface of the electrode presenting the shortest discharge path to the arc. If both these discharges were to take place from the same spot, disintegration of the electrodes would ensue and the lamp life would be uneconomically curtailed. This device, which has been used extensively by research workers to obtain a proper understanding of the processes involved in sustaining the arc discharge in a hot cathode discharge lamp, is now demonstrated to the public.

The phenomenon of luminescence, discovered by Crookes in 1879 and now applied to electric discharge lamps, is demonstrated by a number of cabinets in which only invisible ultra-violet radiation is allowed to fall on luminescent specimens. The first cabinet shows naturally luminescent minerals. The second shows stages in the preparation of a synthetic luminescent material. Pure zinc sulphide is not luminescent, and does not become so with the addition of an impurity. When, however, the mixture is fired, the resultant product is strongly luminescent. Two further cabinets show the response of some materials to long-wave ultra-violet radiation and others to short-wave ultra-violet, and the fact that a material responding to the one may be unresponsive to the other. A fifth cabinet shows the response of the rhodamines which, strangely enough, respond only in the pure form and then only when in either solid or liquid solution.

The water-cooled high-pressure hot cathode mercury discharge lamp is an example of what is at present a research exhibit, but may before long have important practical applications. The tube is of quartz surrounded by a condenser, and from examination of the spectrum of the discharge it is estimated that a temperature of about 8,000° C.—approximately that of the sun—is reached. The light source is 0·5 mm. diam. × 50 mm. long, the pressure 100–200 atmospheres and the power consumption 1,000 watts. An efficiency of 60–70 lumens per watt is obtained. While the life of these lamps is at present only about 100 hours, the red end of the spectrum of the discharge is about ten times as strong as that of an ordinary street-lighting mercury lamp. The colour rendering of the light obtained is thus far more akin to that obtainable by daylight. Even the commercial high-pressure quartz lamp, which will probably be marketed in a few months' time and which works at a pressure of about five atmospheres and a temperature of about 1,000° C., shows a substantial improvement in the red end of the spectrum. Spectrometer demonstrations of the light from these lamps compared with that from tungsten filament lamps are shown.

Universities of the British Empire

FIFTH QUINQUENNIAL CONGRESS

At the fourth Congress of the Universities of the British Empire in 1931, Sir Donald MacAlister observed that not merely for historical or statistical records, but also for the clear and cogent setting forth of current university problems, and for pertinent and practical suggestions for their solution, it had long been his practice to consult the reports of the Proceedings of these Congresses, and seldom in vain.

The Proceedings of the Fifth Congress, held on July 13–17, 1936 in Cambridge*, in no way fall below the standards established by its predecessors, and suggest that the analysing and Socratic methods of the world's earliest university are alive in the modern world's counterparts of the Academy of Athens. "They say. What say they ? Let them say," is the background of their work and effort—taking toll of the past, working for the present, planning for the future—a readiness to discard the unprofitable, to adapt means to ends and to envisage change.

The Prime Minister in his opening address took his stand on the plane of a lofty idealism which stressed the presence of the spirit of youth, of growth, of vigour, of expansion and of adventure in his own university and the hatred of standardization and mass production—common to all universities ; and pleaded for the production of poets like Wordsworth who might inspire Europe and the world with a sense of unity and freedom.

On other aspects of the problems confronting universities, Mr. Baldwin was no less insistent. Research workers should be freed from the trammels of too much teaching and relieved from financial anxiety. Communal life is by no means the least important part of the training obtained at universities—a view strongly expressed in the latest report of the University Grants Committee. Universities may have to specialize in certain subjects and arrange for an exchange of students in the event of their being unable to provide for complete instruction in any subject—the latter suggestion recently happily adopted by the Universities of Oxford and Cambridge.

It was appropriate that the Chancellor should be followed by the Vice-Chancellor, who discoursed on some problems which confront universities. He, too, referred to undue specialization and its dangers—making mention of the arrangement come to with the University of Oxford in respect of the School of Forestry. He had also much that was pertinent to say about training for citizenship—a subject to the discussion of which Sir Ernest Simon made a valuable contribution in his remarks on general, as an alternative to specialized, honours courses, matriculation standards (a question of vital concern to all educational institutions, schools as well as universities), pass degrees, intensive courses in honours subjects, research, libraries, need for wider exchange and health measures for students.

Following this address, the subject of the provision in Great Britain for post-graduate studies for British and overseas students was introduced by Lord Macmillan, who made an eloquent appeal for the establishment of an institute of legal research. The Vice-Chancellor of the University of London gave a lucid description of what is being done for post-graduate medical education by the British Post-graduate Medical School. Lord Rutherford explained what his department is doing at the Cavendish Laboratory, Cambridge ; and one of his colleagues, Prof. J. A. Ryle, told of the development of research in pure medicine at Cambridge. Lord Nuffield's recent munificent gift to Oxford will enable research to be conducted in other departments of the medical faculty.

The functions of universities in the training of teachers was introduced by Sir T. Percy Nunn. One of the more important and trenchant of his observations was that the universities through their technical departments of education should do more to foster education as a national function. Others spoke on the subject from the point of view of overseas institutions, while the Board of Education, through its chief inspector, suggested certain criticisms of university methods to which full consideration should be given. Among these is the isolation of the teacher's life which, as Prof. Frank Smith of Leeds said, must not constitute what is really a condition of imprisonment.

Dr. H. J. Cody, president of the University of Toronto, delivered an address on the relation of Canadian universities to national life, making particular mention of academic freedom, the importance of the great and inspiring teacher and of physical training.

Two subjects for discussion—careers for university students and physical education in the universities—were, as was appropriate, concerned with the well-being of those for whom university education is provided. Great Britain is happy in that it has not experienced as yet the effects of a surplus of failed aspirants for university degrees or even of 'failed matrics'. A career for the university graduate is not

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* Fifth Quinquennial Congress of the Universities of the British Empire, 1936. Report of Proceedings. (Published for the Universities Bureau of the British Empire.) Pp. viii+262. (London: G. Bell and Sons, Ltd., 1936.) 21s.

Exploration of the Mississippi

The Times of December 30, 1836, quoting the *St. Louis Enquirer* of November 14, said: "The distinguished French astronomer and mathematician, Mr. J. N. Nicollet, now engaged in a tour of scientific observation through the different states and territories of the Union, has recently visited the northern regions of the United States, and succeeded in penetrating further into the interior, with a view of making the discovery of the true source of the great 'Father of Waters' than has even been before accomplished. Mr. Nicollet left Port Snelling, mouth of the St. Peter's, about three months since, and at great expense and trouble transported his splendid set of astronomical and other instruments through a country offering obstacles at every step, taking advantage of every opportunity to ascertain latitudes, longitudes, the magnetical variation and dip, the intensity of the force of gravity, geological and mineralogical examination, and indeed every other observation connected with the science, which might be considered useful, not only to himself and the various scientific and literary societies in Europe and the United States, to which he belongs, but to the whole scientific world. . . ."

"It is laid down and established by Mr. Nicollet that the true source of the 'Father of Waters' is to be found in five different rivers, an extension of the waters of which forms La Beasch Lake. Thus has the honour of this discovery so long contended for by many travellers and writers, been reserved for Mr. Nicollet, and we sincerely hope he may succeed (as no doubt he will) in the establishment of his superior claims to the distinction."

Dutrochet's Experiments in Vegetable Physiology

IN the *Athenæum* of December 31, 1836, under the heading "The Breathing of Vegetables" was a reference to the latest researches of the French physiologist and naturalist Rene-Joachim-Henri-Dutrochet (1776–1847). M. Dutrochet, said the *Athenæum*, has recently laid before the Paris Academy of Sciences some further information on his experiments on vegetable physiology. Having observed that the pneumatic organs in different parts of *Nymphæa lutea* contained an air in which there was less oxygen in proportion as these parts were distant from the leaves, it struck him, that the leaves were the sources whence these organs derived their oxygen, and that this oxygen was disposed of by the breathing of the plant, as in animals. After stating his observations at length, M. Dutrochet said: "The results of these experiments are, that the oxygen produced by the leaves under the influence of light is first poured into the pneumatic cavities: into these it is pressed by continued accumulation, and escapes to the outer surface by means of the tracheæ, the orifices of which are situated in the air, and on the leaves. Most of the aquatic plants have these orifices so contrived as not to be entirely closed when in contact with the water, but a few are without these mouths, and then the oxygen is crowded into the pneumatic canals of the footstalks, and from thence is pressed into the stem, which accounts for the enormous quantity of water contained in some of the aquatic plants". Dutrochet re-published the most important of his researches in his "Memoires pour Servir à l'histoire anatomique et physiologique des vegetaux et des animaux" in 1837.

Societies and Academies

Dublin

Royal Dublin Society, November 24, 1936.

H. H. DIXON: The convection of heat and materials in the stem of a tree. When heat is applied locally to the stem of a tree, it is conducted and conveyed both upwards and downwards. The convection is brought about by the movement of material. By means of suitably devised and controlled arrangements, the velocities and the times of these movements may be ascertained and recorded. Movements quite distinct from the movement of water upwards from the roots to the leaves have in this way been observed. They take place in winter, spring and autumn, as well as in summer. They may be found when the tree is bare of leaves and in the darkness of night. While the water from the soil moves upward in the wood, the bark is indicated as the channel for these movements.

J. H. J. POOLE: A new method of measuring the radioactivity of rocks. The powdered rock is heated in a carbon boat carrying a current of about 400–500 amperes in a water-cooled vacuum furnace. The gases evolved, including the radon from the radium present, are then pumped into a previously exhausted ionization chamber, where the number of alpha particles due to the radon and active deposit is counted by means of an amplifier of the Wynn Williams type and an oscillograph. The results so far obtained agree reasonably well with previous measurements made by other methods. An account was also given of some measurements of the radium content of specimens of basalt from the bottom of the Indian Ocean, made by the usual furnace method. The results are appreciably lower than those for surface specimens of basalt.

G. T. PYNE and J. J. RYAN: Investigations on a molecular constant for soured milks. An application to soured milk of the method previously described for the determination of the cryoscopic constant of fresh milk from measurements of its refractive index, chloride content, and soluble phosphate content.

Paris

Academy of Sciences, November 30 (*C.R.*, 203, 1105–1192).

EMILE BOREL: The problem of chances.

HENRI DOUVILLÉ: The shell of the Ostreidés, of the group of *Ostrea cochlear*, genus *Pycnodonta*, and the shell of the Rudists.

RAZIUDDIN SIDDIQI: The theory of non-linear partial differential equations.

J. FAVARD: The approximation of periodic functions by trigonometrical polynomials.

V. A. KOSTITZIN: The asymptotic solutions of biological differential equations.

EDMOND BRUN: Study of the friction of a solid moving in water. When an ebonite disk is rotated at a high velocity in water, there is a measurable temperature difference between the solid and the water; this difference is a function of the distance from the axis of rotation, and is proportional to the square of the velocity of rotation.

JEAN CHAZY: Certain laws of gravitation corrective of Newton's law.

HENRI CAMICHEL: The spectrum of Nova Lacertæ observed with the large telescope at Meudon. The results are in general agreement with what is known about novæ, but there are certain peculiarities. Nova Lacertæ differs from Nova Herculis: its light curve is of the rapid evolution type, its emission lines are wide and badly defined, and it shows lines of interstellar sodium.

BERNARD KWAL: The spatio-temporal fixing of positions and relations of uncertainty in quaternion quantic mechanics.

PHILIPPE TONGAS: A new empirical expression for the specific volume of super-heated steam.

DAVID RAISKY: A new musical string instrument, the bass violin. The instrument described has the range of a violoncello with dimensions approximating to those of a violin.

GEORGES FOURNIER: A geometrical theory of matter.

DOUCHAN AVSEC and MICHEL LUNTZ: Electroconvective vortices. In an electrostatic field, formed in oil between two plane parallel electrodes, cellular vortices of the Bénard type are formed. It is suggested that the existence of these electroconvective vortices may explain a large number of physical, meteorological, astrophysical and crystallographic phenomena.

AUGUSTIN BOUTARIC, LOUIS FERRÉ and MME. MADELEINE ROY: Spectro-photometric researches on the colour of wine.

TIEN KIU: Photographic plates sensitized with sodium salicylate. Treatment with sodium salicylate solutions increases both the contrast and sensibility in the visible spectrum. The action of this reagent is more complex than was at first supposed: the fluorescence theory is insufficient to cover the whole of the facts.

EMILE SEVIN: Zeeman's phenomenon.

ROBERT J. WALEN and MAURICE E. NAHMIAS: Research on the negative proton and some artificial radioactivities.

MARCEL PRETTRE: The laws governing the initial acceleration of slow combustion and delay in inflammation of mixtures of pentane, oxygen and nitrogen.

GABRIEL VALENSI: The mechanism of diffusion through protective oxides and the influence of pressure on the velocity of oxidation of nickel.

GEORGES CARPÉNI: The dissociation constants of reductinic acid and its product of oxidation by iodine. As might have been predicted from its constitution and chemical properties, reductinic acid is, from the point of view of electrometric titration, in every way analogous with reductone and with ascorbic acid. This also applies to its oxidation product with iodine.

MAX BOBTELSKY and MME. LJUBA BOBTELSKY-CHAJKIN: The influence of added catalysts on the catalytic decomposition of hydrogen peroxide in the presence of bichromate.

HUBERT FORESTIER and FRANÇOIS REDSLOB: Decomposition of cadmium ferrite. Study of the conditions under which cadmium ferrite acquires ferromagnetic properties: these properties are shown to be due to the ferric oxide in an unstable ferromagnetic form.

HENRI GUÉRIN: Combined action of hydrogen and heat on the arsenates of the alkaline earths.

SÉBASTIEN SABETAY: A method for the rapid diagnosis and approximate estimation of the primary alcohols, in the presence of secondary and tertiary alcohols, by the formation of trityl esters. The reagent proposed is triphenylchloromethane, which gives esters with primary alcohols of the type $(C_6H_5)_3COR$.

A. VILA: Application of distillation in a cathodic vacuum to the definition of pitches and bitumens.

PIERRE CHATELAIN: Study of parazoxyanisol in the solid, anisotropic liquid, and isotropic liquid states.

FERNAND JACQUET: The southern side of the Tindouf synclinal in the regions of northern Mauritania.

LOUIS DUBERTRET: The stratigraphy of the regions covered by the green rocks of north-west Syria.

MAURICE HOCQUETTE and LÉON ARSIGNY: The mode of formation, action and destiny of the prehaustorium of *Cuscuta epithymum*, var. *trifolii*.

RAYMOND HAMET: The botanical origin of the drugs known in Brazil under the name of 'catuaba'.

RENÉ COUTEAUX: The bacteroids of worms and their relations with sarcolysis.

JEAN JACQUES BOUNHIOL: The limits of decerebration of the larvæ of Lepidoptera compatible with nymphosis.

PIERRE NICOLLE: Researches on the role of the hormones in the physiological variations of the reticulocytary ratio in the rabbit.

GABRIEL GUIGNON: The influence of sunlight on the flight of the diurnal Lepidoptera.

ALBERT VANDEL: The mode of distribution of the sexes in *Trichoniscus* (*Spiloniscus*) *provisorius*. The heredity of monogeny.

A. H. ROFFO and A. E. ROFFO, jun.: Ionization of air by irradiated cholesterol. The irradiation of cholesterol by ultra-violet light is accompanied by ionization phenomena.

Official Publications Received

Great Britain and Ireland

Ministry of Agriculture and Fisheries Agricultural Statistics, 1935, Vol 70, Part 1: Acreage and Production of Crops and Number of Live Stock in England and Wales. Pp. 99 (London: H.M Stationery Office.) 1s 6d. net. [912

Royal Technical College, Glasgow. Annual Report on the One Hundred and Fortieth Session, adopted at the Meeting of Governors held on the 27th October 1936. Pp. 92. (Glasgow: Royal Technical College) [912

Thirty-fourth Annual Report, 1935–1936, of the Imperial Cancer Research Fund. Pp. 44. (London: Imperial Cancer Research Fund) [1012

Broadcasting. Drafts of (1) Royal Charter for which the Postmaster General proposes to apply for the continuance of the British Broadcasting Corporation; and (2) Licence and Agreement between His Majesty's Postmaster General and the British Broadcasting Corporation. (Cmd. 5329) Pp. 26 (London. H.M Stationery Office) 4*d* net. [111

Other Countries

Department of Scientific and Industrial Research. Cawthro Institute. Pasture and Soils Research Publication No. 35: Th Importance of Cobalt in the Treatment of certain Stock Ailments i the South Island, New Zealand. By H. O. Askew and J. K. Dixon Pp 73–92. (Wellington, N.Z.: Government Printer) [812

New Zealand. Department of Lands and Survey. Annual Report on Scenery-Preservation for the Year ended 31st March 1936. Pp. 8 (Wellington: Government Printer.) [812

New Zealand State Forest Service Bulletin No. 8: *Diplodia pinea* in New Zealand. By T. T C Birch. Pp. 32 (Wellington: Government Printer.) 1s. 9*d* [81

Union of South Africa: Department of the Interior, Bureau o Archæology. Map of Prehistoric Paintings and Engravings. Scale of 1·014 in. to 40 Statute miles = 1 : 2,500,000. 36¼ in. × 28¼ in. (Pretoria: Government Printer) [81

British Honduras. Report of the Forest Trust for the Year endin 31st December 1935. Pp. 28. (Belize Government Printer.) [101

Western Australia Annual Progress Report of the Geologic Survey for the Year 1935. Pp. 44. (Perth. Government Printer.) [101